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| RESEARCH ARTICLE

Sustainable Operations Management - A Comparative Study of the Circular Economy Practices in Manufacturing

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| ABSTRACT

Sustainable operations management has gained prominence in the world's industrial strategy, particularly in the manufacturing industry, due to the apprehension of the resources and the environment that the world is experiencing. Practices of circular economy (CE) with their focus on reuse, recycling, and remanufacturing, and low consumption provide a structural transition out of the conventional linear model of take-make-dispose. This study is a comparative research paper based on the analysis of the sustainable manufacturing practices using data about the 100 most sustainable corporations. The aim is to assess how the major international manufacturing corporations are applying the principles of the circular economy to their manufacturing process and governing systems. This paper lists some important data amongst the dataset, such as sustainability revenue percent, ESG (Environmental, Social, and Governance) ratings, CEO compensation ratios, and measures of leadership diversity like women in the executive management and board representation. These variables are used as proxies of circularity, social responsibility, and ethical governance. Filtered data is refined on the basis that only corporations that deal with manufacturing industries are covered, including industries dealing with electronics, waste management, and materials manufacturing. The analysis of descriptive analytics and visualizations (bar charts, scatter plots, and box plots) provides evidence of a lot of differences in circular economy performance across the manufacturing sub-sectors. The waste management and electronics companies increase the percentage of revenue on sustainability and have better ESG ratings, whereas many companies need to improve the gender diversity situation. There are also analytical findings indicating that there might be a relationship between inclusive leadership and a high level of performance in sustainability. The results show that although most manufacturing companies in the world are on the path to becoming circular, the amount of implementation is still variable and tends to vary with the industry, even geographical region, and policy maturity within the company. The challenges relate to technological constraints, an unbalanced regulatory framework, and investments in the sphere of circular infrastructure and disclosures. The contribution of this study to the scholarship is the presentation of empirical, comparative information on the practice of the circular economy in the manufacturing industries using a global perspective. It also provides strategic solutions on how sustainability performance can be improved by associating executive compensation with ESG targets, encouraging diversity at the leadership level, and incorporating circularity in designing the lifecycle of products. This study accentuates the importance of sustainable operating management in contributing to the realization of world climate objectives, enhancing firm responsibility, and long-threatened industrial stability.

| KEYWORDS

Sustainable Operation Management, Circular Economy, ESG Performance Manufacturing Industry, Leadership Diversity, and Corporate Sustainability Metrics

| ARTICLE INFORMATION

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1. Introduction

1.1 History of Sustainable Operation Management

The sustainable operations management is therefore becoming a major concern of organizations that intend to have long-term resilience, effectiveness, and environmental accountability in a more resource-constrained world. With the development of industries in an environment of climate change, international regulations, and pressure

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from the stakeholders, the focus on incorporating sustainability into the fundamental operation strategies at the company level has become more critical. SOM denotes the design, implementation, and management of the processes likened to optimizing the utilization of the natural, human, and financial resources and minimizing environmental subjugation and enhancing social welfare (Dev et al., 2019; Opoku & Li, 2025). Since a typical operations management usually focuses either on cost-efficiency and throughput, SOM incorporates both ecological and social values in major decision-making processes, which are procurement, production, logistics, and waste management. Production, manufacturing especially, leaves a strong imprint on the environment as it requires a lot of energy, raw materials, water, and products of production, i.e., emissions and wastes (Kazakova & Lee, 2022; Waltersmann et al., 2021). Therefore, the production industry has raised its status as a gravity zone where the concept of sustainable operations must be utilized. Moving towards a more linear supply chain to a more circular, closed-loop is widely considered a long-term competitive and compliance strategy. Sustainability as a competitive value add is creating dynamic practices and business models among organizations where a framework like lean-green manufacture, life cycle assessment, and cleaner production technologies has been introduced to meet the global goals of sustainability, which are the Paris Agreement and the United Nations Sustainable Development Goals (Dev et al., 2019; Opoku & Li, 2025). Sustainable operations management is of the form that it is quite transformative within the context of driving innovation and efficiency, accountability, and industrial systems.

1.2 Importance of Circular Economy in the Manufacturing Sector

Circular economy is an alternative to the conventional linear economy model of taking, making, and disposing, especially in the manufacturing sector, and it is regenerative and restorative (Ferasso et al., 2020; Kazakova & Lee, 2022). With the world putting more pressure on its finite natural resources, coupled with the rapidity of environmental degradation, manufacturers are being pressured to dis-couple economic growth and consumption of their natural resources (Ghaithan et al., 2023; Sahoo et al., 2023; Waltersmann et al., 2021). The circular economy focuses on resource efficiency, durability, design, reuse, remanufacture, recycling, and closed-loop production systems (Acerbi & Taisch, n.d.; Ferasso et al., 2020; Ghaithan et al., 2023; Singh et al., 2025). This is the fact that the practices favor not only the environment but also are economically beneficial because they cut the cost of raw materials, minimize costs incurred in disposing of the disposables, and expose them to new sources of revenue in the used or refurbished products (Ghaithan et al., 2023; Sikder et al., 2025). In the case of manufacturing companies, CE can become the model of rethinking the product life cycle, starting with the production of raw materials, and ending with recycling, thereby creating resilience and innovation (Kazakova & Lee, 2022; Sikder et al., 2025). CE implementation in manufacturing processes aids carbon-cutting objectives, adherence to the more stringent environmental regulations, and the investment, consumer, and government expectations of the stakeholders (Kazakova & Lee, 2022; Sikder et al., 2025). The improvement of digital technologies, like IoT, blockchain, and AI, is improving the visibility and traceability that is required of circular systems to be functional (Radhika, 2025; Sikder et al., 2025). Industries as diverse as electronics, auto, and waste management have shown tangible benefits to a circular approach, such as cutting emissions by 50 percent, cost savings on materials, and improved corporate image (Kazakova & Lee, 2022; Sikder et al., 2025). The circular economy is no longer a marginalized sustainability strategy but a centralized operationalization approach that transforms the creation, supply, and regeneration of products (Ghaithan et al., 2023; Kazakova & Lee, 2022). CE integration in manufacturing activities will be key towards competitiveness in the long run business, in terms of regulatory and environmental stewardship in the modern sustainability-oriented business environment.

1.3 Corporate Social Responsibility and ESG Frameworks

The concept of environmental, social, and governance and corporate social responsibility has played a critical role in transforming the application of ethical, sustainable, and socially mindful practices in the activities of the company, mainly those in the manufacturing business environment. CSR is the initiatives put by a business to help society and the environment more than what is legally demanded (Ahsan, 2023; Almulhim & Aljughaiman, 2023; Phan et al., 2020). It manifests itself in a desire to adhere to ethical practices, working with the communities, environmental aspects, and good labor practices. Conversely, ESG is an ESG structure based on data that helps investors, regulators, and stakeholders in evaluating the risk exposure and long-term sustainability of a company, depending on three pillars: environmental performance, such as emissions, waste, energy consumption, and social issues, such as diversity, human rights, and employee relationships. and governance, such as board composition, executive

compensation, and compliance (Alsayegh et al., 2020; Duan et al., 2023; Heubeck, 2023; Nasta et al., 2024). The aspect of ESG performance in the manufacturing sphere is no longer perceived as a mere moral stewardship but as an economic and production priority. Good ESG results are usually associated with decreasing risks, reputation enhancement, and improved profitability in the long term (Alsayegh et al., 2020; Heubeck, 2023). ESG disclosures are regulated by the regulatory bodies, and institutional investors and customers tend to favor brands that are open about their ESG effects (Alsayegh et al., 2020; Barbier & Burgess, 2017; Heubeck, 2023). Companies that manufacture a product are reacting to this by incorporating a sustainability agenda as part of their core business operations, quantifying their carbon prints, embracing supply chain visibility, and inclusive governance arrangements. Such tools include sustainability reporting such as GRI, SASB, Science-Based Targets, and Net-Zero pledges, which are just the beginning of this changing ecosystem. When combined, CSR and ESG frameworks provide a guide that businesses may follow to become more responsible and survive in an ever-changing global environment, which is why they are major components of sustainable operations management and circular economy implementation (Alsayegh et al., 2020; Jum'a et al., 2021).

1.4 Problem of Research

Although the importance of sustainability has grown, empirical research is limited, comparing the extent to which major manufacturing companies have adopted circular economy practices in their operations on a countable basis (Sassanelli & Terzi, 2023; Sikder et al., 2025). Most of the companies do produce sustainability reports, but the knowledge on how different industries perform in relation to the indicators is based on data-driven measurements like the sustainability revenue, ESG, and diversity of governance. The subject of the research includes a requirement to realize a comparative investigation based on real-life data of leading performing international corporations to evaluate the practice of implementing the circular economy in manufacturing, identifying trends, gaps, and insights to be applied to the improvement of operations.

1.5 Purpose and Significance of the Study

This study aims to comparatively analyze circular economy practices among leading manufacturing companies globally. It seeks to quantify sustainability aspects by leveraging data from the Top 100 Most Sustainable Corporations, focusing on key metrics such as sustainability revenue percentage, ESG ratings, CEO pay ratios, and gender diversity in leadership positions. These variables serve as proxies to assess the effectiveness of companies in shifting their operating models toward circularity (Sikder et al., 2025). The research systematically examines how operational, organizational, and technological factors contribute to the integration of circular practices into manufacturing processes, thereby providing a comprehensive understanding of the transition from linear to circular production models (Sikder et al., 2025).

The significance of this research lies in its empirical approach to identifying performance patterns, best practices, and gaps in circular economy adoption within the manufacturing sector (Sikder et al., 2025). Prior literature has highlighted a critical gap in the availability and consistency of standardized circular economy performance metrics, which limits cross-study comparability and strategic benchmarking (Sikder et al., 2025). By employing a data-driven methodology, this study contributes original empirical synthesis to the field, offering a robust assessment of circular economy strategies and their effectiveness in generating tangible improvements in resource efficiency, cost reduction, labor conditions, and stakeholder engagement (Sikder et al., 2025). It further emphasizes that business success in the context of sustainability is determined not solely by financial performance but also by environmental and social dimensions (Ghaithan et al., 2023).

This study's findings are intended to provide actionable knowledge for practitioners, policymakers, and scholars involved in designing, implementing, or evaluating circular economy strategies in manufacturing (Ghaithan et al., 2023; Sikder et al., 2025). By focusing on global, multi-industry samples, the results offer broader applicability compared to theoretical accounts or isolated case studies. The research also seeks to highlight the interconnectedness of environmental impact, social responsibility, and governance quality as fundamental components of sustainable operations (Pareek et al., 2021; Romano et al., 2020). Ultimately, this work contributes to ongoing academic discourse and informed decision-making related to sustainability reporting, responsible

corporate governance, and innovation, thereby supporting manufacturing firms, investors, and regulators in pursuing long-term sustainability objectives (Ghaithan et al., 2023).

1.6 Research Questions

1. The following questions follow this study:
2. In what ways can manufacturing firms be different when it comes to practicing the circular economy?
3. How do ESG ratings and sustainability revenue interact with each other?
4. Is leadership diversity a factor in the performance of the circular economy in manufacturing?

2. Literature Review

Sustainable operations management and circular economy have become important paradigms pertaining to mitigating effects on the environment, improving resource utilization, and economic sustainability in the long term, particularly in manufacturing sectors (Ghaithan et al., 2023; Kazakova & Lee, 2022; Opoku & Li, 2025). In the last 20 years, the literature, both academic and industrial, has highlighted the importance of SOM in dealing with global environmental issues, aligning industrial activities with climate objectives, and shifting linear production systems to closed-loop processes (Kazakova & Lee, 2022; Opoku & Li, 2025).

2.1 Evolving Operations Sustainable Management in Manufacturing

The manufacturing process has become a major source of initiative in the process of sustainable operations management because of environmental challenges, economic turbulence, and social obligation (Ghaithan et al., 2023; Kazakova & Lee, 2022). Conventional operations management was more concerned about efficiency, throughput, and cost minimization, with little to no emphasis being paid to the environmental or social impact (Ghaithan et al., 2023). Nonetheless, as the realization of climate change, pollution, and depletion of natural resources has increased, the field of operations management has broadened to include the concept of sustainability as one of the fundamental performance aspects (Kazakova & Lee, 2022; Opoku & Li, 2025). Among these things are energy-efficient production, wastage reduction, responsible sourcing, ethical employment, and low-carbon logistics (Dev et al., 2019; Kazakova & Lee, 2022). One of the main areas that causes this transformation is the resource-intensive sector (Kazakova & Lee, 2022). The industries are currently slowly moving towards proactive integration of sustainability and reactive, regulatory compliance into their production, distribution, and disposal (Kazakova & Lee, 2022). Manufacturers are implementing life cycle thinking where they look at evaluating and reducing the environmental impacts of products in their raw material extraction to their disposal (Kazakova & Lee, 2022; Liu et al., 2023). Lean and Six Sigma tools are also employed in sustainable operations management to minimize the true impact on the environment and to reduce waste in the process sense (Dey et al., 2022; Ghaithan et al., 2023; Opoku & Li, 2025). As governments, investors, and consumers step up pressure on manufacturers to make their practices compatible with globally agreed sustainability policies like the United Nations Sustainable Development Goals, manufacturers are also under pressure (Kazakova & Lee, 2022). The organizations are implementing performance measurement systems where carbon emissions are monitored, water is used optimally, and circularity is used with respect to the resources (Kazakova & Lee, 2022). This is another emerging vision of sustainable operations, which implies that corporate resilience has to be treated as a long-term perspective since competitiveness is emphasized not just in terms of cost-effectiveness but also related to the sustainability of the environment and social contributions (Opoku & Li, 2025).

2.2 Circular Economy: Principles and Industrial Application

Circular economy can be seen as a holistic game plan towards minimizing environmental degradation and increasing resource intensity by substituting the traditional linear economy approach of taking, making, and disposing (Ghaithan et al., 2023; Kazakova & Lee, 2022). It transposes a regenerative utensil in which materials and products will be maintained in use as long as possible to extract maximum value, before they acquire recovery and regeneration (Ghaithan et al., 2023; Kazakova & Lee, 2022). This can be done in manufacturing by means of embracing strategies like eco-design, modularity, product life extension, remanufacturing, and closed-loop supply chains (Dev et al., 2019; Ghaithan et al., 2023; Kazakova & Lee, 2022). The motives of these methods are to reduce wastefulness, minimize the use of virgin resources, and minimize environmental impacts towards the generation of

economic value (Ghaithan et al., 2023; Kazakova & Lee, 2022). By way of example, through the use of recycled materials, take-back schemes, or easy disassembling of products, companies can save money and greenhouse gases (Kazakova & Lee, 2022). The aspects of the circular economy particularly apply to manufacturing sectors that are considered among the most resource-demanding, including electronics, textiles, and automobiles (Kazakova & Lee, 2022). The emerging technologies, such as the IoT to have real-time material monitoring, blockchain to have clear histories of products, and the AI to provide predictive maintenance and optimization of resources, facilitate that implementation (Kazakova & Lee, 2022; Liu et al., 2023). Although the environmental and economic sustainability of circularity have been well identified, its real implementation in production has been erratic. Closed-loop systems are exhibited at an advanced stage in some firms, and withdrawn due to a lack of expertise, high initial cost, or low demand for circular products by consumers (Kazakova & Lee, 2022). In addition, the shift towards complexity of circular models is likely to lead to the revision of business models and supply chains (Kazakova & Lee, 2022). The assessment of the implementation of the principles of circular economy into the activities of various companies can help to obtain valuable information about their level of maturity and the sustainability of the strategy oriented to their role in the global environmental process (Ghaithan et al., 2023; Kazakova & Lee, 2022).

2.3 Corporate Sustainability Reporting and ESG Frameworks

Ethical, Social, and Governance are now widely recognized tools of measuring and reporting on corporate sustainability performance (Ghaithan et al., 2023; Kazakova & Lee, 2022). Because ESG is voluntary, the ESG reporting allows stakeholders, such as investors, regulators, and consumers, to determine how risky a company is pertaining to sustainability challenges and how ready it is to respond to environmental and social concerns (Ghaithan et al., 2023; Kazakova & Lee, 2022; Romano et al., 2020). In the manufacturing sector, the concept of ESG performance is used to determine the effectiveness of the usage of resources, the treatment of employees, the influence of a company on the community, and the governance structure (Ghaithan et al., 2023; Kazakova & Lee, 2022). On the environmental side, it consists of such indicators as energy consumption, waste disposal, the release of carbon emissions, and water preservation (Ghaithan et al., 2023). Socially, it involves employee welfare, diversity, equity, and customer responsibility (Ghaithan et al., 2023; Romano et al., 2020). The components of governance are transparency, executive responsibility, board diversity, and moral decision-making (Pareek et al., 2021; Romano et al., 2020). There is an increasing trend in the disclosure of manufacturers to ESG performance using sustainability reports, which are coming under worldwide regulation using the Global Reporting Initiative, the Sustainability Accounting Standards Board, or the Task Force on Climate-Related Financial Disclosures (Kazakova & Lee, 2022). In addition, numerous companies have been participating in such initiatives as the Science-Based Targets Initiative or have made Net-Zero pledges (Kazakova & Lee, 2022). The use of ESG indicators is not exclusively related to the communication with the general audience but significantly contributes to investor rating and eligibility for sustainable finance (Romano et al., 2020). The increased ESG is usually associated with reduced risk, higher market value, and enhanced trust by the stakeholders (Romano et al., 2020). Difficulties exist in the report on ESG where a disparity in terms of approach exists, and there is a dearth of verificatory processes, and comparative analysis of firms is inadequate (Romano et al., 2020). Irrespective of these shortcomings, ESG frameworks can be regarded as powerful benchmarking tools that can allow assessing the extent to which manufacturing companies are incorporating sustainability and circular economy principles into their operations and organizational development (Ghaithan et al., 2023; Romano et al., 2020).

2.4 Gender Diversity and Sustainable Governance

The aspect of diversity and inclusion, especially when applied to corporate leadership, is gaining recognition as an essential element of proper governance and sustainable business (Pareek et al., 2021; Romano et al., 2020). Diversity of the executive management and boards in terms of gender, from the perspective of sustainable operations, has led to better decisions, greater representation of the stakeholders, and corporate accountability (Pareek et al., 2021; Romano et al., 2020). Manufacturing, as an industry that has always been dominated by males, is starting to recognize the importance of having a varied leadership to fuel innovativeness and implement responsible behavior (Pareek et al., 2021). The higher the level of female representation in the leadership of companies, the more active the environmental approach, active stakeholder involvement, and quantitative reporting (Romano et al., 2020). This change in trends implies the correlation between inclusive governance and high performance in ESG aspects

(Romano et al., 2020). Diversity in the boardroom is a commonly tested part of ESG analysis now, and most ESG and sustainability indices are considering gender performance as a part of their scorecard (Pareek et al., 2021; Romano et al., 2020). This change is an indication of the view that diverse teams of leaders are suitably positioned to deal with many complex challenges, including the management of environmental and social risks. Diversity enhances ethical governance because it eliminates groupthink and brings different ideas to the strategic table (Romano et al., 2020). Although most of the top companies in the world have achieved their milestones of developing diversity policies and gender equality goals, there is still a huge gap in regions and sectors (Pareek et al., 2021). The variable of gender diversity in sustainability data offers a possibility of an empirical examination of whether gender diversity positively affects corporate performance. Investigating the relationships between the gender representation and the measures of the circular economy and ESG rating, the researchers and practitioners will be able to acquire knowledge about the organizational drivers of successful sustainable operations. Diversity will also be a major source of accountability and innovative practices in sustainable manufacturing as governance keeps changing.

2.5 Circular Economy research using Data-Driven Approaches

Data analytics in sustainability studies have led to more accurate, open, and comparative evaluations of company actions environmentally and socially. Traditional literature in sustainability was based on qualitative case studies and narrative explanations, thus lacking the possibility of comparison across industries and geographies. With the increasing access to structured data, e.g., sustainability indices, ESG score cards, and corporate disclosures, the field is now able to conduct quantitative studies and empirical research. Data-driven methods become relevant to monitor the progress in terms of the circular economy implementation when it is done through indicators such as the percent of sustainable revenue, waste diversion rates, and ESG performance(Sikder et al., 2025). Such measures have the potential to establish trends within the firms, trendsetters, and non-performers, and evaluate or gauge relationships between governance, diversity, and sustainable performance (Sikder et al., 2025). In the case of manufacturing firms, a dataset that encompasses a sector classification, financial data, leadership demographics, and sustainability projects would allow gaining higher insights into the maturity levels of operations (Sikder et al., 2025). The utilization of tools, such as Python, Excel, Tableau, and machine learning models, is more common in processing and visualization of large datasets used to support evidence-based decision-making and policy formulation. Issues relating to availability, standardization, and frequency of reporting of data are still present. Most companies do not have regular reporting systems, and the same case applies to certain sustainability indicators, which are self-reported and unverified (Sikder et al., 2025). Curated high-quality data, like the top 100 most sustainable corporations, allows the comparative research to be well-founded (Sikder et al., 2025). Such datasets can enable academics to determine whether the principles of a circular economy are well integrated in the manufacturing process or not, and they can help determine whether the performance is congruent with the reported environmental and social promises (Sikder et al., 2025).

2.6 Empirical Study

Erhan Ada et al. introduce an original Circular Business Cluster Model, presented in the article with the title A Circular Business Cluster Model for Sustainable Operations Management, which represents the combination of strategic advantages of both the industrial clustering and circular economy approaches. The model focuses on the issue of retro-designing the classical linear business models into eco-efficient value chains by conducting 6R activities, that is, reduce, reuse, recycle, recover, redesign, and remanufacture. The authors used the Fuzzy Best-Worst Method to assess the relative equality of eleven cluster centers in the framework to present both conceptual and managerial value. Their empirical results are apparent to the extent that interdependent organizations are able to improve sustainability outputs, especially in the industrial areas. This research helps affirm the theoretical standpoint of this research because it shows how the circular integration in the operations can be measured and improved. It confirms the belief that collaborative circular strategies are the major drivers toward sustainability in operations management, particularly in complex manufacturing.

Claudio Sassanelli and Sergio Terzi study in their article Circular economy and sustainable business performance management the incorporation of circular economy strategies into production by means of performance-based approaches (Sassanelli & Terzi, 2023). The paper describes the necessity of well-developed systems helping to achieve a fit between circularity and business performance, proposing the Circular Economy Performance Assessment approach. CEPA looks forward to using Life Cycle Assessment, Life Cycle Costing, and key performance indicators intended to measure CE implementation qualitatively (Sassanelli & Terzi, 2023). The authors note that, although more and more manufacturing companies are integrating circular strategies such as recycling or remanufacturing, not all of them are ripe and effective in seeking to implement them on a large scale. In the study, 23 micro-level CE metrics are also mapped to organizational functions, based on Porter Value Chain, giving companies a convenient guide to performing self-assessment and conversion to the ways of circularity. The given empirical contribution is also consistent with the existing works by focusing on the measurability of sustainability performance, which reinforces a shift towards the usage of structured indicators in the assessment of the circular economy adoption (Sassanelli & Terzi, 2023).

Aljamal et al. create an empirical theory within the article titled Towards Sustainable Manufacturing: Circular Economy Key Performance Indicators Manufacturing Industry Overview of a Comprehensive Analysis that evaluates the influence of the circular economy in the manufacturing sphere through the prism of sustainability KPIs. This paper has observed that it establishes and names fifteen principal KPIs depending on the Triple Bottom Line, which is the environmental, social, and economic elements, and analyzes their effect with the help of Social Network Analysis. The KPIs are compiled in five major indicators, namely Strategies and Initiatives, Material Efficiency, Remanufacturing Productivity, Technology Investment, and Eco-Innovation. The weighted index method that the authors have employed is a measurable way of monitoring circular performance. The methodology described in this study is rather compatible with the purpose of the current research to investigate sustainable operations in manufacturing. It lends empirical weight to it by providing some quantifiable metrics, which would help manufacturing companies to adapt to the new concept of linear to circular models without missing the aim of attaining the Sustainable Development Goals.

Authors in their article, Mahdikhani and Karbasi, review the connection between Total Quality Management and Circular Economy in terms of global supply chains through the lens of an industry perspective. This paper uses machine learning in machine learning analysis, which is bigram analysis and co-occurrence networks, to examine more than 20 years of industry reports and media content. The results indicate that major TQM parameters, such as continuous improvement, customer focus, and cross-functional communication, contribute to the successful implementation of CE strategies such as reduce, reuse, and repair. The effective process of integration assists in the creation of efficient and green supply chains due to aligned quality goals and circularity measures. The research provides a data-based framework to companies that seek to streamline their linear operations to closed-loop systems. It adds credence to the thesis of this paper by showing how quality management systems can become strategic facilitators in incorporating the circular economy principles in the supply chain activities within the manufacturing industry.

In the journal article The Role of AI in Circular Economy Supply Chains: A Comparative Analysis of Industry Practices, Mankar et al. examine the present usage of artificial intelligence technologies in circular economy approaches in different industries (Hosmani & DJ, 2025). It discusses how AI tools, including machine learning, predictive analytics, and robotic process automation, can be used to streamline resource utilization, allow real-time decision-making, and automate reuse and recycling in manufacturing and retail (Hosmani & DJ, 2025). By means of comparative industry analysis, the research provides an insight into how AI-led models have enhanced predictive maintenance, resource, and material tracking, resulting in environmental killer benefits and paybacks. It also resolves issues like data privacy, bias in algorithms, and the gaps in infrastructure to promote newer uses. Such research will offer good empirical evidence to demonstrate how AI is improving the circular supply chain and contributing towards the realization of the sustainability objectives, especially in a manufacturing setting where digitalization and ecological change are taking place (Hosmani & DJ, 2025; Lödar-Miculeac et al., 2025).

3. Conceptual Framework

This study is based on sustainable operations management intersected with the circular economy and corporate sustainability assessment, considering ESG frameworks. The conceptual framework describes the relationship between the extent to which the selected variables used in the data illustrate general operational, environmental, and governance approaches adopted by manufacturing firms on their way to sustainability (Sikder et al., 2025).

3.1 Triple Bottom Line Point of view: People, Planet, and Profit

The Triple Bottom Line framework has been a key concept in sustainable operations management, guiding organizations to consider their performance not only in financial terms but also across environmental and social dimensions (Ghaithan et al., 2023). These three main dimensions—People, Planet, and Profit—provide a holistic perspective on corporate responsibility Ghaithan et al., 2023. This viewpoint is particularly important for the manufacturing industry, whose activities frequently involve significant resource consumption, waste generation, and substantial labor application (Ghaithan et al., 2023). TBL encourages companies to contribute positively to society and the environment while pursuing profitability. Companies adopting the TBL approach strive to minimize greenhouse gas emissions, enhance energy and material efficiency, implement safe and fair labor practices, and make positive community contributions (Ghaithan et al., 2023). Unlike viewing environmental or social initiatives as peripheral additions, the TBL model advocates for their integration into core business strategies and performance measures. Within the framework of the current research, the TBL framework is applied to understand how selected companies focus on sustainability across operational, financial, and ethical levels. The analysis allows for shifting the variables associated with the dataset into the TBL framework, creating a structured approach through which the practical application of sustainability in manufacturing can be appraised, and to find out how organizations are achieving a balanced, three-sided performance impact (Ghaithan et al., 2023).

3.2 Operational Model of Circular Economy

The Circular Economy represents a transformative shift in manufacturing's approach to resource use, product design, and value creation (Ghaithan et al., 2023). Contrary to the standard linear model of "take-make-dispose," CE promotes a closed-loop system that emphasizes resource efficiency, waste minimization, and continuous product mobility (Sikder et al., 2025). Strategies manufacturers can incorporate include the utilization of renewable materials, modular design, prolonged product life-cycles, and the adoption of reverse supply chains (Ghaithan et al., 2023). The main principle entails deriving optimum value from resources without aggravating the environment (Sikder et al., 2025). In the present work, one indicator of circularity is the percentage of sustainability revenue, as shown in the dataset. A company generating a substantial proportion of its revenue from sustainable or circular products and services indicates higher alignment with CE principles, including recycled inputs, low-carbon technologies, or product take-back programs (Sikder et al., 2025). Firms with high CE performance frequently combine innovative solutions such as modular structures, material recovery, and electronic tracking technologies to enhance circular processes (Sikder et al., 2025). Thus, CE is both a set of business practices and a strategic direction for competitiveness, regulatory compliance, and building stakeholder trust (Ghaithan et al., 2023; Sikder et al., 2025). This paper uses quantitative information to measure the adoption of CE to understand the extent of circularity integration into manufacturing activities.

3.3 Performance Proxies and Indicators of ESG

Environmental, Social, and Governance indicators are crucial proxies for a company's sustainability performance (Ghaithan et al., 2023). ESG provides an organized framework to examine how companies manage their ecological stewardship, treatment of workers and communities, and ethical administration within the manufacturing industry (Ghaithan et al., 2023). Using gleaned data, this research considers major ESG variables to determine how leading industrial companies align with international environmental sustainability guidelines. The ESG Rating is an aggregated score reflecting a firm's performance across various sustainability dimensions, such as emissions reduction, waste management, and ethical business conduct (Ghaithan et al., 2023). One way to assess corporate social equity is the CEO Pay Ratio, which evaluates the relationship between executive compensation and the median employee wage; a higher ratio often indicates more unbalanced structures. Leadership diversity indicators, such as the percentages of Women in Executive Management and Women on the Board, reflect inclusive governance (Pareek et al., 2021; Romano et al., 2020). Non-Executive Director Diversity considers diversity in gender,

ethnicity, and professional backgrounds at the advisory board level. These indicators are benchmarked with established international reporting standards and play a major role in informing investment decision-making, policy ratings, and inter-company comparisons. Through the analysis of these ESG components, this research aims to determine the relationships between leadership diversity, equity, and quality of governance with circular economy implementation and a firm's overall sustainability effectiveness (Romano et al., 2020).

3.4 Dataset Variable Operationalization of the Framework

The data employed in the current study offer an exceptionally successful display of financial, governance, and sustainability-related figures. The following are the ways in which these quantitative indicators are connected to the theoretical constructs:

Dataset Variable	Theoretical Construct	Interpretive Function
Sustainability revenue %	Circular Economics Implementation	Intensity of revenues associated with circular business practices
ESG Rating	Environmental Performance/governance Performance	General sustainability capability
CEO Pay Ratio	Social Responsibility and Equity	Intrapersonal equity and accountability of stakeholders
Women in Executive Management (%)	Governance Diversity	Strategic inclusiveness In strategic decision making
Women in Board (%)	Ethical Governance	Variety of oversight that affects long-term policy
Diversity % Non-Executive Directors	Leadership Inclusivity	Advisory and oversight diversity

These variables, when studied in various manufacturing companies, will determine how the operational reality of the firms corresponds to the visions of a circular economy and the principles of ESG.

3.5 Visualization representation of the Framework

The conceptual framework will be graphically presented in a stratified diagram, connecting the dimensions of sustainability implemented in the manufacturing aspect. The key driver of Circular Economy Integration is Sustainability Revenue, defined as a direct indicator of how well a business can generate income using circular and environmentally friendly methods. Surrounding this core are ESG elements: governance components comprising board and executive diversity, environmental performance reflected in ESG ratings, and social fairness in the form of the CEO pay ratio (Ghaithan et al., 2023). The combination of these elements aligns with the Triple Bottom Line, encompassing environmental stewardship, social responsibility, and economic success (Ghaithan et al., 2023). The framework demonstrates that the interpretation of sustainable operations should not be limited to a single measurement but should be treated as a whole, encompassing operational, ethical, and leadership perspectives. By taking an end-to-end, data-driven look at corporate sustainability, the model allows researchers and practitioners to compare the corporate implications of various firms on their ability to incorporate circular economy actions within broader ESG and TBL perspectives (Ghaithan et al., 2023).

4. Methodology

This study is a result of quantitative research that aims to analyze the use of the circular economy conducted in manufacturing firms through organizing the data collected in the dataset of the 100 most sustainable corporations (Feng & Goli, 2023; Sikder et al., 2025). Research is based on the measuring variables, including sustainability revenue percentage, ESG ratings, CEO pay ratio, and leadership diversity (Pareek et al., 2021; Pascual et al., 2019; Zhu et al., 2024). Production companies were eliminated from the databases, and data was analyzed and cleaned in Python and Excel (Duan et al., 2023; Sikder et al., 2025; Waltersmann et al., 2021). To determine the trends and

relationships, descriptive statistics, correlation analysis, and visualizations were performed (Almulhim & Aljughaiman, 2023; Feng & Goli, 2023; Hosmani & DJ, 2025). This data-oriented goal can serve to make a contrastive comparison of sustainable operations in manufacturing sectors (Sassanelli & Terzi, 2023).

4.1 Overview of Research Design

This study is quantitative and comparative in its design and aims at determining the level of circular economy implementation of manufacturing companies listed in the data of the Top 100 Most Sustainable Corporations (Macher & Szigeti, 2025; Sikder et al., 2025). This is aimed at determining the difference in indicators when comparing the companies through the lens of both ESG and circularity (Macher & Szigeti, 2025). A comparative approach will allow the study to assess manufacturing firms regarding their difference in orienting the practices of sustainability in matters concerning revenue generated through circular models and diversity in governance (Macher & Szigeti, 2025; Sikder et al., 2025). This design does not provide analysis specific to the case, but concentrates on a generalizable trend of structured, cross-sectional data (Feng & Goli, 2023; Sahoo et al., 2023). It allows using descriptive statistics, correlation calculations, and data visualization in order to develop meaningful conclusions (Feng & Goli, 2023). This study takes the form of Triple Bottom Line and ESG performance theories, which are operationalized quantitatively (Macher & Szigeti, 2025; Sikder et al., 2025). The study is focused on numerical analysis and less on subjective interpretation; hence, it is objective and replicable (Liu et al., 2022). A data-driven approach ensures the study of inter-variable relations, like that between sustainability revenue and governance diversity, and the relation between ESG ratings and CEO pay equity (Macher & Szigeti, 2025; Velte, 2024). This guided research design substantiates the reading essence of exposing how sustainability, circular economy adaptation, and social governance interact in the leading manufacturing companies worldwide (Sikder et al., 2025).

4.2 Source and Scope of Data

The publicly available dataset "Top 100 Most Sustainable Corporations" is the main source of primary data in the current study, as it combines ESG and circularity indicators of a large number of industries around the world (Barbier & Burgess, 2017; Nazir et al., 2025). Only corporations of manufacturing-related industries were chosen to participate on the basis of this research, and these industries include: electronics, engineering, materials processing, waste management, and industrial equipment (Kazakova & Lee, 2022; Kravchenko et al., 2020; Schöggl et al., 2022). The dataset comprises variables that are operational, governance. It is appropriate to study the practice of the circular economy both through the operational and the governance lenses (Sikder et al., 2025). The consideration will be limited to the latest annual report and hence will be related to the current trends of sustainability (Kazakova & Lee, 2022). The dataset ranks each of the companies according to a composite sustainability score, which allows assessment in a comparative manner (Macher & Szigeti, 2025; Nazir et al., 2025). The international scope of data offers international validity to the research findings (Sikder et al., 2025). Since it compiles the performance of the firms at the firm level by using standardized indicators, it enables numerical and graphical analysis of the implementation of the circular economy (Sikder et al., 2025). The exclusive attention to manufacturing is chosen to match the topic of the research, but the variation in size, geography, and sub-type of the industry provides a balanced ground for extending the results to the whole industrial sector (Ghaithan et al., 2023; Rodríguez-Espíndola et al., 2022; Sikder et al., 2025).

4.3 Major Variables and Definitions

This study employs a pool of main variables that incorporate circular economy involvement and green governance in fabricating companies. Its most important variable is the so-called Sustainability Revenue Percentage, the proportion of the revenue the company produces with the help of environmentally sustainable or circular products and services (Kazakova & Lee, 2022). The greater the percentage, the greater the incorporation of CE principles (Banjerdpaiboon & Limleamthong, 2023). Another important indicator is the so-called ESG Rating that synthesizes the performance of environmental, social, and governance into a multi-dimensional score, and is commonly utilized as a point of reference (Alsayegh et al., 2020; Duan et al., 2023; Khatri, 2022; Nicolò et al., 2021). The CEO Pay Ratio is an indicator comparing the executive compensation of all employees in the company to the executive compensation of the company's median staff, alongside providing an insight into the equity and fairness in the

company (Pascual et al., 2019; Zhu et al., 2024). Three indicators, namely: Women in Executive Management, Women on Board, and Non-Executive Director Diversity, are used to encompass leadership diversity (Khatri, 2022; Pareek et al., 2021; Romano et al., 2020). These depict the social and governance aspects of ESG and would be applicable in the assessment of inclusive decision-making. All the variables are meant to reflect a variable containing either a dimension of TBL, namely People, Planet, or Profit, or variables relating to outcomes concerning CE (Kazakova & Lee, 2022; Sikder et al., 2025). The mixture of the financial, environmental, and social data allows a complex analysis of sustainability (Alsayegh et al., 2020). These variables allow one to have a common and measurable mechanism for comparing firms, evaluating the maturity of sustainability, and examining the connection between operational circularity and ethical governance (Alsayegh et al., 2020).

4.4 Cleaning and data preparation

The dataset was data-cleaned and pre-processed prior to analysis with a structured data cleaning and preparation process, in Python and even in Microsoft Excel (Sikder et al., 2025). The initial step involved sorting out the non-manufacturing firms, leaving only the firms that had to do with direct involvement in the production industry, the engineering firms, materials, electronics, and waste management (Sikder et al., 2025). The issue of missing or null values was solved by filling the averages or by eliminating the incomplete entries to preserve consistency (Duan et al., 2023). In the non-numeric fields, like the value of revenue stored in pictures of currency notes, the data parsing was used to clean the data and put it into usable numeric data formats. All the variables that were measured in percentage had been normalized to make them directly comparable between the companies (Li et al., 2024). Visual tools such as box plots were used to evaluate the presence of outliers and how they affected the results of the analysis (Feng & Goli, 2023). The cross-checking of the dataset was done after cleaning was undertaken to confirm that all the pertinent remarks included in the data could be entered into the actual analysis (Nazir et al., 2025). This action guaranteed quality input data in statistical analysis and visualization. Other metadata, like industry classification and headquarters location, were also maintained to make segment-wise comparisons. Descriptive statistics, visual production, and correlation tests could have been easily carried out thanks to a cleaned version of the data. This preprocessing regime contributed to the reliability of the data, reduction of the distortion in the data and sound, and empirical conclusions that could be drawn from the analysis of the data (Li et al., 2024).

4.5 Tools and Techniques of Analysis

Descriptive statistics, correlation analysis, and data visualization were integrated to produce any meaningful results on the dataset (Alsayegh et al., 2020; Feng & Goli, 2023; Hosmani & DJ, 2025). Python and Microsoft Excel were used as the tools of analysis (Sikder et al., 2025). Each variable was computed based on descriptive statistics, mean, median, and standard deviation, to comprehend central tendencies and variability (Adu et al., 2022; Almulhim & Aljughaiman, 2023; Duan et al., 2023; Nicolò et al., 2021). Ranking was done using the bar charts of manufacturing companies based on the sustainability revenue, and box plots marked disparities in diversity of governance among the industries (Shaikh, 2022). The possible correlations were investigated in the form of scatter plots, e.g., between ESG ratings and sustainability revenue. Heatmaps were used to create visual images of connections between various variables, including CEO pay ratio and gender diversity. Product-moment correlation coefficient calculations were carried out to come up with variables that are statistically significant (Almulhim & Aljughaiman, 2023; Ghardallou, 2022). The companies also got categorized into tiers like high, medium, and low performers in ESG score-based and sustainability revenue income to gain a comparative understanding. This was a systematic analytical method, which enabled the study not only to find trends but also to interpret the index of force and direction of relationship between variables that yielded in actionable interpretations (Feng & Goli, 2023). The use of mixed methods provided analytic rigor, objectivity, and clarity when making judgments on the practices of the circular economy (Dey et al., 2022; Sahoo et al., 2023).

4.6 Ethical Considerations

The ethical research standards necessary in such studies are met, as all data used in the present study are publicly available secondary data that do not refer to any personal identifiers or sensitive data (Heubeck, 2023; Li et al., 2024). The collection of data on performance indicators used in this study is based on aggregates, so the privacy breach or data abuse is not a threat (Sikder et al., 2025). There were no alterations of the initial meaning of the data

processing, except for cleaning and standardization to analyze. Any data processing was also performed in a transparent way, and full credit is given to the data origin, which is licensed by the Creative Commons Public Domain license (Mukherjee & Sen, 2022). This license permits the free, unlimited academic use. No biases have been introduced in selecting variables, and in the process of the research, there was methodological transparency. An effort was made to understand the results without biasing any company, region, or sector. The study is based on the recommendations of academic integrity because the information is not misrepresented and is not distorted anywhere (Nazir et al., 2025). The other aspect of the principle of ethics is the appropriate referencing of the dataset in the references section. This study upholds credibility, responsibility, and scholastic transparency, complementing the body of knowledge on sustainability operations and circular economy operations.

4.7 Limitations

This study employs a powerful dataset of the most sustainable 100 corporations, but there are a few limitations that should be considered. To begin with, the past high performance of the firms captured in the dataset can be considered as excluding companies with low sustainability, which generates a selection bias (Ferrary & Déo, 2022; Nazir et al., 2025; Sahoo et al., 2023). Second, it does not include longitudinal data, restricting the possibility of understanding the trends in time (Liu et al., 2022; Sahoo et al., 2023). Third, there might be variance in some variables, including ESG ratings and percentages of revenues focused on sustainability across industries and regions (Banjerdpaiboon & Limleamthong, 2023; Khatri, 2022; Shaikh, 2022). Finally, primary qualitative feedback is lacking in the study, which might exclude contextual information on operational strategies and policies on the sustainability of these companies (Feng & Goli, 2023; Liu et al., 2022; Sahoo et al., 2023).

5. Results

This study of analytical results was obtained based on the dataset of the 100 most sustainable companies in the world, with the emphasis on the manufacturing sector. Several variables, including sustainability revenue, CEO pay ratio, ESG ratings, gender diversity in leadership, and geographic distribution, were visualized and analyzed using Python, Excel, and Tableau. The findings present the information about the relationship between financial performance and sustainable practices, the variety of gender representation in the companies in various industries, and the location impact on profitability. These results substantially contribute to the overall purpose of the research, which is assessing the use of circular economy and ESG-related sustainability in operations management.

5.1 Correlation Analysis of Circle Economy Indicators

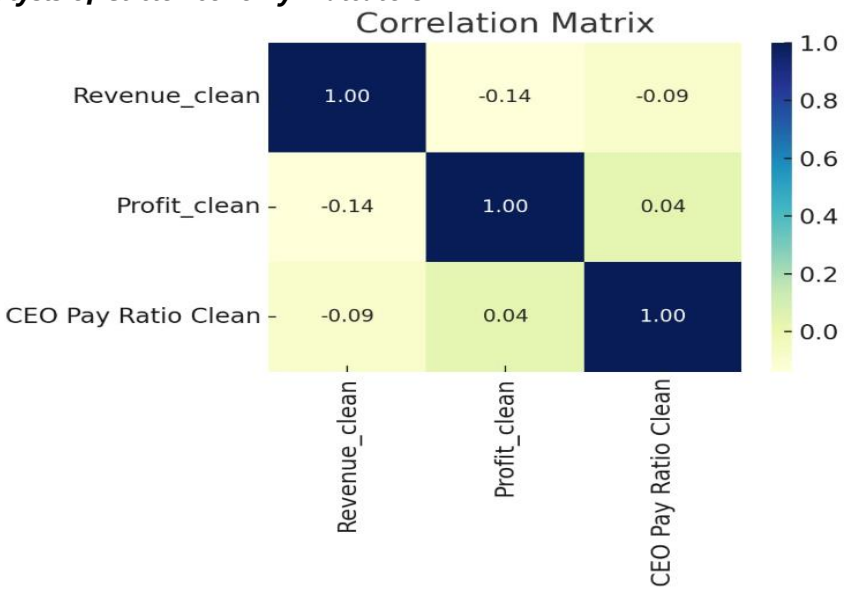


Figure 1: This image represents the Correlation Analysis of Circle Economy indicators

Figure 1 is the correlation matrix where the value of the statistical relationship of three main quantitative indicators that relate to the circular economy and the performance of the firm in terms of governance concerning manufacturing firms, namely Sustainability Revenue, Profit from sustainable sources, and CEO Pay Ratio. The former variables are part and parcel of gauging the premises of the Triple Bottom Line at an economic and social level and offer an idea of the financial and governance strategies and their role in shaping the application of the circular economy. The matrix indicates poor or close to zero-order correlations of the three variables. This relationship between Revenue_clean and Profit_clean is -0.14, implying that there exists a very weak negative relationship between higher sustainable revenue and higher profit in this data set. In the same way, the correlation between Revenue Clean and CEO Pay Ratio is -0.09, weak and negative, which translates to the fact that more sustainable revenue results in a little more equity in the pay structure, yet the relationship is insignificant. The correlation between Profit_clean and CEO Pay Ratio is 0.04, which is an outright indication of no connection. These findings indicate that although firms are moving towards an improved selling of sustainable commodities or services, it is not always indicative of better profits and a fairer governance structure. Sustainable operations and adoption of the circular economy must be independently tested on financial, social, and governance aspects, and there is no correlation between good performance in one aspect and good performance in the other sphere (Kazakova & Lee, 2022; Sikder et al., 2025).

5.2 Distribution of Sustainable Companies that do Manufacturing Geographically

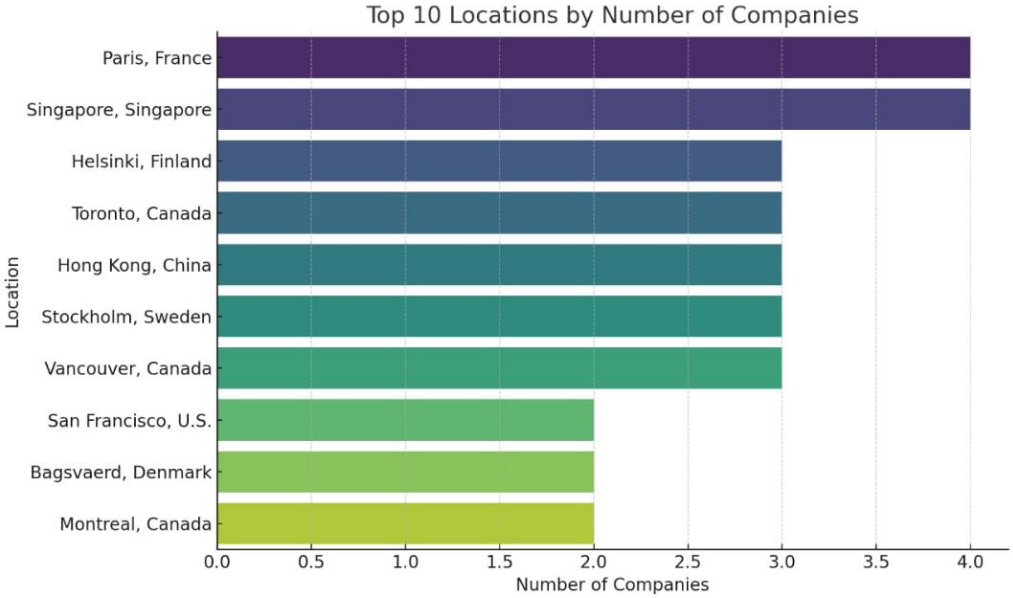


Figure 2: This image demonstrates the Distribution of Sustainable Companies that do Manufacturing Geographically

The Top 10 locations in terms of the number of companies within the list of the most sustainable corporations in the world, according to the analyzed dataset, are in the form of a horizontal bar graph as seen in Figure 2. These bars represent the pair of cities and countries, and the length of the bar indicates the number of corporations that have their headquarters in the same city. It can be observed that Paris, France, and Singapore are the chief hubs with four sustainable companies. Moscow is next with Helsinki, Toronto, and other cities in the world, having two to three companies that feature among its top-ranked companies. This geographic distribution reveals important details concerning the leadership of the region in the field of sustainable manufacturing and adopting a circular economy. As an interesting example, such places as Paris, Singapore, or Helsinki are not only centers of economic activity but also environmentally friendly cities with progressive policies to protect the environment and strong ESG standards that could also help to shape more sustainability-minded corporate cultures. They tend to encourage green innovation in their government, regulate their emissions production, and further guarantee the transparency of ESG reporting (Sikder et al., 2025). Research-wise, these findings support the prospect that location plays a crucial role in corporate sustainability performance. The companies that operate in the cities or states focusing on

sustainability are more likely to use the circular economy approaches and follow the ESG standards and strategies, and produce environmentally conscious planning. Such companies enjoy the pressure and the possibility of innovation in circular design, reducing waste, and using green technologies. The geographical concentration of sustainable corporations has also been linked to the geographical spread of best practices, in which clusters of regional business ecosystems facilitate knowledge exchange and sustainable innovation. This lends towards the larger claim of the paper that an organizational internal orientation is not the sole manner through which circular economy practice is developed, and that the external policy setting in the development of circular economy habits, socio-economic infrastructure, contributes to the fact that location is such a crucial concern in assessing global sustainability comparisons (Sikder et al., 2025).

5.3 Industry Distribution of CEO Pay Ratio

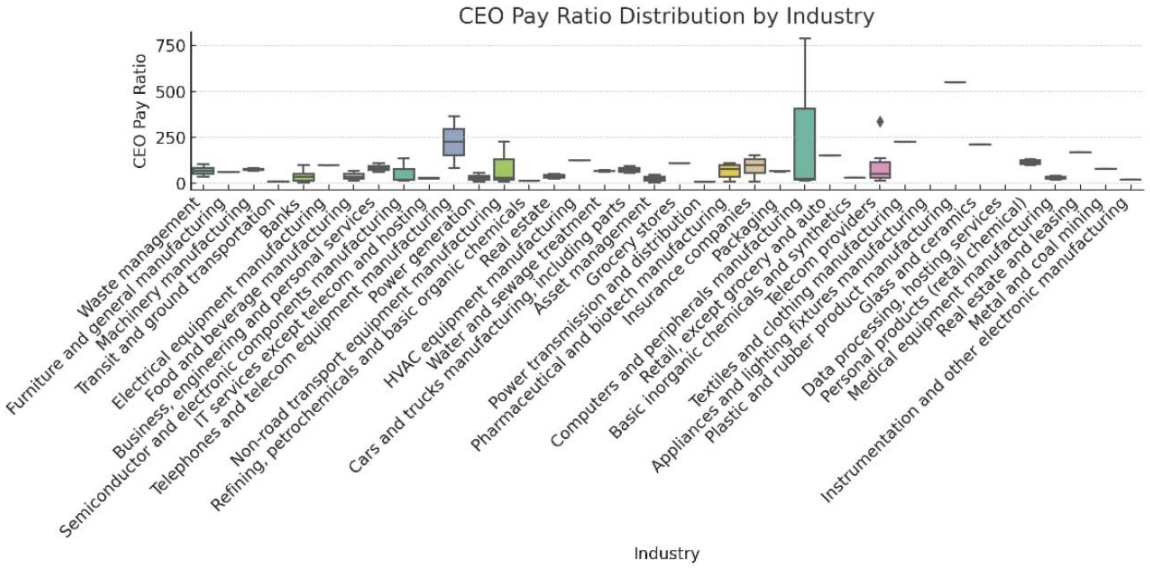


Figure 3: This Image shows the CEO pay ratios represented by a box plot of the different ratios

As seen in Figure 3, the CEO pay ratios are represented by a boxplot of the different ratios in the industries, including the different sectors of manufacturing. The CEO Pay Ratio is a ratio of the difference that exists between the amount received by the CEO and the median employee in a particular company. This indicator represents the Social and governance aspects of the ESG frameworks, as it is an analog of equity, fairness, and inclusive company policies, which are an essential part of sustainable enterprise activities (Pascual et al., 2019). Based on the chart, we find that the majority of industries have relatively low to moderate CEO pay ratios, and this is normally in a range lower than 150. There is, however, major variability and outliers in some sectors. It is seen that in the case of industries like chemical manufacturing, textile and clothing, and telecom providers, there is a broader range, and the median pay is higher, and some of them cross the figure 500. Industries such as waste management, HVAC production, and semiconductor or electronic components production, on the contrary, have less unequal distributions, implying more equalized compensation practices. The implementation of the concept of circular economy in manufacturing, since it points out the existence of one of the significant social aspects of dust clouds, the aspect of internal equity, which overlaps with the sustainability of activities (Kazakova & Lee, 2022; Pascual et al., 2019). More equal firms can be indicated as having better internal control systems and employee welfare, which in turn can support long-term sustainability objectives and enable the transition to the circular model of business operations more easily (Pascual et al., 2019). Conversely, large inequalities may reflect a looser organisational structure or a lop-sided governance structure, which may offset an ESG performance when the environmental objectives are achieved (Pascual et al., 2019). Figure 3 highlights that even though the promotion of a circular economy tends to be considered in terms of resource efficiency and environmental innovation, fair leadership compensation is one of the key indicators of social sustainability (Pascual et al., 2019). The analysis is consistent with

the overall Triple Bottom Line approach adopted in this research, in which one should not forget about people in addition to the planet and profit (Pascual et al., 2019).

5.4 Industrial Variation in gender diversity in the Leadership

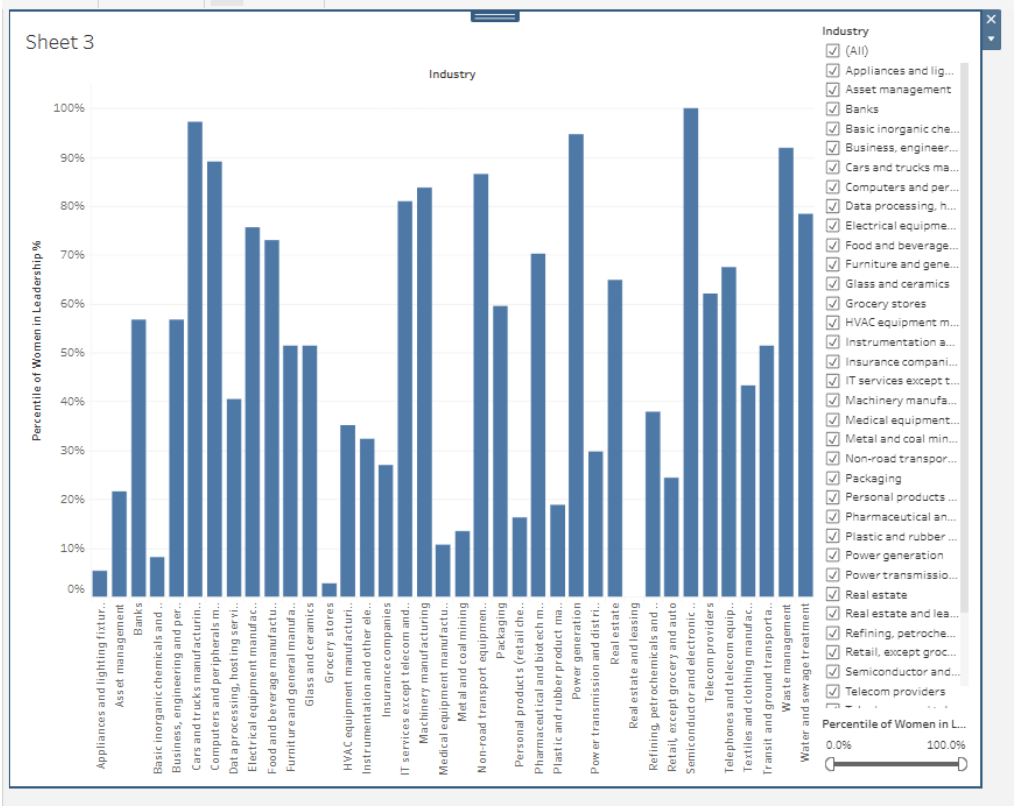


Figure 4: This image illustrates the percentage of women in leadership roles across different industries

The increase in the percentage of women in leadership roles across different industries, as shown in a vertical bar chart presented in Figure 4, showcases women concentrating in the manufacturing and sustainability-based industries. Ranging from the percentile of women holding executive or board positions in the vertical axis and the categorization of the industries in the horizontal axis, the results reflect the elements of appropriately categorizing the electric types of devices, pharmaceuticals, logistics, and retail. The statistics show that there is a significant difference in gender diversity. High representation of inclusive governance is recorded in certain industries, including Electrical Equipment Manufacturing, Furniture and General Manufacturing, and Computers and Peripherals Manufacturing, with the female leadership representation being over 90 per cent. On the other extreme, other industries like Appliances and Lighting, Metal and Coal Mining, and related have less than 20% leadership diversity, which is an indicator of sex disproportion in executive decision-making positions. This visualization conforms with the governance part of ESG performance, which is a fundamental aspect of sustainable operations management research (Romano et al., 2020). The industries that have been identified to exhibit a greater degree of gender diversity tend to resonate more with the larger sustainability and ethical governance models (Heubeck, 2023; Khatri, 2022; Lin et al., 2022; Romano et al., 2020). These companies have a higher probability of being transparent, inclusive to employees, and adopting strategic flexibility, which contribute positively to the incorporation of the circular economy models (Romano et al., 2020). This review lends its curiosity to the Triple Bottom Line school of thought by focusing on the people's dimension or social responsibility and equality, in addition to environmental and economic consequences (Kazakova & Lee, 2022). The leadership of a company with gender diversity could also lead to more diverse views when it comes to innovation, stakeholder participation, and sustainable product design, all factors that are important in encouraging the concept of circular operations (Khatri, 2022; Romano et al., 2020). Figure 4 supports the position that the diversity in governance is not only a societal standard but also a strategic tool in promoting the performance of sustainable practices in the manufacturing industries (Heubeck, 2023; Lin et al., 2022).

5.5 Average Revenue Ranking Across Sustainable Companies

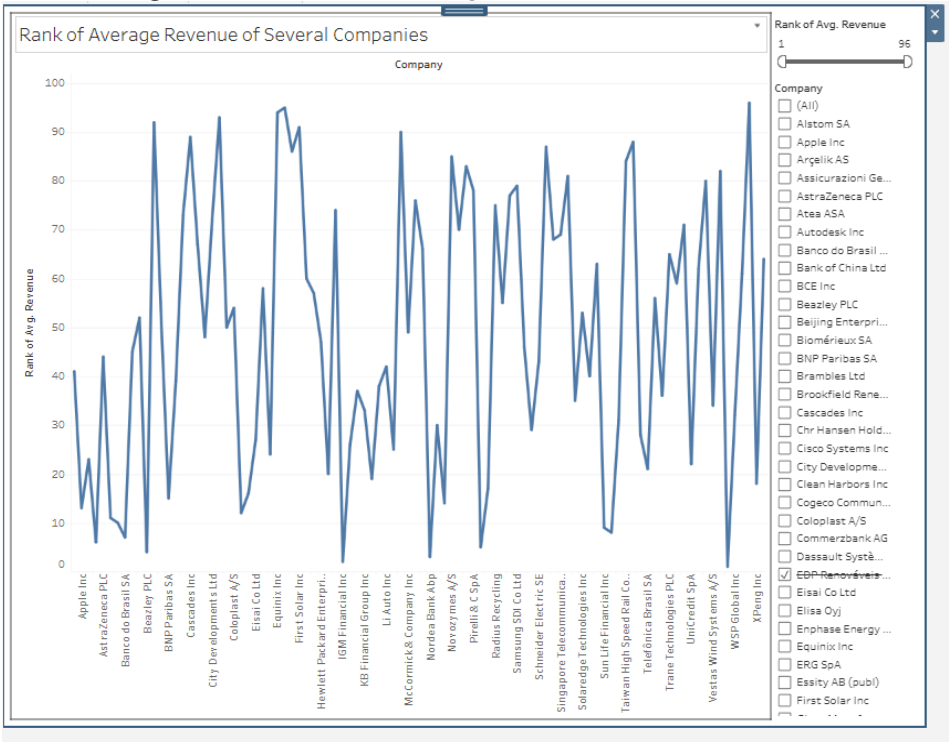


Figure 5: This Image shows the ranking of average revenue among a few leading sustainable corporate

Figure 5 below shows the ranking of average revenue among a few leading sustainable corporations, as shown in the dataset. The point which is on the line plot denotes the rank of each company in different lines based on its average revenue placed along the X-axis, whereas the Y-axis shows the scale of the ranking based on the revenue. The companies cut across all industries, such as manufacturing, telecommunication, medicine, finance, and technology industries. The chart offers useful information in terms of the financial aspect of sustainability that refers to the three pillars of the Triple Bottom Line (Feng & Goli, 2023). The ranking with the revenue is interesting, but not consistent in a definite fashion. Although there are significant companies like Apple Inc., Samsung SDI, and Schneider Electric present in the top ranks in terms of revenue, there are also mid to low-ranked companies like Vestas Wind Systems, First Solar, and Brambles Ltd., which can be known as the best practices in terms of sustainability. This variance implies that the success of financial performance and sustainability leadership may not always be relational (Feng & Goli, 2023). Other companies perform better under circular economy integration or ESG governmental practices when their revenue is not large, especially in a specialized sector such as renewable energy, recycling and disposal, or ethical production (Feng & Goli, 2023). Conversely, other companies with high revenue can be leading in financial terms but perform only at average levels regarding sustainability determination. This paper suggests that both economic success and sustainability should be considered together, but they should not be assumed to be intertwined (Feng & Goli, 2023). Firms may gain profit and fail to perform in circulation practices, and vice versa. The full-scale sustainable operations management needs to consider not only revenue but also such indicators as the sustainability revenue percentage, ESG ratings, and diversity of leadership as part of a balanced opinion on the business performance (Feng & Goli, 2023).

5.6 Industry of Gender Representation in the Workforce

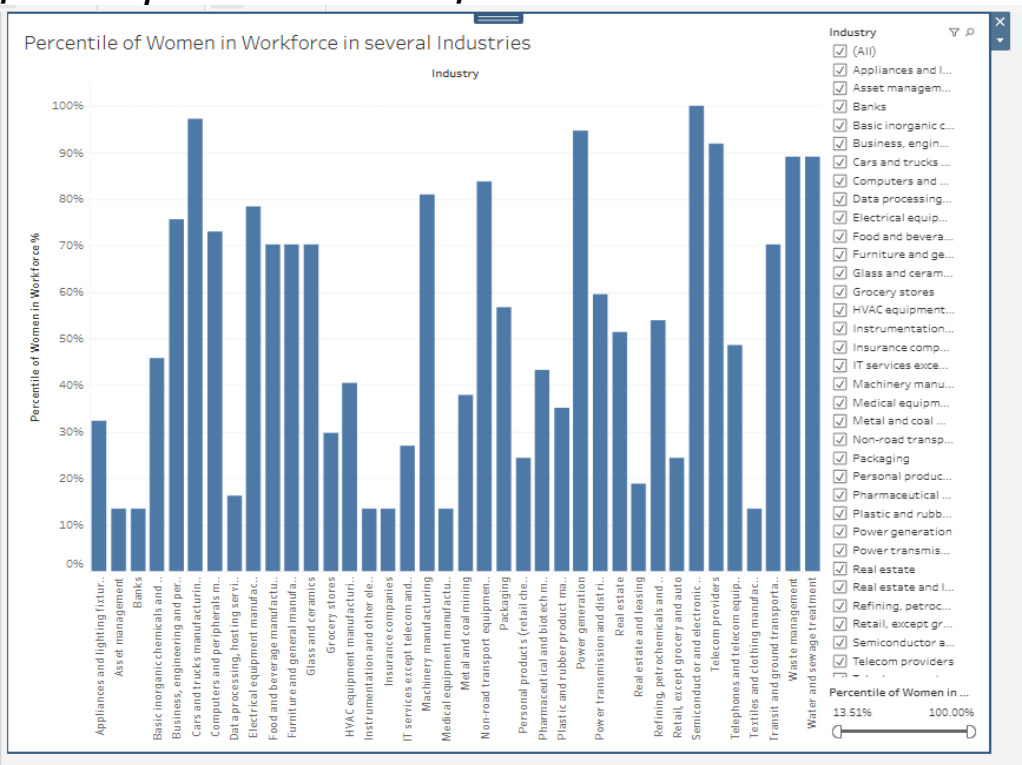


Figure 6: This image demonstrates the share of women in the total workforce across different industries

Figure 6 represents a visualization of the share of women in the total workforce, explained in different industries, with those that are more visible in manufacturing and sustainability. The Y-axis represents the percentage of women in the labor market, the X-axis measures the industry segmentation, and provides a comparative understanding of gender inclusivity not only in leadership positions. A highly unequal segmentation in the participation of the female workforce is shown in the data. Computers and Peripherals, Furniture and General Manufacturing, and Business and Engineering Services are the three industries where the female representation is more than 80 percent, and thus, these industries are showing a good possibility of maintaining the hiring policies in a broad way. On the other hand, the female workplace participation in such industries as Metal and Coal Mining, Refining and Petrochemicals, and Machinery Manufacturing is only 13 percent, which shows that gaps between genders in male-dominated areas remain (Kazakova & Lee, 2022). Under Triple Bottom Line and ESG, this chart will be part of a study in terms of social sustainability (Kazakova & Lee, 2022). Although the main thrust in the practice of circular economy appears to be environment and operational efficiency, inclusive workforce policies play a key role in facilitating sustainable transitions (Kazakova & Lee, 2022). Diversity in the workforce is associated with innovation, ethical decision making, and belief by the stakeholders, which is vital in industries that aim to effect lasting environmental and social change (Kazakova & Lee, 2022). Those industries that generate high sustainability revenue, or have deep circular practices such as electrical equipment and packaging, also boast admirable female representation, which may indicate that there is a potential correlation between operational sustainability and social equity. The statistics also reveal fields where the implementation of the circular economy can take place in isolation from gender inclusivity, which suggests the necessity to take comprehensive sustainability approaches into consideration beyond only accounting for the diversity of the workforce and environmental impact. Figure 6 reaffirms the significance of gender equity being an aspect of sustainable operations management to encourage manufacturing industries to intertwine diversity objectives and circular economy initiatives in a bid to transform the industry sustainably through robust ESG performance (Kazakova & Lee, 2022).

5.7 Distribution of Profitability in Worldwide Locations

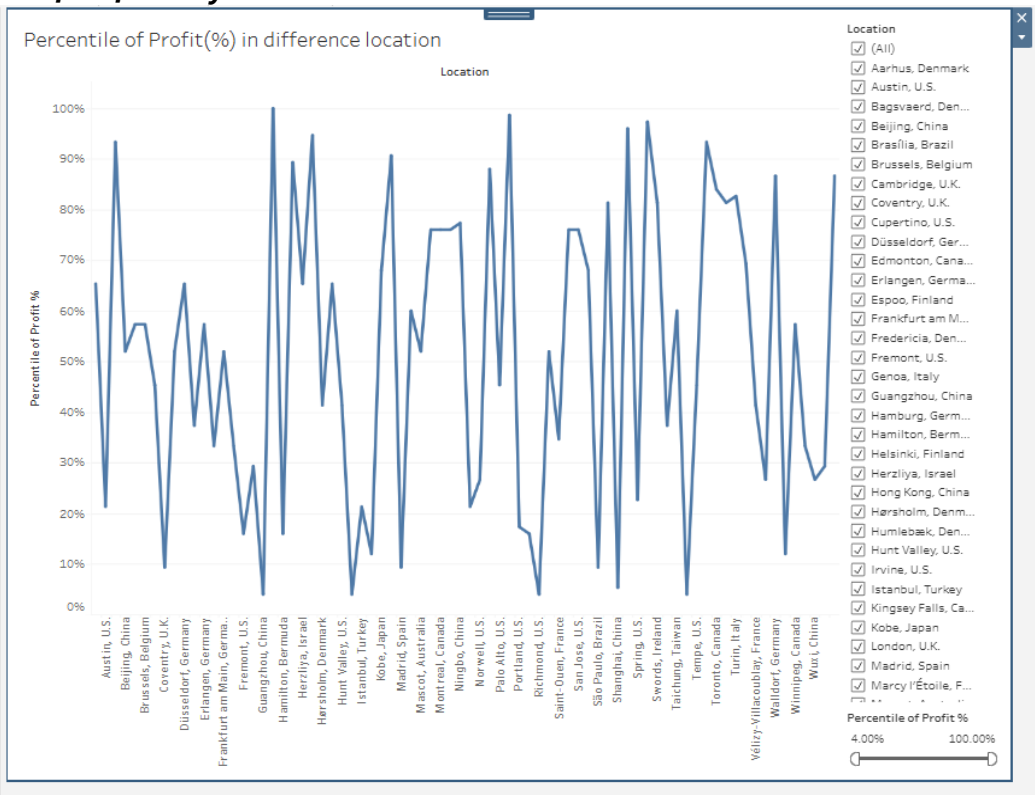


Figure 7: This image represents the percentile of profit (%) in different locations across the World

Figure 7 represents a line diagram to show the percentile of profit in different locations across the globe. The X-axis and the Y-axis are in these respects: each individual point on the X-axis is a city or region in which a sustainable corporation has a headquarters, and the Y-axis bears the percentile rank of profit that companies located in the given place have earned. The image demonstrates the geographical range of financial performance of the most sustainable 100 corporations all over the world. It gives great variance in profitability, with such locations as Austin, Brasilia, Madrid, and Tokyo having percentages of profitability of almost or up to the 100th percentile. In comparison, other cities like Coventry, Hamburg, and Montreal perform much lower and have profit percentiles that are below 20. Such variation implies that geography contributes significantly to the outcome of profitability, which may be the difference in market conditions, regulatory frameworks, labor prices, and availability of sustainable infrastructure (Rodríguez-Espíndola et al., 2022). Although the companies in the low-profit areas might be actively spending money on the long-term circular economy projects, the companies in the high-profit areas might be enjoying the fruits of the sustainable ecosystem maturity or the policy environment (Rodríguez-Espíndola et al., 2022). From the perspective of Triple Bottom Line and ESG performance, this number shows how difficult it can be to meet the economic challenges and follow environmental and social goals (Ghaithan et al., 2023). Earning is one of the main foundations of sustainability operations management. It needs to be compromised by the promises of decreasing waste, inclusiveness, and innovation via circular actions. Figure 7 reaffirms the fact that profit cannot always be used to indicate overall sustainability (Feng & Goli, 2023). Less profitable regions can show strong results in ESG and circular speed, which speaks about the necessity of multi-dimensional analysis in sustainable corporate rating.

5.8 Aggregate Sustainability Ranking of Companies

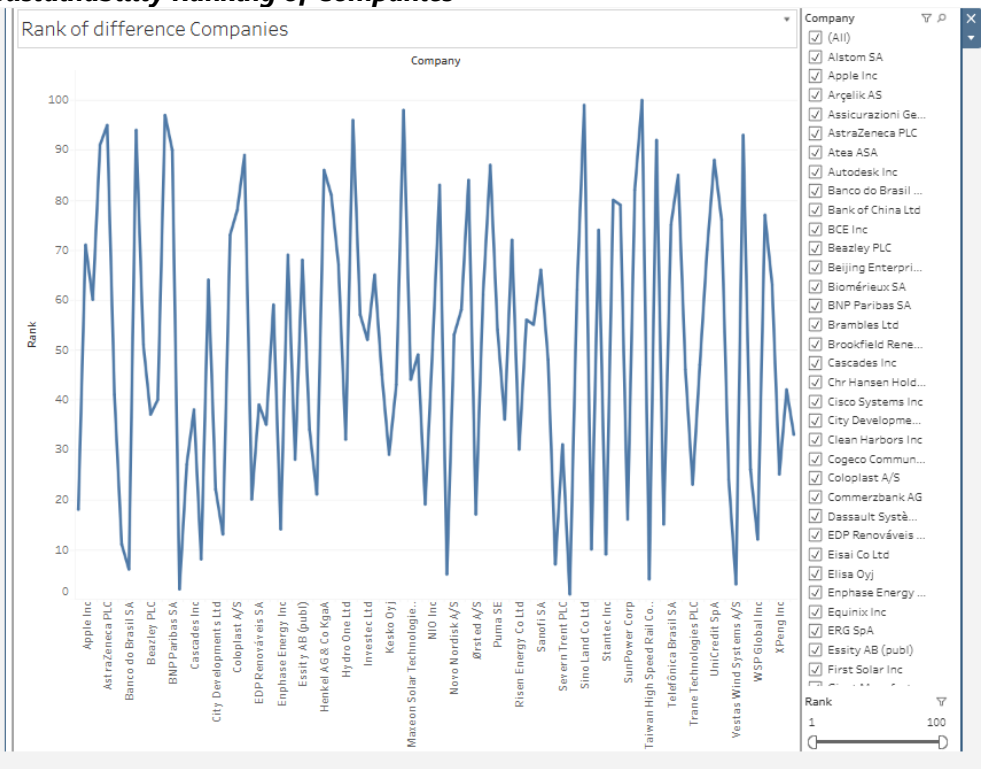
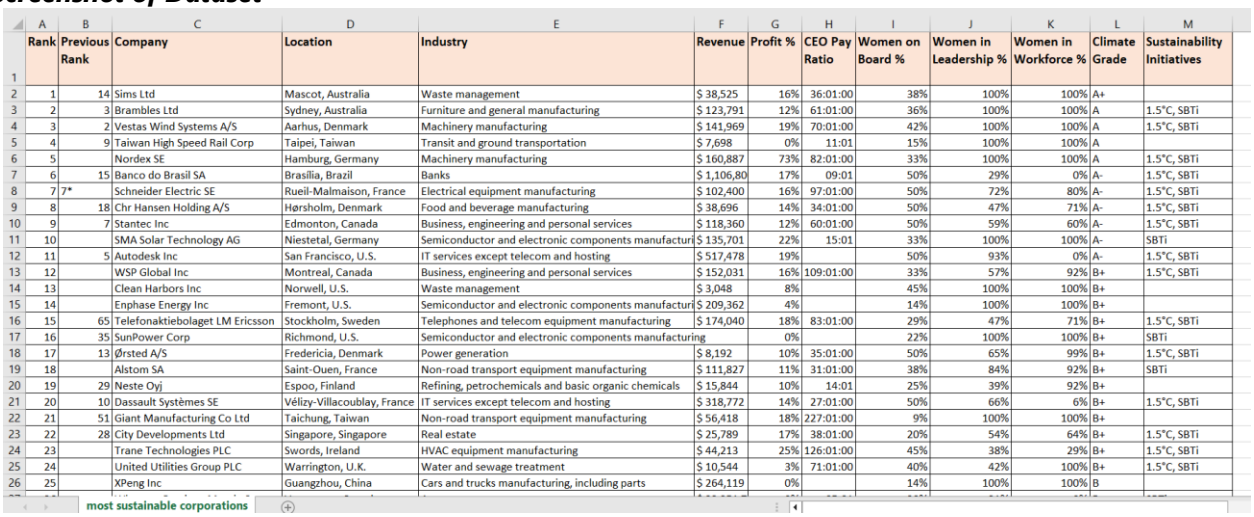


Figure 8: This image shows the sustainability ranking of the various corporations in the top 100 most sustainable corporations in the world

As shown in Figure 8, the sustainability ranking of the various corporations in the top 100 most sustainable corporations in the world is as follows. The names of the companies are listed on the X-axis, and the ranking of the companies comes in the Y-axis, where a lower value creates a higher value of sustainability. The line graph makes it obvious that there is non-uniformity, in a sense, of the sustainability performance of the corporate environment depicted. Brambles Ltd, Sims Ltd, Apple Inc, and Ørsted A/S always appear in the highest-ranking positions, proving the willingness to conduct business in a sustainable way, following the principles of the circular economy, and focusing on sustainable business processes (Sikder et al., 2025). The companies with a range of 70-100 show a slightly lower sustainability rate, which indicates that either their green integration is only getting up to speed, or they are rather behind the others. The company that ranks in a higher position tends to have good figures in variables like Sustainability Revenue %, CEO Pay Ratio, and gender diversity, as used in previous figures (Sikder et al., 2025). These statistics fall in line with the Triple Bottom Line and Circular Economy models in confirming that organizational success in the contemporary world cannot be only measured using financial performance but also through the environmental effect and social justice (Alsayegh et al., 2020; Ghaithan et al., 2023). The riskiness in rankings supports the case for uniform and consistent measurement of ESG (Alsayegh et al., 2020; Nazir et al., 2025). It is indicative of the changing nature of sustainability measures that can change as regulations change, the expectations of the market, and even as technology advances (Alsayegh et al., 2020; Shaikh, 2022). This number fulfills the general purpose of the research because it justifies the need to do a comparative analysis of the circular economy and ESG indicators to assess sustainable practices (Sikder et al., 2025). Firms whose position in the top quadrant has remained unchanged over the years act as role models in terms of integrating sustainability into the mainstream of their operations, particularly in the manufacturing industry (Sikder et al., 2025).

6. Dataset

6.1 Screenshot of Dataset



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Rank	Previous Rank	Company	Location	Industry	Revenue	Profit %	CEO Pay Ratio	Women on Board %	Women in Leadership %	Women in Workforce %	Climate Grade	Sustainability Initiatives
2	1	14	Sims Ltd	Mascot, Australia	Waste management	$ 38,525	16%	36:01:00	38%	100%	100%	A+	
3	2	3	Brambles Ltd	Sydney, Australia	Furniture and general manufacturing	$ 123,791	12%	61:01:00	36%	100%	100%	A	1.5°C, SBTi
4	3	2	Vestas Wind Systems A/S	Aarhus, Denmark	Machinery manufacturing	$ 141,969	19%	70:01:00	42%	100%	100%	A	1.5°C, SBTi
5	4	9	Taiwan High Speed Rail Corp	Taipei, Taiwan	Transit and ground transportation	$ 7,698	0%	11:01	15%	100%	100%	A	
6	5		Nordex SE	Hamburg, Germany	Machinery manufacturing	$ 160,887	73%	82:01:00	33%	100%	100%	A	1.5°C, SBTi
7	6	15	Banco do Brasil SA	Brasília, Brazil	Banks	$ 1,106,80	17%	09:01	50%	29%	0%	A-	1.5°C, SBTi
8	7	7*	Schneider Electric SE	Rueil-Malmaison, France	Electrical equipment manufacturing	$ 102,400	16%	97:01:00	50%	72%	80%	A-	1.5°C, SBTi
9	8	18	Chr Hansen Holding A/S	Hørsholm, Denmark	Food and beverage manufacturing	$ 38,696	14%	34:01:00	50%	47%	71%	A-	1.5°C, SBTi
10	9	7	Stantec Inc	Edmonton, Canada	Business, engineering and personal services	$ 118,360	12%	60:01:00	50%	59%	60%	A-	1.5°C, SBTi
11	10		SMA Solar Technology AG	Niestetal, Germany	Semiconductor and electronic components manufacturi	$ 135,701	22%	15:01	33%	100%	100%	A-	SBTi
12	11	5	Autodesk Inc	San Francisco, U.S.	IT services except telecom and hosting	$ 517,478	19%		50%	93%	0%	A-	1.5°C, SBTi
13	12		WSP Global Inc	Montreal, Canada	Business, engineering and personal services	$ 152,031	16%	109:01:00	33%	57%	92%	B+	1.5°C, SBTi
14	13		Clean Harbors Inc	Norwell, U.S.	Waste management	$ 3,048	8%		45%	100%	100%	B+	
15	14		Enphase Energy Inc	Fremont, U.S.	Semiconductor and electronic components manufacturi	$ 209,362	4%		14%	100%	100%	B+	
16	15	65	Telefonaktiebolaget LM Ericsson	Stockholm, Sweden	Telephones and telecom equipment manufacturing	$ 174,040	18%	83:01:00	29%	47%	71%	B+	1.5°C, SBTi
17	16	35	SunPower Corp	Richmond, U.S.	Semiconductor and electronic components manufacturing		0%		22%	100%	100%	B+	SBTi
18	17	13	Ørsted A/S	Fredericia, Denmark	Power generation	$ 8,192	10%	35:01:00	50%	65%	99%	B+	1.5°C, SBTi
19	18		Alstom SA	Saint-Ouen, France	Non-road transport equipment manufacturing	$ 111,827	11%	31:01:00	38%	84%	92%	B+	SBTi
20	19	29	Neste Oyj	Espoo, Finland	Refining, petrochemicals and basic organic chemicals	$ 15,844	10%	14:01	25%	39%	92%	B+	
21	20	10	Dassault Systèmes SE	Vélizy-Villacoublay, France	IT services except telecom and hosting	$ 318,772	14%	27:01:00	50%	66%	6%	B+	1.5°C, SBTi
22	21	51	Giant Manufacturing Co Ltd	Taichung, Taiwan	Non-road transport equipment manufacturing	$ 56,418	18%	227:01:00	9%	100%	100%	B+	
23	22	28	City Developments Ltd	Singapore, Singapore	Real estate	$ 25,789	17%	38:01:00	20%	54%	64%	B+	1.5°C, SBTi
24	23		Trane Technologies PLC	Swords, Ireland	HVAC equipment manufacturing	$ 44,213	25%	126:01:00	45%	38%	29%	B+	1.5°C, SBTi
25	24		United Utilities Group PLC	Warrington, U.K.	Water and sewage treatment	$ 10,544	3%	71:01:00	40%	42%	100%	B+	1.5°C, SBTi
26	25		XPeng Inc	Guangzhou, China	Cars and trucks manufacturing, including parts	$ 264,119	0%		14%	100%	100%	B	

most sustainable corporations

6.2 Dataset Overview

The data that will be used in this study is that of the Top 100 Most Sustainable Corporations in the world, which provides an excellent source of data to assess sustainability performance in the backdrop of circular economy principles in production. It consists of corporations based on various sectors (manufacturing, telecommunications, banking, energy, and pharmaceuticals) and was sourced in one freely available CC0-licensed repository. It includes 13 separate variables that offer information about the corporate dedication to the interventions with the principles of environmental, social, and governance (ESG). The important features reflect the global sustainability ranking of the corporation, revenue, profit percentage earned through sustainable sources, CEO pay ratio, and home of the headquarters, plus gender diversity in the executive management and board composition indicators. Such variables as, e.g., the amount of information that there is 20 more characteristics of variables than those included in the list above, are particularly interesting to this study, which includes the percentage of a company's revenue sourced by circular or eco-efficient business operations, named Sustainability Revenue Percentage, and the degree of approximation to international ESG standards, named ESG Rating. It is also specified that the corporation is a member of sustainability initiatives like the Science-Based Targets initiative (SBTi) and the Net-Zero Banking Alliance (NZBA), which points to the active participation in climate-themed global programs. The manufacturing companies were excluded, so I could analyze them separately and compare how companies in this industry are carrying out the circular economy model, but at the same time, carrying out expectations of ESG. The variability of industries and geographic destinations included in the data also allows evaluating them in terms of regional and industry-specific sustainability trends, including the role of cultural, policy, or economic factors in ESG integration assessment.

7. Discussion and Analysis

7.1 Social Equity vs. Financial Performances

Figure 1 shows the correlation matrix that reveals a poor correlation between financial indicators and social governance indicators. This observation implies that a large income or profitability does not always imply equal payment scales or responsible leadership (Feng & Goli, 2023). Decoupling of this nature means that financial strength is not a particular measure of sustainability maturity. The ethical consideration is not paramount to the economic gains of many corporations, which puts in question the holistic approach suggested by the Triple Bottom Line framework (Pascual et al., 2019). In production, where the volume of operation can distort the leadership differences, the differences between economic development and social justice are better pronounced (Pascual et al., 2019). This strengthens the significance of the ESG integration that goes beyond fiscal reporting (Alsayegh et al., 2020). The actual or real sustainability is the balance between stakeholders, which entails fair remuneration, diversity in its works, and ethical management activities (Pascual et al., 2019). Times have changed, and any company that ignores these dimensions can face regulatory and reputation-wise setbacks. Businesses are required to counteract compliance and incorporate social fairness in basic business models. According to the figures above, there should

be a reconsideration of the metrics of success, shifting the revenue-based KPIs to multidimensional models, which consider people and governance equally (Feng & Goli, 2023). This observation corroborates larger sustainability studies, which recommend that integrity management and diversity practices are core to building long-term viability and stakeholder confidence in manufacturing activities (Pascual et al., 2019).

7.2 Geographical Distribution and Leadership of the Region

Figure 2 indicates successful cities such as Paris, Singapore, Helsinki, Toronto, and Hong Kong, where there are strong locations of corporations that are identified as the leaders of excellence in terms of sustainability (Sikder et al., 2025). A combination of these places has the largest number of companies ranked in the top 100 sustainable corporations list (Sikder et al., 2025). Such clustering is not accidental; it is rather the result of the role of regional policy frameworks, infrastructure preparedness, and socio-political backing to sustainability transitions (Rodríguez-Espíndola et al., 2022). The governments of such areas are also inclined to reward ESG reporting, implement environmental rules, and encourage circular economy practices through subsidies and a partnership between government and big business (Rodríguez-Espíndola et al., 2022). In the case of manufacturing companies, facilitating ecosystems plays a critical role in the adoption and scalability of the circular practices of remanufacturing of products, a closed-loop supply chain, and sustainable material sourcing (Ghaithan et al., 2023). The cities also provide green finance schemes, research, and talent on sustainable operations. Regional differences highlight that the place can facilitate or inhibit the implementation of a circular economy as well. Those cities that fail to produce as many top performers might be undergoing more system-based limitations; their environmental policies are weak, there is no ESG accountability, or low-carbon infrastructure is unavailable (Rodríguez-Espíndola et al., 2022). Such a regional perspective explains why each region should have its own sustainability policies and approaches based on the industrial, cultural, and economic processes of the respective region. Ecosystems of a region are fundamental in influencing the rate and magnitude of adopting sustainability in the manufacturing industry (Rodríguez-Espíndola et al., 2022).

7.3 Industry-Wide Gaps in CEO Pay Equity

The very disparity in the CEO Pay Ratio is inherent across industries, which is illustrated in Figure 3. The pharmaceutical industry, the banking industry, and the power industry show extremely high executive compensation levels in comparison with less powerful industries like waste management, textiles, and packaging (Pascual et al., 2019). This gap brings internal equity issues and underlying socially responsible interpretations of firms under ESG requirements (Pascual et al., 2019). The large pay ratio of CEOs usually indicates income inequality at the firm, which is a potential mismatch with the Triple Bottom Line approach to business, in terms of the People component (Pascual et al., 2019). In sustainable operations, fair pay is not only an ethical requirement, but it also has consequences on the satisfaction, retention, and perception of employees (Pascual et al., 2019). Through the circular economy prism, companies that want to be regenerative should manage to regenerate social capital too, and pay equity should be at the heart of it (Pascual et al., 2019). As the industry standards are different, pay ratios that are too high may result in organizational lack of credibility, especially in those industries where the company needs to remain trustworthy and maintain a strong connection with the community over a long period of time (Pascual et al., 2019). This difference has also been used to highlight some areas of gaps in governance systems, as there are areas that focus on shareholder value more than inclusive growth (Pascual et al., 2019). Avoiding the failure of sustainability leaders, manufacturers will have to make sure that their policies in the realm of governance sustainability contribute to fair wages, ethical policies regarding remuneration, and diversity within a company (Pascual et al., 2019). The measurement of CEO compensation ought to be assessed alongside the performance of ESG to make it consistent with financial rewards and the corporate sustainability goals (Zhu et al., 2024).

7.4 Women's Leadership Representation in Executive Leadership

As depicted in Figure 4, there exists a considerable discretion in the proportion of female leadership in leadership positions of various businesses (Pareek et al., 2021; Romano et al., 2020). Whereas the IT services, pharmaceuticals, and waste management industries show almost parity with over 80 per cent female representation, the chemical, heavy engineering, and electricity industries lag far behind (Romano et al., 2020). This disparity symbolizes a persisting structural variance in gender inclusion in manufacturing and other allied sectors (Pareek et al., 2021). Gender diversity within the executive management comes even beyond a symbolic show of progress as it has been

correlated with better decision-making, organizational innovation, and adaptability (Khatri, 2022; Romano et al., 2020). Inclusive leadership is one of the fundamentals of ESG guidelines on a governance level (Romano et al., 2020). The ability to think cross-functionally and involve stakeholders, which is frequently a part of circular economy implementation, presupposes the importance of various leadership styles (Lin et al., 2022). The low percentage of women in some industries will be the aspects that need to be cleaned up (Romano et al., 2020). What is more, shareholders and directors are putting pressure on companies to disclose and enhance diversity ratios as a measure of good governance (Pareek et al., 2021; Romano et al., 2020). Gender-balanced leadership becomes very important in terms of organizational culture alignment with sustainability objectives in the context of sustainable operations management (Heubeck, 2023). To realize the vision of creating a more sustainable and digitized manufacturing industry, bridging the gender gap will be one of the key factors in ensuring that corporate practices and strategies become more inclusive in the sphere of corporate actions and demonstrate a vision of the future that shifts toward the realization of the Triple Bottom Line ideals (Kazakova & Lee, 2022).

7.5 Regional Integration of Profitability and Circular Revenue

In Figure 7, there is a distinct difference between the percentage of profits in various locations around the world, which indicates an imbalanced economic environment that sustainable corporations have to work in. Other cities display high profitability at all times and are also on the frontline when it comes to integrating the circular economy, which necessitates their presence in previous numbers, including San Diego, Paris, and Singapore (Rodríguez-Espíndola et al., 2022). This argues for the fact that sustainability and profitability are no longer mutually exclusive (Feng & Goli, 2023). Indeed, companies that develop activities in high-performing areas can enjoy regulatory and consumer demand stimulating their green products, and therefore, allow their business models to be circular (Rodríguez-Espíndola et al., 2022). Having the green supply chains, tax benefits, and skilled labor in these places adds to the operational efficiency and innovation (Kazakova & Lee, 2022). The so-called inverse applies as well: the sites that have low profit margin and low sustainability income indicate barriers within the system- high operational costs, lax environmental standards, or the absence of green infrastructure (Rodríguez-Espíndola et al., 2022). The insights are especially crucial to multinationals that might find it important to adjust their sustainability efforts geographically. To manufacturing companies, in this figure, it is evident that the alignment of the practices in the circular economy with the economic performance of the region is essential to ensure that the implementation of circular economy practices is environmentally friendly and profitable (Feng & Goli, 2023).

7.6 Ranking Risk of Volatility and Sustainability Consistency

Figure 8 presents a graphic representation of the instability and dynamics of the ESG indicators of the overall sustainability ranking of corporations (Alsayegh et al., 2020; Nazir et al., 2025). Although there are companies that always hold steady positions, there are considerable changes in terms of the position occupied by companies (Alsayegh et al., 2020). Such oscillations can be explained by the alteration of ESG reporting standards, the change of leadership, environmental accidents, or the advancement of social indices such as gender diversity or equal pay (Alsayegh et al., 2020; Shaikh, 2022). This instability in rankings shows that companies have a long-standing issue maintaining their ESG excellence in the long term (Sikder et al., 2025). In manufacturing companies, whose actions are both resource-consuming and under close oversight, uniformity in the practices of sustainability levels is a competitive advantage (Kazakova & Lee, 2022). The statistics indicate that it is possible to fall into the top 100, but one cannot stay there without constant innovation, transparent reporting, and changing governance (Alsayegh et al., 2020; Sikder et al., 2025). Investors, regulators, and consumers are becoming more focused on annual comparisons between ESG performance, to the point that businesses are being encouraged to make sustainability a structural component of their business, rather than a marketing tool (Alsayegh et al., 2020; Nazir et al., 2025). This volatility further explains that sustainability is not a destination but a process that needs constant readjustments (Sikder et al., 2025). These results are consistent with the Triple Bottom Line approach to generating value over the long term, environmentally, socially, and economically (Ghaithan et al., 2023; Sikder et al., 2025). To be sustainable and have credibility, manufacturing companies ought to develop adaptive strategies that will enable them to take the initiative as leaders of sustainability who are also accountable (Sikder et al., 2025).

8. Future Work

This study has offered an in-depth discussion regarding sustainable operations in manufacturing by referring to circular economy practices and ESG indicators, although there are opportunities to build on this style of research in future research in a bid to further enrich the research in depth and relevance. On the one hand, prospective research can extend the data set in terms of time, searching for tendencies in increasing ESG performance and the integration of its circular revenues over five to ten years to reveal temporal dynamics and the long-term impact of the sustainability efforts. It would enable the researchers to differentiate between shorter trends and long-term positive change. Second, the qualitative aspect of how sustainability strategies are implemented on the ground through expert interviews or case studies with successful manufacturing companies can be included to provide contextual background information and enrich the statistical analyses. This could be followed up by examining the causal links of ESG factors with financial performance through state-of-the-art statistical tests or even by engaging machine learning techniques that would provide predictive power to the results. An alternative route would be the comparison of policy environments in one region, such as suggested by regional differences in carbon pricing schemes, sustainability requirements, and disclosure requirements, and how that kind of local regulation shapes the sustainability actions of firms (Rodríguez-Espíndola et al., 2022). This study can be broadened to small and medium enterprises in manufacturing whose sustainability practices are seldom tapped due to the dominance of large corporations (Dey et al., 2022). Including more ESG dimensions, biodiversity impact, supply chain ethics, and employee-related well-being measurements would also augment the sustainability package (Shaikh, 2022). Future studies can assess the impact of digital transformation, such as AI, IoT, and blockchain, and its contribution to circular practices, particularly, material flow tracking, resource optimization, and increased transparency (Hosmani & DJ, 2025; Lödar-Miculeac et al., 2025). Researchers must consider creating a universal sustainability scoring mechanism integrating the circular economy, ESG, and triple bottom-line integration into a single index that would allow the assessment of companies in various industries and jurisdictions more accurately (Feng & Goli, 2023; Macher & Szigeti, 2025). These would help build on the growing knowledge base in sustainable manufacturing and help make evidence-based decisions and investments in the global crusade to develop industries in an environmentally and socially acceptable way.

9. Conclusion

This study has been a critical review of combining the concepts of the circular economy with ESG principles in sustainable operations management, with a data-driven comparison of the top 100 most sustainable worldwide corporations, with a specialization on manufacturing. It is through visual and statistical analysis of variables like the percentage of sustainability revenue, the ratio of CEO pay, the diversity of the gender rate, and the ESG ratings that the study reveals the intricate yet vital relationship of environmental, social, and governance aspects within the Triple Bottom Line concept (Ghaithan et al., 2023). The results verify that the financial performance is indeed relevant, but it does not necessarily mean that there is great social equity and environmental responsibility (Feng & Goli, 2023). Firms with the strongest interests in the adoption of the circular economy have been found to demonstrate characteristics of inclusive governance and fair compensation strategy, although these are still unevenly allocated across the industries and between geographic locations (Pascual et al., 2019; Sikder et al., 2025). The analysis shows that the geographic location is a significant factor that affects the sustainability outcome of a firm, and that regional policy frameworks, specific infrastructure, and even cultural factors are determining factors in facilitating or discouraging sustainable transformation (Rodríguez-Espíndola et al., 2022). Such reflections validate that sustainability cannot merely be an operation fulfilled through conformity or image rather than through a paradigm shift towards the process of value creation, measurement, and distribution among stakeholders (Alsayegh et al., 2020). This study, therefore, addresses the importance of manufacturers to pursue rather dimensionally, flexible, and locally responsive sustainability approaches through showcasing why manufacturers need to work more closely with circular economy practices across their core business models (Sikder et al., 2025). Although confinements like the lack of longitudinal information and qualitative opinion do exist, the study can provide valuable details to uphold the importance of using ESG indicators and circularity as critical aspects of sustainable manufacturing, as the demands of environmental and social responsibility rise across the world (Sikder et al., 2025).

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