



Degree Program in Management

Course of Corporate Strategy

**A Comparative Analysis of AI-Driven Corporate Social
Responsibility Initiatives in Italian and Scandinavian
Manufacturing Firms and Their impact on Strategies
and Competitive Advantages**

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Abstract

This thesis investigates how Artificial intelligence (AI) is implemented in Corporate Social Responsibility (CSR) initiatives by large manufacturing companies in Italy and Scandinavia, and how this integration impacts the firms' performance. Different research discussed the importance of AI and sustainability separately, but few of them analyzed their intersection with a strategic approach, in particular through a cross-country comparison. This study wants to solve this gap and understand how AI applications create value when applied in CSR initiatives through a qualitative research based on the experiences of six Italian and Scandinavian large manufacturing firms.

From the findings it emerged that AI applications are utilized in different CSR initiatives, such as energy management, demand forecasting, material recognition for circular economies and real-time monitoring of sustainability indicators. These tools in addition to the environmental benefits brought also operational efficiency with cost reductions and smooth processes. This AI-CSR integration derived both from a stakeholder pressure and a proactive strategy to drive innovation and efficiency. The study shows how Scandinavian firms are more proactive in the application of this strategy, while Italian companies follow a more compliance-oriented approach. This research is based on three main theoretical frameworks Resource-Based View (RBV), Stakeholder Theory and Strategic CSR. Through the application of these theories, it emerged that the integration of AI applications in CSR initiatives contributed both to sustainability outcomes and operational value, transforming sustainable initiatives from compliance driven functions into strategic capabilities that brought to the creation of a competitive advantage. During the implementation of these strategies technical and organizational challenges were faced by the companies, but they were solved through targeted investments and collaborative approaches. This research contributes to the existing literature on strategic sustainability and provides practical information for managers and policymakers on how to manage AI applications in CSR initiatives and how to create value from them.

Keywords: Artificial Intelligence, Corporate Social Responsibility, Stakeholder Theory, Manufacturing Sector, Strategic CSR, Resource-Based View, Competitive advantage.

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Table of Contents:

1. Introduction.....	6
1.1 Background and relevance of the study	6
1.2 Research Gap and Research Question	8
1.3 Thesis Structure	9
2. Literature Review and Theoretical Framework	10
2.1 The Manufacturing industry in Italy and in Scandinavian Countries 10	
2.2 Artificial Intelligence (AI) in the Manufacturing Sector	13
2.3 Corporate Social Responsibility (CSR): Definitions and Evolution 16	
2.3.1 CSR metrics and the role of ESG.....	19
2.4 Competitive Advantage and Value Creation	21
2.5 The Resource-Based View (RBV)	22
2.5.1 AI applications as a Strategic Resource	25
2.6 Stakeholder Theory	27
2.7 Strategic CSR.....	29
2.8 Theoretical Framework Model: An Integrated Approach	31
3. Methodology	33
3.1 Research Design and Approach	33
3.2 Data Collection	35
3.3 Data Analysis Strategy	37
3.4 Research Quality	38
4. Findings	41
4.1 Approaches to CSR and AI across companies	41
4.1.1 CSR approaches and strategies	42
4.1.2 AI applications	44
4.2 The specific AI applications in CSR initiatives	48
4.3 The Strategic Role of AI implementation in CSR initiatives.....	53
4.4 The impact on Competitive Advantage and Firm Performance....	56

4.5	Challenges and Barriers in the Implementation of AI in CSR practices.....	61
4.6	Future Strategies and Investments	65
4.7	Perceived Differences across Countries.....	69
5.	Discussion	74
5.1	From CSR to Strategic CSR: The Role of AI in the Evolution of Corporate Sustainability.....	74
5.2	AI as a Strategic Resource: A RBV Perspective	76
5.3	Stakeholder Influence and Institutional Context in Driving AI for CSR	79
5.4	Organizational Capabilities and Implementation Approaches: How companies adopt AI in CSR	82
5.5	Outcomes and Value Creation through AI-Driven CSR	86
5.6	Strategic Outcomes: The Link Between AI-Driven CSR initiatives, Firm Performance and Competitive Advantage	89
5.7	Cross-Country Differences: Sustainability, Digital Readiness and Strategic Adoption of AI	92
5.8	Overcoming Implementation Challenges and Barriers in the application of AI in CSR and Future Investments.....	95
6.	Conclusion	100
6.1	Answering the Research Question.....	100
6.2	Theoretical Contribution and Practical Implications	102
6.3	Recommendations for Policymakers and Companies.....	104
6.4	Study Limitations, Ethical Considerations and Future Research Directions	106
	Bibliography:	109
	Appendices:	119

1. Introduction

This research wants to explore the ways in which Artificial Intelligence (AI) applications are utilized by manufacturing companies to address Corporate Social Responsibilities (CSR) initiatives and how these applications can bring to a competitive advantage in the market. In particular, Italian and Scandinavian companies will be analyzed to understand the differences between the approaches. Artificial Intelligence is defined as a computer system able to perform tasks that normally required human intelligence, such as decision making or data analysis. CSR initiatives, on the other hand, are defined as a part of a company's business model that help in being environmental and socially responsible.

1.1 Background and relevance of the study

The integration of Artificial Intelligence (AI) in the Corporate Social Responsibility (CSR) initiatives is gaining more and more importance in recent years. Different AI applications are transforming the ways in which firms address environmental, social and governance (ESG) concerns and how they manage those innovative practices to enhance their strategic and competitive positioning. According to Singhania et al. (2025), to stay competitive in the market, companies have to rely on AI technologies to improve operational efficiency and promote ethical and sustainability practices. Yadav et al. (2024), found that these interventions are needed mainly in the manufacturing industry since it is facing a rapid digitalization. In according to this, a shift in corporate strategies is needed due to the growing global emphasis on sustainability, the regulatory pressures and evolving stakeholder expectations; as stated by Farayola et al. (2023), AI-driven solutions are becoming essential in aligning business operations with CSR objectives.

Due to their resource-intensive operations and a high environmental footprint, the manufacturing firms are at the forefront of this transformation. In this context different AI technologies are used to drive more sustainable production processes, reduce carbon emissions and increase transparency in supply chain management. According to Li et al. (2017) and Buchmeister et al. (2019), the main AI applications used in the manufacturing sector are: machine learning, predictive analytics, computer vision and digital twins; those usages are giving the best results in terms of costs and benefits. In the context of

Scandinavian countries (Sweden, Denmark, Finland and Iceland), where sustainability has always been the focus of businesses and government attention, AI adoption in CSR initiatives is particularly relevant. Strand et al. (2015) and Zhao (2018), studied how these countries have established strong environmental regulations and strong stakeholder engagement frameworks to incentivize businesses to integrate AI-driven sustainability measures in their core operations. By comparing this approach with the Italian, which has a distinct industrial landscape and regulatory environment, provides a unique perspective on how different AI applications can enhance CSR strategies in different economic and cultural contexts.

The examination of how AI-driven CSR initiatives contribute to the competitive advantage in the manufacturing firms operating in different cultural and regulatory environments provides the relevance of this study. While prior research has analyzed AI applications in different business functions, limited studies have focused on its intersection with CSR and how it influences firm performance. This research aims to bridge the existing knowledge gap and provide insights for best practices, challenges and broader implications for corporate sustainability strategies, by investigating how manufacturing firms in the Northern Europe and Italy integrate AI into CSR initiatives

This study aligns also with the broader discourse on responsible AI adoption, which emphasizes an ethical usage of AI in order to reduce risks such as bias, lack of transparency and regulatory non-compliance. Understanding the role of AI in advancing CSR is important for companies and policymakers, since its applications are changing increasingly faster the business models and governance structures. The findings from this research can provide valid insights to inform corporate decision-makers on optimizing AI investments for sustainable growth while ensuring compliance with regulatory standards. In addition to this, frameworks that encourage responsible AI use in CSR initiatives can be designed by policymakers, creating a more sustainable and socially responsible industrial landscape without affecting the firm performances.

1.2 Research Gap and Research Question

Despite the great amount of literature on Corporate Social Responsibility (CSR) and Artificial Intelligence's applications in the manufacturing sector, research remains fragmented regarding the specific impact of AI-driven CSR initiatives on firm performance. In particular, a comparative study between countries to analyze the differences in strategies is lacking. As described in the precedent paragraphs, existing studies have explored how CSR initiatives can bring companies to reach a competitive advantage and others on how AI is able to increase corporate efficiency. However, research is lacking in having a unique model that describes the combination of the two, particularly in cross-country comparisons where regulation, cultures and industrial structures are different. Also, the current literature does not address how AI can transform CSR initiatives from a compliance-driven obligation into a strategic function.

Prior research focused mainly on traditional CSR rather than strategic AI-driven approaches that are able to transform CSR initiatives in value-creating mechanisms. While AI's ability to improve sustainability reporting and resource allocation has been studied, there is a lack of qualitative research exploring how AI-driven CSR initiatives are being adopted and in which way they are contributing to the firm's performance. In addition to this, limited attention has been given to the challenges and opportunities across different industrial landscapes. By understanding these differences, it will be possible to study how AI applications in CSR generate value. In addition to this, research analyzed the impact of AI's applications on ESG performances, but the literature lacks insights into how companies are integrating AI in CSR initiatives and if it represents a useful practice. To address these gaps, this research will explore the following research question:

“How does the implementation of AI in CSR initiatives impact the overall firm performance in Italian and Scandinavian manufacturing firms?”

By analyzing AI-driven CSR initiatives in Italy and Scandinavia that are two different manufacturing contexts, this study will contribute to the literature on AI as a strategic resource in CSR. The research will offer new insights on how AI is changing CSR strategies and on how the combination of the two can bring to a competitive advantage.

Moreover, it will provide a comparative perspective on how Italian and Scandinavian manufacturing firms approach this strategy. Valuable implications for businesses, policymakers and scholars interested in the future of technology-driven corporate sustainability strategies will emerge from the study.

1.3 Thesis Structure

After this introduction chapter, the literature that was found relevant to the research is presented in the chapter named “Literature Review”, also including the theoretical framework. Then follows a chapter presenting the method used to conduct the study and different aspects and considerations made. In the following chapter, the results from the data collection are presented. The chapter named “Discussion” will analyze the data that have been collected through the theoretical framework created in the precedent chapters. Lastly, the thesis is concluded, the research question will be answered and suggestions for future research as well as practical and theoretical implications are presented.

2. Literature Review and Theoretical Framework

As the topic has been introduced in the first part, it is important to base the research on scientific basis by analyzing the existing literature and the theoretical framework on which it is based. In particular, in the first part, the evolution of the manufacturing industry, AI and CSR practices will be discussed to have a broader understanding of the topic. Then the concept of competitive advantage and three main theoretical frameworks will be analyzed, on which will be based the specific theoretical framework of the thesis.

2.1 The Manufacturing industry in Italy and in Scandinavian Countries

In the global economy the manufacturing sector represents a fundamental part that contributes to the industrial and technological development. It is defined by Zhong et al. (2017) as a group of companies united by a common way of working: transforming raw materials into finished goods through mechanical, chemical or digital processes. The sectors included in the manufacturing industry are many and they go from the automotive and textiles to the aerospace and electronics. From an historical point of view, manufacturing has evolved from labor-intensive manual production to highly automated and AI-driven processes that enhance efficiency and sustainability. According to Esmaeilian et al. (2016), during the years the sector has become more and more digitalized, integrating new technologies to optimize production lines and minimize wastes. So, in the manufacturing there is the need of continuous innovation to keep up with the demand and new technologies. Furthermore, as globalization intensified market competition, according to Hui & Choon (2024), efficiency and sustainability in the production processes are continuously researched by manufacturers. To do that, in recent years, the integration of smart technologies and environmentally friendly industrial models are essential.

Over the centuries, in the manufacturing sector different industrial revolutions have followed one another; scholars define 4 main revolutions each bringing significant

technological advancements. The First Industrial Revolution (Industry 1.0) began in the late 18th century, during this period mechanization was introduced, in particular, thanks to steam-powered engines, the industry's production capabilities increased. The Second Industrial Revolution (Industry 2.0) occurred in the late 19th and early 20th centuries. In this period mass production was introduced thanks to the discovery of electricity and assembly line manufacturing. The Third Industrial Revolution (Industry 3.0), emerging in the mid-to late 20th centuries, comprehended the adoption of computers, automation and robotics. According to Jiang & Qu (2020), this revolution reduced the reliance on human labor and increased the precision in the manufacturing process. The current era is experiencing Industry 4.0, this revolution is characterized by the integration of cyber-physical systems (CPS), the Internet of Things (IoT) and the presence of Artificial Intelligence that is able to analyze big data, creating a disruption in the manufacturing. Research conducted by Machado et al. (2020), analyzed how those innovations that the companies are experiencing are revolutionizing the manufacturing process, in fact the classic factory is transforming in a smart factory where machines communicate autonomously and optimize production efficiency in real-time. However, as evidenced by Narkhede et al. (2024), a transition toward Industry 5.0 is emerging. This new revolution is improving human-machine collaboration and sustainable manufacturing, aspects already present in the industry 4.0. The real change is that Industry 5.0 aims to balance technological progress with social responsibility by promoting human-centric innovation and environmental consciousness in industrial production, while Industry 4.0 prioritized just automation and operational efficiency with a focus on reducing costs and improve production. According to Sartal et al. (2020), this shift represents a crucial advancement where human expertise is helped with technological power to create a sustainable and ethically driven industrial landscape.

One of the largest European's manufacturing producers is Italy, known in all the world for the "Made in Italy", synonym of quality. The Italian manufacturing is famous also for its strength in automotive, fashion and textile industries. According to Supino et al. (2016), the country's manufacturing sector is largely composed of small and medium-sized enterprises (SMEs), which account for over 90% of the industry, emphasizing the high-quality production. The "Made in Italy" label contributes significantly to the

national economy as it is recognized in all the world for its excellence in luxury goods, industrial machinery and artisanal craftsmanship. Despite its industrial strengths, as stated by Supino et al. (2016) , Italy faces challenges in fully embracing Industry 4.0, particularly among SMEs, which often lack in financial and technical resources needed for digital transformation. To face these difficulties the Italian government has introduced policies to encourage the AI adoption, automation and sustainable manufacturing practices. However, according to Sartal et al. (2020), barriers such as low Research and Development (R&D) investments and bureaucratic complexities have affected the country's progress toward a fully digitalized manufacturing ecosystem. In contrast to some of other European countries, Italy is divided between highly modernized and technologically advanced firms and those that remain attached to the traditional production methods, highlighting the need for a more incentivized and integrated approach toward innovation in the manufacturing sector.

On the other side, Scandinavian countries, involving Sweden, Denmark, Norway, Finland and Iceland, as demonstrated also by the research of Bakry & Campelo (2018), are the most advanced and sustainable manufacturing industries in the world, driven by a strong focus on automation and green technology. Scandinavian manufacturing is largely export-oriented, with major sectors including automotive, electronics, textile and renewable energy solutions. The region's industrial landscape is dominated by large multinational companies (MNCs), which have a great interest in investing in Research and Development and benefit from collaborations with universities and businesses. A key feature of Scandinavian manufacturing industry is its commitment to sustainability and circular economy. For example, as stated by Bonnet et al. (2019), countries like Sweden and Denmark are aligned with the European Green Deal and Industry 5.0 principles, in fact they are leaders in low-carbon manufacturing and waste reduction initiatives. This is given also by the support of governments that sustain AI-driven automation and digital transformation, ensuring that companies remain competitive while minimizing the environmental impact. According to Bakry & Campelo (2018), Scandinavian companies have a strong focus also on the human labor, in fact alongside AI and robotics there is a commitment on employee upskilling to guarantee work.

By comparing the Italian and Scandinavian manufacturing sectors some differences can be evidenced in the technology adoption, sustainability policies and ways of creating a competitive advantage. Scandinavia has a higher degree of automation and AI integration, while Italy, especially in the SMEs has some difficulties in digital transformation. Regarding sustainability, Scandinavian companies have stricter environmental regulations and greater investments in green manufacturing, Italy instead, according to Supino et al. (2016), is gradually advancing towards sustainability but is not at the top levels of the Scandinavian countries. Government policies also play a crucial role in changing the industrial growth, as Scandinavian governments provide substantial financial incentives and policy support for Industry 4.0 adoption, Italy is facing bureaucratic hurdles and fragmented industrial policies that slow down the digitalization. To remain competitive in a global market that is evolving faster and faster, despite the differences, both regions necessitate the integration of sustainability and digitalization initiatives in their manufacturing strategies. Italian and Scandinavian companies have an opportunity by shifting to Industry 5.0, to refine their industrial approaches, focusing on long-term environmental and social responsibility.

Overall, while both Italy and Scandinavia possess strong manufacturing sectors, their approaches differ significantly. The study will explore in detail these approaches and strategies adopted by Italian and Scandinavian companies to understand in which way they differ and if some similarities could emerge. The focus will be mainly on the application of AI in CSR initiatives and how they bring to a competitive advantage.

2.2 Artificial Intelligence (AI) in the Manufacturing Sector

To have a better understanding of the topic is essential to understand what AI is and what are its main applications in the manufacturing industry. Artificial Intelligence (AI) is a transformative technology that emerged across industries and through its application companies are able to drive efficiency, innovation and achieve a competitive advantage, Ng et al. (2021) defined AI as a computational system that is able to perform tasks that

traditionally required human intelligence, such as reasoning and solve problems. AI is a general definition, but there are different subsets that it includes, for example machine learning (ML), deep learning, natural language processing (NLP), computer vision and reinforcement learning. All these subfields, according to Helm et al. (2020), contribute to improve automation and data-driven decision-making in corporate environments. Other important AI applications are the adaptive learning and pattern recognition, in fact these usages are fundamental in optimizing different industrial processes.

The manufacturing sector presents different applications of AI, for example it plays a crucial role in reducing costs or optimizing operations by enhancing productivity. Research conducted by Buchmeister et al. (2019), showed that a useful implementation is Digital Twins (DTs), a technology powered by AI, that allows manufacturers to create virtual models of physical systems. Through them it is possible to have a real-time monitoring of operations and machines, in this way the processes are optimized. Nosirov et al. (2024) found that Digital Twins are also able to do predictive maintenance, an application that is able to minimize downtimes and operational disruptions resulting in high-cost savings. This is possible thanks to the ability of analyzing a great amount of sensor data to detect anomalies and predict equipment failures before they occur. A study conducted by Wu et al. (2024), showed that another important AI application is computer vision. It is used to find possible defects and for automated quality control; in this way companies are able to improve product consistency and reduce wastes. Singhania et al. (2025) sustained that these AI advancements, by reducing material consumption, energy usage and environmental impact, contribute to sustainable manufacturing. Additionally, according to Zhao (2018), a great innovation brought by the usage of AI are the smart factories, they are AI-powered robotic automations where intelligent machines collaborate with human workers to increase efficiency and minimize errors. Also, the supply chain benefits from AI applications, in fact manufacturers are helped in tracking real-time inventory and enhancing demand forecasting, leading to cost reductions and increased responsiveness to market fluctuations.

AI is applied also in other aspects of business to improve corporate strategies and decision-making. According to Yadav et al. (2024), to get important information and have

a clearer understanding of complex market conditions, machine learning models are utilized. These applications are particularly relevant in the manufacturing sector because they allow companies to have a real-time monitoring of the market conditions, allowing production teams to optimize production and improve risk assessment of overstocking.

Additionally, Strand et al. (2015) found that, to support ESG (Environmental, Social, and Governance) reporting, AI-driven analytics are becoming essential since they automate data collection and ensure accuracy in sustainability disclosures. Marketing strategies and the interactions with the customers are also experiencing the use of AI. Farayola et al. (2023), discussed how, through natural language processing (NLP), that is an AI application, the automation in customer services is facilitated. By creating chatbots able to solve common problems in a very fast and easy-to-use way, the operational efficiency and customer satisfaction are improved. While in marketing, AI is able to create personalized advertising and improve customer targeting by using predictive analytics and consumer behavior modeling (Li et al., 2017). Finally, according to Lachuer & Jabeur (2022), AI is also helping in human resource management through AI-based recruitment processes, employee performance tracking and predictive analytics for workforce planning.

Nowadays manufacturing companies are also facing problems in terms of cybersecurity, for this reason AI-powered solutions are becoming essential to protect the business. To identify and neutralize security risks in real time, vast amount of network data is needed, and it can be analyzed through AI-driven threat detection systems. This usage helps companies protect sensitive information and ensure business continuity. According to Zhao (2018), AI is also revolutionizing the way in which companies are making strategic decisions, in fact by leveraging on big data insights managers are able to refine business models and make evidence-based strategic decisions. Similarly, AI is helping also in corporate finance decisions by automating risk management processes and regulatory compliance.

Despite its great potential, AI implementation presents also different challenges, including ethical concerns, regulatory compliance and the need for significant

investments in infrastructures and skill development for the employees. Other potential problems, according to Lachuer & Jabeur (2022), could emerge when by implementing AI solutions companies have to align with corporate responsibility principles. In this case it is required to meet data privacy laws by ensuring transparency in AI-driven decision-making and, if they occur, address potential algorithmic biases. One of the main concerns is the rapid evolution of AI that requires continuous investments and adaptation to ensure that the business can effectively leverage on this innovation by keeping up with the new improvements. According to Ahdadou et al. (2024), the main concerns regard the long-term economic implication of AI adoption, such as the cost of AI integration, the potential for market disruption and the evolving landscape of AI-driven business competition; is important to understand if the investment in AI could repay the great investments that it needs. Finally, as evidenced by Kar et al. (2022), there are also some concerns regarding job displacement due to AI automation, in this case policies that promote reskilling and workforce transformation to balance technological progress with social sustainability are needed.

AI is a general term that contains a lot of different applications, and it continues to evolve day by day. Its integration into different businesses and in manufacturing will become increasingly sophisticated, driving new levels of innovation and industry excellence. By strategically leveraging on AI companies will achieve better performances in terms of efficiency and competitiveness and at the same time they will be able to contribute to more sustainable and responsible business practices. The alignment between AI, business strategy and corporate social responsibility will be essential in ensuring economic growth and societal well-being at the same time.

2.3 Corporate Social Responsibility (CSR): Definitions and Evolution

Corporate Social Responsibility (CSR) is defined by G. Li et al. (2021) as an approach that businesses adopt to balance profit-making with social and environmental considerations. As stated by Shkalenko & Nazarenko (2024), it is not only about

respecting regulation rules, these initiatives involve also voluntary activities that want to improve social well-being and environmental sustainability. CSR activities comprehend a large variety including reducing carbon footprints, fair labor practices, stakeholder engagement and sustainable processes. According to Zhao (2018), over time, CSR has evolved from a simple moral responsibility of the companies to a key factor in the business strategy, where environmental, social and governance (ESG) factors are integrated in the corporate decision-making to enhance long-term sustainability and competitive advantage.

CSR was introduced for the first time in the early 20th century, when businesses began facing increasing pressures regarding their social responsibility. During this period, corporations were expected to contribute to societal and environmental welfare, but still there were no formal regulation. Starting from the mid 20th century CSR gained formal recognition, in fact scholars such as Howard Bowen introduced the concept of business having obligations toward society beyond economic gains. Between the 1980s and 1990s there were a shift toward structured CSR frameworks, in fact Carrol's Pyramid classified corporate social responsibilities into 4 principal areas: economic, legal, ethical and philanthropic (Carroll, 2016). During the 21st century, with the introduction of sustainability reporting, the adoption of global standards like the Global Reporting Initiative (GRI) and the integration of AI-driven transparency mechanisms into business models, CSR gained even more importance. In today's corporate environments, CSR has changed from a voluntary initiative to a strategic vision, in order to use this approach to gain a competitive advantage in the market. As stated by Lachuer & Jabeur (2022), in recent periods, greater transparency and accountability from corporations is demanded by the different stakeholders, particularly investors and regulators, this is given by the fact that concerns as climate change or corporate ethics have gained more importance. A study conducted by Supino et al. (2016) found that companies that integrate CSR principles in their strategies are more likely to increase brand reputation, attract investments and increase the competitive advantage. Another empirical study conducted by Machado et al. (2020), suggests that businesses with stronger CSR commitment tend to experience improved financial performance and greater customer loyalty respect to the others. When talking about CSR is necessary to talk about the environmental crisis that the world is

experiencing. This situation brought policymakers and regulators, through the European Green Deal and the implementation of ESG reporting mandates, to increase the pressure toward a CSR model. According to Khan et al. (2024), with the recent regulation firms have to align their decisions and operations with global sustainability goals to contribute to a more sustainable world and remain competitive on the market.

As the world's technology innovations increased exponentially during the recent years, the role of Artificial Intelligence in CSR has gained importance. Through the utilization of AI companies have changed the way in which manage sustainability initiatives. According to Bakry & Campelo (2018), different advantages are brought by the utilization of AI, for example businesses are able to monitor the environmental impact in real-time and optimize energy consumption. Shkalenko & Nazarenko (2024), found that with the use of AI and in corporate social responsibility initiatives companies can also improve risk management. Moreover, by analyzing ESG data, AI is able to increase corporate decision-making; this help companies in understanding potential risk factors associated with sustainability decisions. The AI-driven transformation of manufacturing toward smart factory environments has also been linked to enhanced ESG performance, demonstrating how digital innovation can foster sustainable industrial growth. In fact, as demonstrated by Singhanian et al. (2025), companies that align the CSR initiatives with AI-powered sustainability solutions gain a competitive advantage in the market by improving efficiency, meeting regulatory standards and increasing stakeholder trust.

In the future the integration between CSR initiatives and AI will guarantee a greater transparency and accountability in the corporate sustainability practices thanks to the technology advancements. Strand et al. (2015), stated that circular economies principles and enhanced ESG reporting frameworks will redefine corporate responsibility in the coming years, pushing businesses to adopt sustainability strategies that involve all the sectors of the firms. New growth opportunities will be unlocked with the integration of CSR initiatives in the manufacturing business models, according to Machado et al. (2020), the market position of socially responsible companies will increase in an era where corporate responsibility is a fundamental aspect of business success.

2.3.1 CSR metrics and the role of ESG

Corporate Social Responsibility (CSR) initiatives need to be evaluated with objective criteria in order to be understood and analyze the impact of the different activities done by the companies. Usually, they are evaluated through different frameworks and reporting standards, the most comprehensive and used approach is the Environmental, Social and Governance (ESG) criteria. According to Yadav et al. (2024) the ESG metric is a structured way to evaluate a company's performance beyond financial indicators. This type of criteria aims to ensure adherence to responsible practices by businesses and maintain stakeholder trust. To understand how well a company integrates sustainability into its operations, during the years, ESG has become the main benchmark for investors and regulators. The ESG metric measures the CSR initiatives of the different companies through three main criteria: Environmental, Social and Governance.

The Environmental (E) component evaluates company's impact on the natural environment. The factors that are included are: carbon emissions, waste management, water usage and renewable energy adoption. A good environmental performance is achieved when a company has as a priority resource efficiency and circular economy initiatives. According to Wu et al. (2024), an example is given by the companies in manufacturing or logistics. In these cases, AI-driven monitoring systems are adopted to optimize energy consumption and reduce emissions, in this way the whole production process results more environmentally friendly. This type of intervention enhances the score for the Environmental part of the ESG metric.

The Social (S) pillar evaluates how companies manage the relationships with employees, customers and suppliers. The main indicators to evaluate the Social part are: labor practices, diversity and inclusion, human right policies, workplace safety and community engagement. This dimension is relevant because, as explained by Nosirov et al. (2024), a good effort by companies in employee well-being often bring to higher workforce productivity and consumer loyalty. Social impact and corporate reputation can be enhanced through different types of initiatives. For example, G. Li et al. (2021) evidenced how AI-driven analytics help businesses to improve working conditions by promoting transparency and ethical treatments. In addition to this, initiatives such as education

programs or employee volunteerism increase the social impact and the corporate reputation.

The Governance (G) dimension evaluates corporate leadership, ethical decision-making, risk management, compliance with regulation and transparency in financial reporting. In this case the factors that increase this metric are board diversity, anti-corruption policies or shareholder rights. A study conducted by Bakry & Campelo (2018), demonstrated how companies with a strong governance are more likely to build investor confidence and ensure long-term financial stability. The governance could be improved also through AI initiatives, an example is given by the research of Shkalenko & Nazarenko (2024) where machine learning algorithms increased the corporate transparency by detecting fraudulent activities and controlling the alignment of the strategy with regulation.

According to Kelkar & Katole (2023), with the introduction of regulatory frameworks such as the Global Reporting Initiative (GRI), the Task Force on Climate-Related Financial Disclosures (TCFD), and the Sustainability Accounting Standards Board (SASB), ESG reporting has gained even more importance. These standards are used to guide companies in measuring sustainability performances, providing stakeholders with comparable ESG data. Companies are increasingly adopting ESG annual reports as an important part of the company strategy. Many investors, as stated by Supino et al. (2016), expect a commitment toward responsible business practices. Also in this case AI tools to analyze ESG performances are increasingly being used since they are more precise with data collection and accuracy toward regulatory requirements.

The rising influence of ESG in corporate decision-making has also brought companies to the development of ESG investment strategies, where investors prioritize companies with stronger sustainability performances. According to Bhutta et al. (2022), with the introduction of new financial instruments such as green bonds or socially responsible investments (SRI) funds, more and more investors are prioritizing to move capital toward businesses committed to long-term sustainability. This trend is confirmed also by the research of Wu et al. (2024) that showed how companies with higher ESG scores tend to

outperform their peers in the financial markets because they are better equipped to manage risks and adapt to the evolving regulatory scenarios.

ESG measurement is adopted by many companies in this period, but it still faces some challenges. For example, there are some problems connected to the reliability of data and greenwashing practices, where companies exaggerate their sustainability efforts. According to Nosirov et al. (2024) a uniform ESG regulation across countries should be implemented, in this way problems of data inconsistencies and comparing difficulties could be solved. In addition to this some firms exalt some minor sustainability initiatives to enhance their public image without making real changes. Shkalenko & Nazarenko (2024) addressed this problem with the use of AI to improve the transparency in the initiatives and understand the real impact on the sustainability practices of the companies. In the future ESG metrics will be implemented more, pushing businesses to integrate sustainability into their strategic plan. This is given by the increasing demand for sustainable companies by the different stakeholders and the increasing rules given by regulators toward a more sustainable business. This study will analyze how companies, through the integration of AI supports, could increase their CSR initiatives and ESG metrics to stay competitive in the market.

2.4 Competitive Advantage and Value Creation

Competitive advantage is a fundamental concept in strategic management, it refers to a firm's ability to have better performances respect to its competitors by creating and sustaining superior value for customers and stakeholders. Porter, (1985) defined competitive advantage as the unique attributes and capabilities that enable a company to achieve higher profitability or differentiation in its industry. Value creation, instead, is linked to competitive advantage and represents the process by which firms develop products or services that increase economic outcomes. According to Warr (1994), the relationship between competitive advantage and value creation is strong, in fact firms that generate value gain a competitive advantage and a sustained competitive advantage allow a continuous value creation.

In the manufacturing sector, competitive advantage can be derived from different factors, an example is through operational efficiency or technological innovations. According to Olorunyomi Stephen Joel et al. (2024), the integration of AI applications in the manufacturing processes is a factor that could increase the competitive advantage of a company. In particular, AI is able to reduce production costs and increase products quality through different applications such as predictive maintenance or real-time data analytics. The application of AI in CSR initiatives is able to create a greater competitive advantage for a company because in this way the business objectives are aligned with societal and environmental responsibilities. In fact, Asemah et al. (2013) demonstrated that the strategic use of AI in CSR initiatives is used by companies to apply value-driven corporate strategies that support profitability and market differentiation. In the manufacturing sector this connection between AI-driven CSR initiatives and competitive advantage is particularly relevant. As demonstrated by Andes et al. (2020), sustainability issues and efficiency are mainly important in this sector and AI enables manufacturers to improve resource allocation and supply chain transparency. These applications help companies to reach a long-term value creation by focusing on sustainable business practices.

In conclusion, competitive advantage and value creation are linked and both involves the long-term business success. In the manufacturing sector, AI is a strategic enabler that enhance operational efficiency and CSR initiatives, in this way firms are able to integrate sustainability into their core business strategies. As stated by Purwanto et al. (2023), since AI solutions continue to evolve, firms that effectively leverage on its applications will gain a greater competitive advantage and will be well positioned to meet stakeholder expectations and sustain long-term profitability in a complex market such as manufacturing.

2.5 The Resource-Based View (RBV)

In strategic management a fundamental framework is represented by the Resource-Based View (RBV). This concept explains how firms achieve and sustain a competitive advantage by leveraging on their unique internal resources and capabilities. The main focus in the RBV is on internal resources of a firm, while the traditional market-based perspective emphasizes external factors. According to Barney (2001), a sustained

competitive advantage derives from resources that are valuable, rare, inimitable and non-substitutable, defined also as VRIN resources. The origins of the Resource-Based View can be associated with the Edith Penrose's work in 1959. This study emphasized the role of internal resource utilization for the growth of the firm. Barney (2001) formalized the role of the VRIN resources and the Resource-Based View gained even more importance. Through the valuable, rare, inimitable and non-substitutable criteria a systematic approach to evaluate if a firm's resource could provide a lasting competitive advantage emerged. Research by Khanra et al. (2022) evidenced how, over time, RBV has been extended to incorporate also the dynamic capabilities theory. In this way, it is recognized that firms must develop and adapt their resource base in response to continuously changing market conditions. The Resource Based View's relevance has been reinforced through this theoretical evolution. In fact, in contemporary business environments, companies must continuously explore technological advancements, globalization and sustainability challenges.

The added value given by RBV to companies is a structured approach to assess and manage strategic resources that contribute to a better performance. Madhani (2010) found that in competitive markets, such as manufacturing, unique resources, if properly leveraged, can differentiate companies. For example, proprietary technologies or specialized human capital of a firm can make the difference by adding value to the production phase. Lockett et al. (2009), found that the emphasis on internal strengths encourages firms to develop capabilities that competitors cannot easily replicate. This emphasis will bring to a strong competitive advantage that is carried on through knowledge management and innovation. In this context, a crucial role is played by knowledge-based resources, such as intellectual property and research and development (R&D), since they enable firms to create innovative products and services that reinforce their market position. In addition to this, research by Sugiarno & Novita (2022), found that in the RBV the role of intangible assets is essential, since they demonstrate how internal capabilities contribute to the long-term business success. For example, an organizational culture or a proper leadership are fundamental for a company to reach its goals. These evidences are important to understand that the Resource-Based View framework help corporate leaders. In particular, they are facilitated in identifying and

prioritizing resource investments that could maximize value creation and ensure long-term strategic differentiation.

In the manufacturing sector, RBV is particularly relevant thanks to the capital-intensive nature of the production processes and the increasing reliance on advanced technologies to drive efficiency and innovation. According to Khanra et al. (2022), manufacturing firms depend on both tangible and intangible resources to maintain their competitive positioning. Tangible resources, for example, are represented by machineries, infrastructures or raw materials while intangible resources are represented by technical expertise or process optimization practices. Perifanis & Kitsios (2023) found that strategies such as differentiation or cost leadership are facilitated if companies are able to effectively leverage on their resources. In addition to this, research by Khanra et al. (2022) found that, to increase the competitiveness and meet the increasing demand for sustainable products, investments in resource-efficient production methods, circular economy practices and green technologies are needed. All of these examples highlight how a focus on a Resource Based View approach is essential to secure a long-term stability and profitability in the manufacturing sector.

The different economic and industrial contexts meet different RBV approaches. By analyzing the Italian and Scandinavian contexts, key differences emerge. In Italy, where a great part of the manufacturing sector is composed of small and medium-sized enterprises, RBV is often adopted with the strategic use of craftsmanship. Supino et al. (2016), found that Italian companies, especially in industries such as fashion and automotive rely on artisanal knowledge, design excellence and specialized workforce skills to maintain the competitive advantage. These intangible resources align with the Resource-Based View principles since they are difficult to imitate for competitors. In this way Italian firms reach a long-term differentiation on the global market. The situation is different in Scandinavian manufacturing firms, in this case technological innovation, sustainability and automatization are prioritized as key resource-based strategies. Some examples are given by large companies such as Volvo, Vestas and Nokia that invest heavily in green technologies, AI-driven automation and workforce digitalization to enhance their competitive advantage. This continuous resource development and

innovation of Scandinavian firms is emphasized also by the strong collaboration between industry and research institutions. According to Dwivedi et al. (2012), this aligns with the dynamic capabilities' extension of RBV. The concept is that companies not only acquire valuable resources but also have the ability to reconfigure them in response to the evolving industry trends and technological advancements.

In the application of a RBV framework, companies have to deal also with government and industrial policies. In relation to this, research by Votto et al. (2021), found that investments in R&D, workforce training and sustainable initiatives are facilitated if strong public and private partnerships are present. In this way develop strategic resources is easier for companies. This is the case of Scandinavian firms, while, according to Supino et al. (2016), Italian firms often rely more on internal innovation and regional business networks, reflecting the diverse ways in which RBV is adopted in different economic structures. These differences demonstrate that even if different industrial landscapes are present, Resource-Based View represent a flexible and applicable framework.

To conclude, in strategic management, the Resource-Based View is a fundamental framework that help companies to understand how to develop and sustain competitive advantages by relying on internal resources. In particular, the RBV is fundamental in industries requiring continuous innovation and operational efficiency such as manufacturing. While Italian firms apply this framework through craftsmanship, brand heritage and niche market expertise, Scandinavian companies rely on technology, sustainability and automation to foster differentiation. RBV remains a relevant and powerful theoretical framework to rely on in a market where globalization and technological advancements continuously change the business.

2.5.1 AI applications as a Strategic Resource

In modern business strategies Artificial Intelligence applications have become an essential resource. They can be associated with the Resource-Based View framework, this because AI applications have characteristics that make them valuable, rare, inimitable and non-substitutable resources. According to Keding (2021), they are valuable because they are able to optimize decision-making, enhance operational efficiency, reduce costs and

create new business opportunities. The rarity of AI applications is given by the complexity and expertise required to develop, integrate and manage them effectively. Perifanis & Kitsios (2023) found that great investments are required to fully utilize AI's strategic potential. In particular, is important to invest in data infrastructure, talent acquisition and advanced algorithms, in this way the creation of barriers to entry for competitors will be possible. Different AI applications are also inimitable, this because is difficult for other companies to replicate identical AI-driven systems. The continuous learning capabilities and reliance on proprietary market data are crucial to develop a system that is not possible to copy. Finally, as demonstrated by Mrida et al. (2025), AI applications are also non-substitutable, since the same level of automation is not offered by other technologies, in addition to this they are able to make data-driven decisions and to adapt to the diverse business environments.

Industries that require process optimization and real-time analytics, such as manufacturing, need different AI applications as strategic resources. As demonstrated by Khanra et al. (2022), in manufacturing, AI-driven automation improves quality control, predictive maintenance and production planning. In this way companies are able to reduce downtimes and increase efficiency. Different advantages are given by the diverse AI applications, AI integrated in operations, such as machine learning, can reduce operational costs and enhance product innovation. AI-powered systems can analyze production data to detect defects early in the manufacturing process, preventing costly recalls and waste. Perifanis & Kitsios (2023) demonstrated that AI applications can help companies in the energy-efficient manufacturing. In particular, by optimizing the resource usage, the environmental impact is reduced and is easier to align with sustainability regulations and stakeholder interests. According to Votto et al. (2021) AI applications are also able to enhance human resource management and strategic decision-making.

The increasing digitalization of industries and the rapid technological advancements are making AI applications even more important. Mrida et al. (2025) found that firms that are not adopting AI risk to fail in the future since competitors are leveraging on its transformative capabilities. With continuous changes in the market environment and technology advancements, organizations must invest in new technologies such as new AI

applications to remain competitive (Perifanis & Kitsios, 2023). These investments align with the RBV's emphasis on continuous developing of internal resources to sustain a long-term competitive advantage. The integration of AI applications in the manufacturing processes are offering a strategic resource to help reaching a long-term success in the industry. In this framework is explained why companies should leverage on AI applications through the RBV, the problem is that this theory is only internally focused, so does not count the external factors that will be essential to answer the research question.

2.6 Stakeholder Theory

A fundamental concept in business and strategic management is the Stakeholder Theory. It explains that corporations should consider the interests of all the stakeholders in the decision-making processes. This concept was first introduced by Freeman et al. (2010) and it challenges the traditional shareholder model. In particular, this framework explains businesses have responsibilities toward employees, customers and regulatory institutions. According to Baumfield (2016), companies that work within a network of interdependent relationships, to reach a long-term success, have to balance the interests of the diverse groups of stakeholders. This perspective goes beyond the financial performance as it includes also social and ethical considerations, and it recognizes that companies operate in a complex socio-economic environment.

The Stakeholder Theory core principle is that businesses must create value for all the stakeholders affected by their activities. As demonstrated by Omran & Ramdhony (2015), this approach has been accepted by companies and does not conflict with the maximization of value wanted by the shareholders. This good relationship between stakeholder and shareholder perspectives is given by the fact that a business that foster sustainable relationships with the different stakeholders is able to mitigate risks and enhance the long-term value creation. Quantitative research by Gao et al. (2021), found that companies adopting stakeholder-oriented strategies acquire greater brand loyalty and customer engagement. In this way the financial performance is improved, since satisfied stakeholders contribute to business success.

The relevance of Stakeholder Theory has grown significantly in the context of CSR initiatives. According to Bansal et al. (2023), companies are recognizing that by integrating stakeholder concerns in their strategy, the reputation and regulatory compliance are increased. The study analyzed also that after the COVID-19 pandemic the importance of stakeholder-oriented business models increased. This because companies that prioritized stakeholders' interests demonstrated greater resilience and adaptability. This shift brought companies to apply the Stakeholder Theory also in corporate governance and in CSR initiatives. The increasing adoption of AI in corporate decision-making has reinforced the importance of Stakeholder Theory. Baumfield, (2016) demonstrated that businesses by incorporating AI-driven analytics into their stakeholder management are better equipped to assess stakeholders' will and tailor their CSR initiatives to meet evolving societal expectations. However, the use of AI introduces also some ethical dilemmas such as data privacy, so according to Gao et al. (2021) a stakeholder-inclusive approach to AI governance would ensure transparent and accountable AI strategies.

Looking at the international perspective, Stakeholder Theory has been applied differently across various economic systems. In Scandinavian countries, Stakeholder Theory is deeply integrated in business practices, this because as demonstrated by Bakry & Campelo (2018), Scandinavian firms typically adopt stakeholder-oriented governance structures. Particularly relevant are transparency and environmental sustainability in Scandinavian corporate governance models. In Italy, instead, the attention to stakeholder necessities is given more by a compliance to regulation. As demonstrated by Supino et al. (2016), Italian firms instead of real stakeholder management frameworks adopt informal governance structures and localized CSR initiatives to solve stakeholder concerns. These variations across countries evidence the adaptability of Stakeholder Theory in different contexts.

In conclusion, Stakeholder Theory continues to be applied in the recent strategic business management. Its focus on balancing the interests of different stakeholders provides companies a framework to achieve a sustainable growth and adapt also to the increasing

demand for CSR initiatives. In particular, with global challenges such as climate change, businesses are required to adopt a stakeholder-oriented approach to corporate governance. As the business landscape evolves, Stakeholder Theory will ensure a guide for companies seeking to navigate the complexities of modern corporate responsibility while maintaining long-term profitability and stakeholder trust. This framework explains why companies should implement CSR initiatives, the problem is that is extremely focused on external expectations, and it does not consider the internal capabilities and necessities of the company, for example reducing costs or reach a competitive advantage.

2.7 Strategic CSR

The concept of strategic Corporate Social Responsibility extends beyond the traditional philanthropic and compliance-driven initiatives by utilizing social and environmental considerations into a company's core business strategy. The classic CSR initiatives are often reactive while strategic CSR, according to Atiq & Karatas-Ozkan, (2013), is aligned with the firm's mission and leverage responsible businesses practices to create a competitive advantage. As demonstrated by Fatima & Elbanna, (2023), companies that implement CSR as a strategic function do not perceive these initiatives as a cost or as something that is mandatory to do, but as an integral part of corporate strategy that enhance brand reputation and customer loyalty. With this approach firms are able to exploit CSR initiatives to differentiate themselves in competitive markets, in particular in industries where sustainability is fundamental for the long-term success. The transition through strategic CSR is given by the necessity for companies to adapt to the increasing stakeholder expectations and regulatory requirements for a more sustainable way of conducting the business. For this companies found a way to integrate sustainable practices in their business model while maintaining financial growth. As demonstrated by Atiq & Karatas-Ozkan, (2013), firms that use strategic CSR anticipate social and environmental challenges instead of responding to them, this is possible through the incorporation of sustainable and ethical considerations in their decision-making processes. According to Sahu & Pratihari, (2015), this ability to integrate CSR into long-term corporate planning allows companies to reduce risks and explore new markets opportunities while addressing societal and environmental concerns.

As demonstrated by Keding, (2021), an important component of strategic CSR is given by the adoption of Artificial Intelligence, in fact the application of AI in recent years has changed how companies design and implement their CSR initiatives. A useful application is AI-driven analytics that allow companies to control and adapt environmental and social impacts in real time. Perifanis & Kitsios, (2023) found that, with the integration of this AI measure, companies reach a greater transparency and an improved resource efficiency. Another AI application studied by Perifanis & Kitsios, (2023) is the AI-powered supply chain monitoring that helped companies to track carbon footprints and optimize logistics while reducing emissions. This ability to integrate AI into CSR strategies transforms sustainability into a strategic asset to increase stakeholder trust and corporate performance. AI is also able to help firms to anticipate social and environmental challenges with predictive CSR, in this way they can align their strategies with evolving stakeholder expectations. As demonstrated by Sahu & Pratihari, (2015), through data analytics and machine learning models, companies can analyze regulatory trends and consumer preferences to adjust the CSR initiatives. This change to a predictive approach helps firms in responsible innovation. Fatima & Elbanna, (2023) found that the strategic integration of AI in CSR increases also ESG performance, this is possible thanks to AI-driven support systems that help corporate leaders to choose sustainability investments more effectively. For example, AI-powered energy management systems reduce resource consumption and also environmental footprints, generating better ESG performances and also reducing the costs.

The progression from traditional CSR to strategic CSR highlight the importance of aligning sustainability with corporate growth objectives. In particular, this strategy is facilitated with the implementation of AI systems that help companies with the problem of creating CSR initiatives that are economically valuable. In this way strategic CSR represent a source of competitive differentiation and corporate resilience. In an era where sustainability is both a regulatory necessity and a strategic advantage, the ability to integrate AI into CSR initiatives will define the next generation of responsible corporate leadership (Fatima & Elbanna, 2023). This framework is useful to understand how a company can transform regulation's compliance necessities into strategic advantages, but

it lacks in explaining on which resources rely to do that, so a specific framework is needed.

2.8 Theoretical Framework Model: An Integrated Approach

To answer the research question a specific theoretical framework is needed, it resumes some concepts of the Resource-Based View, Stakeholder Theory and Strategic CSR.

Figure 1: Study's analytical model developed by the author

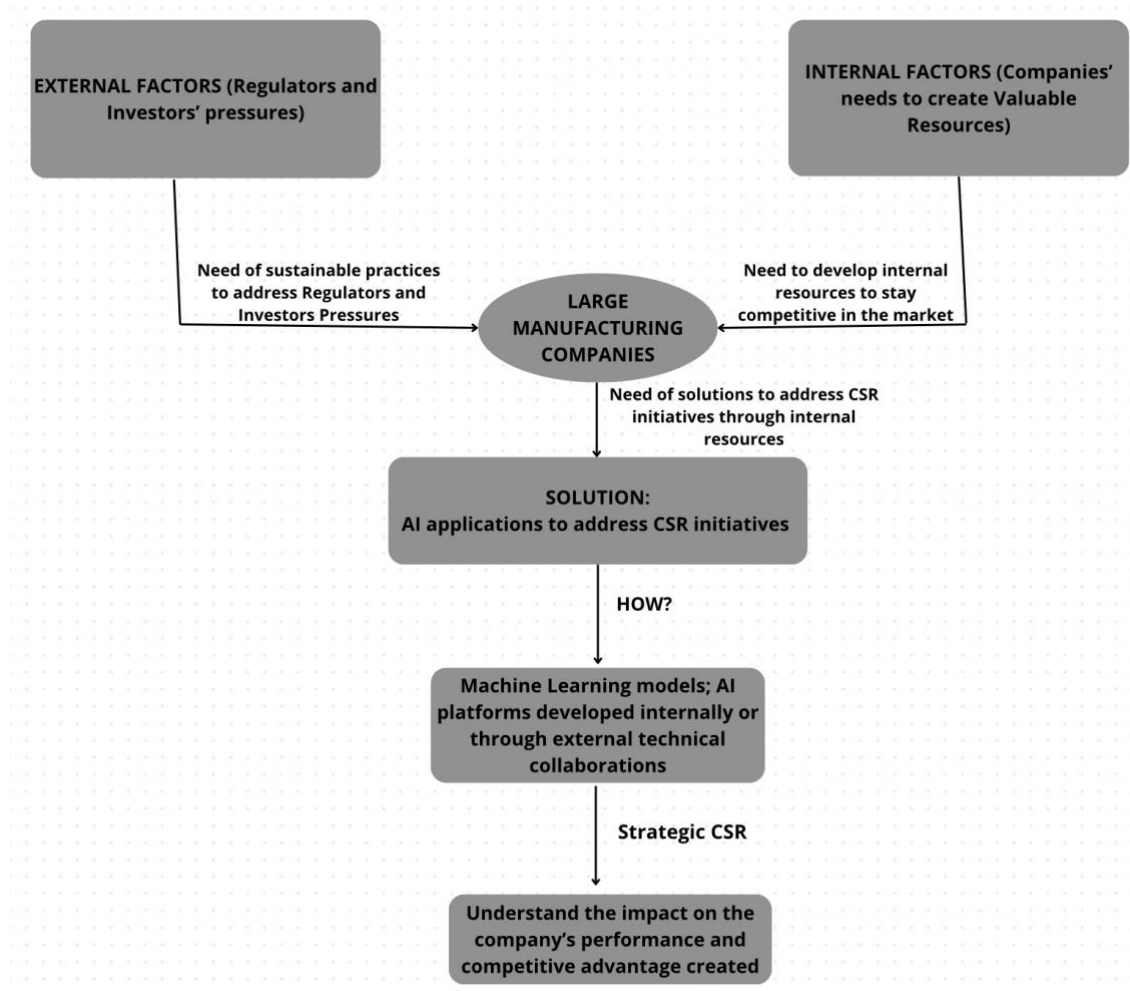


Figure 2 represents a summary of the study's theoretical framework. It illustrates the main components and perspectives needed in analyzing how large manufacturing companies are adopting AI in their CSR initiatives to gain a competitive advantage.

The area on the left represents the external factors, explained by the stakeholder theory, that are pushing manufacturing companies to more sustainable practices. In this section all the stakeholders' necessities are represented, focusing in particular on regulation and investors that in recent years are pushing to get more sustainable companies. On the right, instead, are represented the internal factors, so the necessities of the company. In particular this section, explained by the Resource-Based View, integrate the internal necessities of manufacturing companies such as gain a competitive advantage or reduce costs. With the intersection of the external and internal factors, manufacturing companies need to find a solution to remain competitive on the market and meet stakeholder expectations. This is possible by integrating AI applications internally developed with CSR initiatives. Trough the strategic CSR theory combined with the RBV it will be possible to understand in which way companies are adopting AI in CSR initiatives, since AI applications are important to transform simple CSR initiatives into strategic CSR initiatives. Finally, it will be possible to understand also if the different AI applications in CSR initiatives will be effective to reach a competitive advantage.

3. Methodology

After having analyzed the existing literature and the necessary theoretical framework to answer the research question, a chapter on the chosen methodology for collecting and studying the data is needed. Firstly, the research approach and design are discussed and motivated. After that, the methodology for data collection and data analysis is described. Finally, research quality and limitations are discussed.

3.1 Research Design and Approach

A qualitative comparative case study design is adopted in this research to explore how large manufacturing companies in Italy and Scandinavia are implementing AI in Corporate Social Responsibility (CSR) initiatives and the impact on firm performance. According to Creswell et al. (2007), qualitative research focuses more on words than numbers. A qualitative approach in this study is considered useful for its emphasis on understanding non-numerical variables. For example, contextual concepts, organizational strategies and stakeholder perspectives will be better understood through this methodology. In fact, these variables are essential in analyzing the integration of AI into CSR frameworks in different cultural and industrial contexts. The focus on Italian and Scandinavian manufacturing companies allows a comparison of two different industrial landscapes. In particular, the Scandinavian manufacturing sector is considered, as demonstrated by the ranking of RobecoSAM (2024), at the top levels in CSR initiatives and ESG levels, while the Italian is in a situation of mean ranking with a lot of potential to grow in these sustainable practices. This qualitative approach allows also a comparison between the cultural attitudes toward sustainability, the regulatory environments and the different levels of innovation and technologies.

The qualitative nature of the study enables the exploration of insights from professionals directly involved in CSR initiatives and AI strategy within their organizations. This approach allows a comprehensive understanding on how AI tools are adopted to increase CSR initiatives. In addition to this, also the alignment with broader strategic objectives and competitive positioning is easier to analyze. As AI adoption in CSR is an emerging and complex phenomenon, qualitative research facilitates the investigation on

motivations, processes and outcomes that may not be quantifiable but are essential for theory development and practical implications.

The study will utilize semi-structured interviews with relevant people that are working on AI or CSR initiatives in large manufacturing companies in Scandinavia and Italy. These interviews are necessary to understand the different experiences, challenges and benefits of AI integration in CSR initiatives. The comparative analysis will highlight the identification of similarities and differences between countries in the strategic use of AI in CSR initiatives. This aspect will bring valuable insights into how contextual factors, such as culture or regulation, influence the strategy of a company through sustainable and innovative solutions. In addition to the primary data collection, the systematic literature review, done in the precedent chapter, will support the interpretation of findings. To conduct the literature search, Academic databases such as Scopus and Web of Science were used. Within those databases specific keywords were used, they included: “CSR”; “AI applications”; “AI applications in the manufacturing sector”; “AI applications in CSR strategies”; “manufacturing sector”; “corporate strategies in AI applications” and “corporate strategies in sustainability practices”. The Boolean operators employed to search efficiently for relevant literature and cover entirely the topic were “AND”, “OR”, and “NOT”. Finally, filters were applied to limit the results to only scientific and peer-reviewed articles and studies published within the last 20 years. Exceptions were made for some theoretical definitions stated some years before and for theoretical frameworks that emerged from some books. According to the exclusion and inclusion criteria, articles were selected based on their relevance to the research question and their focus on AI applications, CSR initiatives and the manufacturing sector. To determine the relevance of each article, before full-text analysis, abstracts and conclusions were reviewed. Instead, the exclusion criteria included studies with a primary focus on unrelated aspects of AI applications in CSR initiatives and non-peer reviewed sources.

This approach toward the analysis of the literature will ensure an alignment also with the theoretical framework of the study. In particular, the framework will guide the analysis by examining AI as a strategic resource, understanding stakeholder-driven motivations and exploring the change from traditional CSR to the strategic approach. Through this

qualitative comparative research design, it will be possible a detailed exploration of how AI adoption in CSR contributes to firm performance. This will be possible by considering also internal capabilities, external pressure and strategic intentions. The findings are expected to offer insights relevant to both academic literature and practical implementation for companies that aim to use AI for sustainable and responsible growth.

3.2 Data Collection

To understand how large European manufacturing companies adopt AI in their CSR initiatives, semi-structured interviews were used as primary data collection method. A semi-structured interview is based on an interview guide with a set of predetermined questions, but there is also the possibility for the interviewee and the interviewer to answer freely and ask follow-up questions. According to DiCicco-Bloom & Crabtree (2006), semi-structured interviews offer a balance between structured comparable data across respondents and the flexibility to explore different themes based on participant's unique experiences and insights. This method is related with the qualitative nature of the research, in fact in this way it is possible to have a deeper understanding on how AI is strategically integrated in CSR initiatives in the manufacturing sector.

The participants selected for the interviews are relevant people involved in CSR, sustainability or AI and innovation strategy within their respective organizations. The companies selected for the study represent leading firms in the European manufacturing and fashion industry since according to Doanh et al. (2023) the companies in this specific sector are making more and faster processes in the CSR and AI initiatives. In particular, three Italian companies and three Scandinavian companies have been selected to make a concrete comparative analysis between the two different models. The Scandinavian firms are represented by Lindex, H&M and Bestseller, while the Italian firms include Gucci, Benetton and Radici Group. These companies were chosen based on their engagement in CSR initiatives and their efforts in integrating AI technologies into their business processes.

Interviews were conducted with professionals working in different relevant roles, for example in sustainability departments or innovation and technology units. This selection

has permitted that participants could provide insights into both CSR implementation and AI adoption. The interviews were conducted in-person or via digital communication platforms, depending on the location and availability of the interviewees. All the interviews were recorded with the interviewee's approval and lasted between 30 to 60 minutes. This time depended on the availability of the respondents, but it was sufficient to cover the set of predefined topics. According to Busetto et al. (2020), recording is useful in qualitative studies to ensure that the answers are correctly understood and allows a better conversation during the interview because the interviewer does not need to take notes. The interviews were then transcribed to understand better what was said during the interviews, so a better analysis of data was enabled. However, the transcriptions and the recordings were eliminated after the thesis to respect the integrity of the companies. Moreover, any company secrets were not included in the transcription or revealed to anyone that were not part of the interview. Finally, three interviews were conducted in Italian and three in English.

The interview's questions that are present in the (Appendix 1) were designed to explore areas such as motivations for AI adoption, types of AI technologies used, the role of AI in CSR strategy, the impact on firm performance and the challenges faced during the adoption. The sample consists in six interviews, this number were sufficient to reach the theoretical saturation, a concept that according to Hennink & Kaiser (2022), happens when additional interviews will not provide additional data. To preserve confidentiality and encourage respondent's answers, the identities of the interviewees have been anonymized, so the names will be indicated as "Respondent 1", "Respondent 2", "Respondent 3", "Respondent 4", "Respondent 5" and "Respondent 6". The different respondents are associated with their position in the "Table 1". The data gained in the interviews represent the core primary data source for the study and is supplemented by publicly available documents and a systematic literature review to provide more data and resources.

This data collection approach ensures reliability and depth in understanding how AI technologies are utilized in CSR initiatives and their perceived impact on firm performance and competitive advantage. The insights gained from the interviews are

fundamental also for the comparative analysis between Italian and Scandinavian manufacturing firms and the main information are represented in “Table 1”.

Table 1: Interviews’ insights

Respondent	Job Title	Date and Time	Online or In Person
Respondent 1	Circular Business Innovation Manager	24/03/2025, 45 min.	Online
Respondent 2	Project Manager in the Strategic Sustainability Department	26/03/2025, 60 min.	Online
Respondent 3	Project Manager in E-commerce and Sustainability	26/03/2025, 55 min.	Online
Respondent 4	Sustainable Products & Supply Chain Manager	28/03/2025, 40 min.	In Person
Respondent 5	Sustainability/CSR/ESG/Manager	01/04/2025, 30 min.	Online
Respondent 6	Lead AI Specialist	03/04/2025, 35 min.	Online

3.3 Data Analysis Strategy

The data collected from the semi-structured interviews was analyzed and systematically interpreted through a thematic analysis approach. According to Belotto (2018), thematic analysis is a common method to analyze data when conducting qualitative research. This approach was the most suited for the study because is perfect to identify and analyze specific patterns or “themes” in the qualitative data. In this way it is possible to have a rigorous examination of complex data such as the integration of AI in Corporate Social Responsibility initiatives. Another reason for using thematic analysis is the fact that is also a flexible method that can be used for many types of data, including interviews.

To have a rigorous analysis, the six-phase process to make a thematic analysis approach outlined by Braun & Clarke (2023) was used. The first step was a repeated reading of interview transcripts and reflective notetaking, this stage permitted to familiarize with data. In fact, as stated by Braun & Clarke, (2023), it helps the researcher to immerse in the content and identify preliminary concepts. The second phase involved generating

initial codes, here meaningful concepts, such as AI adoption processes, CSR initiatives and strategic motivations, were evidenced and coded across all the interviews. To have a better understanding is important to know that “coding” is the interpretation of data done by the researcher where feature and patterns across the interviews are classified and labeled into a code (Skjott Linneberg & Korsgaard, 2019). Always according to Skjott Linneberg & Korsgaard (2019), themes are a group of codes identified in the transcripts of the interviews, these can be found through repetitions or theory-related materials that emerged.

The third phase consisted in putting together the codes to generate potential themes that captured broader patterns within the data. These themes were reviewed and refined during the fourth phase to ensure coherence. In this phase key themes emerged around the following topics: AI applications as strategic advantages, CSR transformation through AI, performance outcomes of CSR initiatives, and contextual factors that influenced the adoption. These themes were defined and named during phase five to reflect on the main narratives that emerged from the participants’ interviews. In the six and final phase, the themes were interpreted in relation to the research question and theoretical frameworks, in particular the relations between the Resource-Based View, Stakeholder Theory and Strategic CSR were considered. The systematic comparison between Italian and Scandinavian firms was facilitated through the organization of the transcripts and the visualization of the thematic relationships. In this way similarities and differences were better identified. To conclude, the thematic analysis strategy enabled a comprehensive understanding of how large European manufacturing companies adopt AI in their CSR initiatives. The analysis brought to useful insights into strategic motivation, implementation processes and the key differences in two different European Regions.

3.4 Research Quality

In qualitative research is fundamental to ensure quality and credibility of the findings. In this study, research quality has been addressed through the credibility, transferability, dependability and confirmability criteria. According to Johnson et al. (2020), these criteria represent a structured approach to assess the quality of the study. This approach

is necessary to replace traditional quantitative notions that incorporate objectivity in the study.

Credibility refers to the accuracy of the data and the interpretations that derive from it. In this research, credibility was ensured through methodological triangulation. This method, according to Bekhet & Zauszniewski (2012), is able to link the primary data gained from the interviews with secondary data sources, such as company documents, and analyze them together. In addition to this, member checking was employed to allow interviews participants to review the interviews summaries to verify that their perspectives were correctly reported. Finally, credibility was ensured also through a lot of time spent in the checking of the data. This phase included multiple readings of transcripts and codes that contributed to a deep understanding of the context and reduced the risk of misunderstandings.

Johnson et al. (2020), defined transferability as the extent to which the findings of the study can be applied to other contexts. In general, qualitative studies does not aim for broad generalizations, in fact this study provides a specific description of the research setting, participant roles and organizational contexts. The study refers to the application of AI in CSR initiatives in Scandinavia and Italy by comparing large manufacturing firms, so the topic is specific on this. Readers can assess the applicability of the findings to other industries or other geographic regions with similar characteristics. Dependability is defined by Johnson et al. (2020) as the consistency of the research process. To achieve this characteristic all the stages of the research were reported. In fact, a clear and transparent description of the research design, data collection and data analysis were presented. Through the review of these sections, it is possible to understand the decisions taken regarding coding and data management. This allows other scholars to replicate the research process, ensuring methodological coherence throughout the study.

Johnson et al. (2020) defined confirmability as the objectivity of the findings and the way in which they are affected by the participants' perspectives or researcher bias. In this study, to reach confirmability, a high degree of reflection on data was adopted. The researcher reflected on possible own assumptions, potential biases and the influence on

data collection and analysis. So, to support findings, direct quotes from participants were used, in this way the interpretations remained linked to the data. All the processes to arrive to codified data also increased the transparency of the decisions. To conclude, the overall research quality of the study has been ensured through rigorous methodological processes. The findings are credible, contextually relevant and based on the participants interviews. These practices were necessary to offer meaningful insights on the strategic adoption of AI in CSR initiatives in large manufacturing firms.

4. Findings

After having illustrated how the study has been conducted, it is necessary to report the key findings that emerged from the semi-structured interviews with valuable people in the manufacturing sector. This section will explore important insights about the implementation of AI applications in CSR strategies and their impact on the overall performance. This chapter will address also the challenges and barriers that the companies faced and the differences between countries will emerge. To have a better understanding of the researched companies, some information is presented in Table 2, and at the end of each paragraph there will be a table to resume the main findings. Finally, at the end of the Findings section there will be a table explaining all the main findings that emerged from the interviews.

Table 2: Researched companies' insights

Company	Description
Lindex	Swedish fashion chain, part of the Stockmann Group, with around 480 stores in 18 countries, offering women's wear and kids' clothing
H&M	Global Swedish fashion retailer known for offering trendy and affordable clothes with thousands of stores in 70 countries.
Bestseller	Danish fashion company with over 2800 stores in 44 countries. It sells clothing and accessories for women, men and kids.
Gucci	Italian luxury fashion house. It offers a wide range of products, from handbags to clothing. It had 529 stores worldwide and is part of the French luxury group Kering.
Benetton	Italian fashion company that operated 3800 stores worldwide. It offers a range of clothing and accessories for men, women and children.
Radici Group	Italian multinational company. It operates in over 20 countries and its focus is on textiles.

4.1 Approaches to CSR and AI across companies

In this section the general approaches of the different companies toward CSR initiatives and AI will be explored. In particular, the focus will be on what emerged from the interviews and understand if CSR is already part of the companies' strategies and if they are already leveraging on AI applications.

4.1.1 CSR approaches and strategies

The interviews conducted with six manufacturing companies in the fashion industry (Lindex, H&M, Bestseller, Gucci, Benetton and Radici Group) highlighted the role of Corporate Social Responsibility as a part of the corporate strategy. All companies reported that CSR has become a structural element of their operations, involving mainly environmental and social dimensions. CSR initiatives are also considered by all the six companies an important part of their current and future business models.

From the interviews it emerged that Scandinavian companies (Lindex, H&M and Bestseller) are using CSR initiatives as integrated practices across departments and not as isolated within a single team or business function. Respondent 1 from Lindex stated: *“Sustainability is part of our identity. It is something that is integrated across all the departments, not only the one that deals with that.”* (Interview 1, 24/03/2025). Respondent 2 from H&M said: *“We don’t treat sustainability as something that is separated from the rest, it’s integrated in every function, and every team has its own responsibilities in achieving certain goals”* (Interview 2, 26/03/2025). Also Respondent 3 from Bestseller emphasized that sustainability and so CSR initiatives are part of the company’s culture, in particular said: *“Our Fashion FWD strategy defines the direction for our sustainability work, it’s a company-wide responsibility”* (Interview 3, 26/03/2025). The Fashion FWD strategy represents the Bestseller’s long-term sustainability strategy to reduce the environmental impact, and it stands for “Fashion Forward”. From the semi-structured interviews with these three companies, it emerged that CSR initiatives are supported by structured plans and frameworks. Respondent 2 from H&M described an approach that is setting long-term goals to become climate positive by 2040 and work toward circularity throughout the value chain. Respondent 3 from Bestseller mentioned the existence of performance targets linked to sustainability and described the implementation of the strategy as shared across all departments.

The Italian companies (Gucci, Benetton and Radici Group) presented CSR initiatives as something that is part of the companies’ culture but is associated more with the specific sections that are in charge of it rather than a commitment that is part of all the

organization. In these companies CSR is associated also with a strategic function, with approaches that integrate brand positioning and group-level directives. Respondent 4 from Gucci explained: *“CSR initiatives are aligned with Kering’s sustainability guidelines and with our internal values”* (Interview 4, 28/03/2025). According to Respondent 4, the CSR strategy is defined in accordance with group-level goals but is adapted to the specific characteristics of the Gucci brand. Benetton highlighted the historical importance of CSR for the company stating: *“Sustainability has always been part of Benetton’s identity”* (Interview 5, 01/04/2025). The focus of the company is on combining product quality with respect for environmental principles. At Radici Group, according to Respondent 6, CSR was described as part of the company’s responsibility since they are also materials manufacturers. Respondent 6 said: *“Our approach to CSR is based on life cycle thinking. We analyze the environmental impact of our products from the beginning to the end of the chain”* (Interview 6, 03/04/2025). The company also integrates sustainability into its operations through reporting practices in relation to emissions and raw material sourcing.

All of these approaches toward CSR initiatives were mainly related to the environmental aspects, but also social practices emerged during the interviews. Respondent 1 from Lindex emphasized the importance of gender equality and women’s empowerment for the company. In particular, it emerged that the company sees social responsibility as linked to its brand identity, so the company’s social focus goes beyond the simple compliance to regulation. Also H&M, Bestseller and Benetton highlighted the importance of social practices but they were more focused on fair and safe labor practices, fair wages and responsible sourcing. All the three companies are using partnerships with NGOs and audit suppliers to maintain transparency and engage in social practices. Gucci evidenced an approach more focused on internal equity and external advocacy aligned with the Kering Group’s ESG goals. According to Respondent 4 from Gucci: *“We invest in education, equal opportunity and creating a workplace that reflects our values”* (Interview 4, 28/03/2025), this evidenced also the importance that Gucci gives to sustain global campaigns on social justice and human rights linked to its luxury identity. Finally, Radici Group as it is also a raw materials manufacturer, is focused more on worker safety

and internal training to pay attention to the work conditions and have an inclusive work environment.

From the interviews few information emerged regarding governance practices sustained by the companies. Despite this, all six companies confirmed the existence of internal frameworks and organizational roles dedicated to CSR management. In different cases, dedicated sustainability departments were cited as responsible for coordinating activities and supporting integration across operational areas. The coordination across departments was mentioned by both Scandinavian and Italian firms, but with different levels of internal formalization. A recurring point across all the interviews was the importance of aligning CSR initiatives with external expectations. According to this, all the companies referenced regulatory frameworks and consumer awareness as elements that influence how CSR is defined and implemented. An example is given by Respondent 5 from Benetton that stated: *“We want to meet international expectations and ensure transparency also in how we work internally”* (Interview 5, 01/04/2025). Similarly, Radici Group evidenced the role of industry-specific regulations and emphasized the need to communicate the ESG performance.

All companies described CSR as a process that involves different departments and monitoring tools. In addition to this, all respondents referred to CSR as a long-term commitment and not just a one-time initiative just for marketing effort. As stated by Respondent 4 from Gucci: *“Sustainability is not something temporary but is part of our strategy for the future”* (Interview 4, 28/03/2025). To conclude, the interview findings show that CSR is considered a strategic and cross-functional element in all the six companies. The approaches could be different, but each firm described CSR as an important part of their organizational model that is integrated in the business operations, responsive to the external demand and guided by internal goals.

4.1.2 AI applications

In this paragraph the approach toward AI and how the companies are using it in their processes and strategies will be reported. The AI applications in CSR initiatives will be analyzed in the next chapter to have a better understanding.

From the six interviews with the different companies operating in the fashion manufacturing industry, emerged that all of them are currently employing or developing AI technologies in their organizations. The main usages are to support operational efficiency and improve decision-making processes. Some differences emerged in how companies are integrating AI, and which type of AI models are being used, but the main applications are in forecasting, inventory management, production monitoring or retail optimization.

The Scandinavian companies are utilizing AI in a broader and more advanced way across different business areas. Starting from Lindex, Respondent 1 described how the company is using mainly machine learning tools to support forecasting and planning. In particular, the company is using them to optimize product allocation and reduce imbalances across stores. According to Respondent 1, *“We use AI mainly to better predict demand and reduce errors between demand and supply”* (Interview 1, 24/03/2025). AI is also used to improve the accuracy of size prediction and so reduce overstocks. Respondent 2 from H&M explained that AI applications are used in different operational and analytical processes. The main usages are in demand forecasting, pricing strategies and online personalization and the AI applications involve mainly machine learning and computer vision models. As stated by Respondent 2: *“AI supports our e-commerce through product recommendation engines and it also help us in deciding how much stock goes where”* (Interview 2, 26/03/2025). Respondent 2 also said that H&M has developed a framework called “Responsible AI”, which is a tool that includes internal guidelines to ensure an appropriate use of AI applications. Respondent 3 from Bestseller reported that the company is using an AI platform developed in collaboration with IBM that is called “Fabric.ai”. This AI platform is used to support collection planning and trend forecasting. The platform uses internal data and external market intelligence to help during the development of new clothes collections. Respondent 3 stated: *“Fabric.ai is used by our designers and product teams to understand what trend will emerge and what customers want”* (Interview 3, 26/03/2025). To conclude, Respondent 3 affirmed that AI in Bestseller is also used to reduce inefficiencies in product assortment across markets.

Among the Italian companies, the adoption of AI was described as more targeted to specific business areas. Starting from Gucci, Respondent 4 affirmed that AI is utilized mainly to optimize inventory levels and support demand forecasting. The systems are integrated through Kering's centralized digital platform and adapted to Gucci's specific needs. Respondent 4 said *"We use predictive dashboards to understand demand and optimize production quantities, this because we are a luxury brand and the unsold products will be more difficult to sell in the periods after the launch"* (Interview 4, 28/03/2025). Respondent 5 from Benetton described that the company is using an AI application in their retail operations by focusing on real-time environmental control. Respondent 5 stated: *"In our Florence store is present an AI system that automatically adjusts the lights and temperature depending on how many people are in the store and on the weather conditions"* (Interview 5, 01/04/2025). The Respondent highlighted that some of their stores have an integrated AI system that is able to manage heating, ventilation, air conditioning and lightning based on real-time occupancy and temperature data. Finally, Respondent 6 from Radici Group said that AI is applied in the production mainly and is used to process operational data and improve quality control. Respondent 6 explained that AI works in combination with Internet of Things (IoT) sensors to monitor the production performance in real time. Respondent 6 stated: *"We use AI to identify when something is deviating from the standard"* (Interview 6, 03/04/2025). In addition to this, AI is used with other digital platforms to increase the traceability of materials during all the production process.

In all six companies, AI is utilized and described as a support to increase production and planning accuracy but is also important to understand how companies have implemented these systems. The implementation methods of AI vary between companies and is mostly managed by IT teams in collaboration with other departments.

Starting from Lindex, Respondent 1 answered that the AI systems that they are using were developed in partnership with external Swedish technology providers, but the utilization and the monitoring are handled internally. The Respondent analyzed how, for the company, was simpler to implement the systems with external collaborations initially and manage them internally after having a deeper understanding of them. In H&M, according

to Respondent 2 the company uses a combination of internally developed tools and collaborative projects with external labs. The Respondent explained: *“We have our own AI teams, but we also work with external partners, mainly when we are trying new things with AI”* (Interview 2, 26/03/2025). In Bestseller the AI platform Fabric.ai, based on predictive analytics and data modeling technologies was implemented through a strategic project between Bestseller’s internal data teams and IBM’s engineers. According to Respondent 3, now this AI platform is used regularly across departments.

Going now to the Italian companies, starting from Gucci, the AI tools were developed by the parent company, Kering Group. So, in this case, Respondent 4 affirmed that the technical development is centralized, and Gucci adapts the tool to its needs. According to Respondent 5 from Benetton, their AI system was developed in collaboration with a technical provider and installed in some of their main stores such as the one in Florence. Finally, according to Respondent 6 from Radici Group, the AI implementation has been carried out through internal development in collaboration with some specific research centers.

The AI implementation strategies also vary between the companies. A hybrid approach was utilized in Lindex, H&M and Radici Group that combined internal development and external expertise. Bestseller implemented a strategic collaboration with IBM, Gucci relied on centralized tools from the group Kering and Benetton worked with a technical partner for a specific application. To conclude, according to the Respondents AI is generally integrated into existing business functions and all the companies made investments in AI to enable the adoption.

Table 3: Type of AI used; AI commitment and CSR Commitment of the Interviewed Companies

Company	Type of AI used	AI Commitment	CSR Commitment
Lindex	Machine Learning models	Medium-High; focused on improving forecasting and reducing waste	High; CSR integrated across all departments and central in the company's culture
H&M	Machine Learning and Computer Vision	High; broad AI integration and development of internal models	High; sustainability integrated in every function and long-term goals set
Bestseller	AI platform (Fabric.ai), Market intelligence tools	High; strategic AI tool used in collection planning	High; fashion FWD strategy guides sustainability and cross-department AI utilization
Gucci	Predictive Analytics, AI platform developed with Kering	Medium; adapted use of group-developed AI tools for inventory and logistics	Medium-High; aligned with Kering's ESG strategy and adapted at brand-level
Benetton	Machine Learning and AI for sensor and data analysis	Medium; focused use of AI in pilot projects	Medium-High; CSR initiatives are part of the brand identity with a focus on social and environmental impact
Radici Group	Machine Learning, Predictive analytics and a combination of AI and IoT	High; multi-system AI deployment with real-time monitoring and traceability	High; CSR initiatives are important mainly toward environmental responsibility

4.2 The specific AI applications in CSR initiatives

From the interviews with Lindex, H&M, Bestseller, Gucci, Benetton and Radici Group, detailed insights on the specific AI applications to support CSR initiatives emerged. Across all respondents, it emerged that AI is primarily utilized to improve Environmental performance rather than Social or Governance. The main CSR initiatives that benefit from AI applications are waste reduction, resource efficiency and emissions monitoring and each company used different AI technologies.

Starting from Respondent 1 from Lindex, it emerged that AI is used to contribute to the company's goal of waste reduction through improved forecasting models. The respondent explained that the company uses machine learning models to predict customer demand

and size distributions, in this way the company is able to minimize overproduction and stock excess. According to Respondent 1: *“By using AI to understand what customers will buy and in which sizes, we are able to reduce the amount of unsold products, and so decrease wastes and labor processes that have a great impact on the company’s emissions”* (Interview 1, 24/03/2025). This approach allows Lindex to produce the optimal quantities and avoid wastes, in this way is able to contribute to sustainability goals. The system can do that by processing internal sales data and historical trends to generate insights that assists the planning teams in determining the optimal quantities to produce. In addition to demand forecasting, Respondent 1 highlighted also the application of AI for material traceability within the supply chain. Respondent 1 stated: *“We are also experimenting AI models that are able to increase the visibility of materials along the supply chain, in this way we are able to increase transparency and meet the sustainability standards”* (Interview 1, 24/03/2025). This initiative wants to support the ethical sourcing and supply chain accountability environmental objectives. According to Respondent 1, AI by providing real-time data and increased tracking capabilities is helping Lindex in reaching these goals.

Other AI applications in CSR initiatives emerged from H&M, in particular, according to Respondent 2, the focus is on increasing circularity and enabling real-time monitoring of sustainability indicators. The main application of AI in H&M’s CSR initiatives is an AI-powered textile sorting system created in collaboration with external research centers. Respondent 2 described that this system uses computer vision and near-infrared (NIR) spectroscopy technologies to recognize and categorize different textile materials. Respondent 2 said: *“AI is able to identify textiles effectively by recognizing material types, in this way we are able to recycle materials and old clothes”* (Interview 2, 26/03/2025). By using AI for material identification, the company is able to separate different fiber types of materials and old clothes, in this way the quality and efficiency of the recycling processes is increased. According to Respondent 2 this directly contributes to H&M’s commitment to adopt circular production models and reduce wastes generated by unsorted or improperly recycled textiles. In addition to this application, H&M applies AI to support real-time monitoring of sustainability indicators throughout its supply chain. Respondent 2 explained that H&M is using a machine learning model that is able

to collect data from different suppliers and provide ongoing visibility on key environmental metrics (emissions, water consumption, energy use). In this way H&M can track in real-time the progresses towards sustainability targets and if a part of the supply chain deviates from the standards or the goals, the company is able to respond immediately to the problem. This model is also utilized to help in corporate decisions. In fact, the machine learning model is able to calculate the possible emissions of a project and help managers in understanding which is more sustainable.

At Bestseller, the application of AI in CSR is done through Fabric.ai, an advanced platform developed in collaboration with IBM. This platform combines predictive analytics and machine learning models to optimize product assortments and improve forecasting accuracy. The sustainability objective is to reduce overproduction and minimize wastes. Respondent 3 explained that the AI platform by processing internal sales data with external trend insights is able to provide recommendations to design and production teams related to the environmental impact. Respondent 3 said: *“Fabric.ai help us in understanding what customers want, so we can produce the right quantities and design the right products”* (Interview 3, 26/03/2025). In this way the AI platform helps in avoiding overproduction and the environmental impact associated with unsold stock. The avoiding of overproduction was identified from Respondent 3 as one of the most significant sustainability challenges for the company. So, by integrating AI-powered forecasting, Bestseller lower the environmental footprint associated with material use, manufacturing and operations connected to surplus goods. In addition to this, Respondent 2 stated that Fabric.ai is also used to balance commercial goals with sustainability considerations by assisting decision-making in assortment optimization. The AI platform considers environmental factors when suggesting product mixes, allowing Bestseller to assess the potential sustainability impact of their assortment decisions alongside financial outcomes.

Going now to the Italian companies and starting from Gucci, the interview revealed that the company is using AI in CSR initiatives to improve inventory management and contribute to waste reduction. These applications, according to Respondent 4, are in line with the Kering Group’s global sustainability strategy. Also Gucci utilizes an AI platform

that combines machine learning algorithms and predictive analytics. The tool is part of the Kering's centralized digital platform but is aligned with Gucci's specific needs. The company applies AI to refine sales forecasting and align production volumes with the market demand. According to Respondent 4: *"The predictive dashboard guides us in defining production quantities. This helps us in reducing overproduction and limit wastes"* (Interview 4, 28/03/2025). The AI application analyze historical sales data and seasonal patterns to provide actionable insights for production planning teams. In addition to this, Gucci utilizes AI also to increase the efficiency of logistics operations, reducing the environmental footprint of product distribution. Respondent 4 said that the AI platform help the company to analyze logistics flows and optimize transport routes, in this way they are able to reduce emissions from product shipments and select more efficient transportation methods.

At Benetton, according to Respondent 5, Artificial Intelligence is integrated in CSR initiatives to improve energy efficiency within retail environments and reduce the overall company's environmental footprint. Respondent 5 evidenced that Benetton has implemented an AI-based system in some of its main physical stores that is designed to monitor and control heating, ventilation, air conditioning and lightning systems based on real-time environmental data and occupancy levels. The system is based on machine learning algorithms integrated with sensor technologies, which continuously collect data on variables such as customer presence, indoor temperature and external environment conditions. Respondent 5 explained: *"The AI system adjusts lightning and temperature automatically, depending on how many people are in the store and the outside temperature"* (Interview 5, 01/04/2025). This real-time adjustment enables Benetton to optimize energy consumption during the day ensuring that energy is not wasted. The results of this AI application have been quantifiable, in fact Respondent 5 evidenced that, in their Florence store, Benetton achieved a 20% reduction in energy consumption. This outcome aligns with Benetton's CSR objectives of improving resource efficiency and lowering greenhouse emissions. The system helps in reducing electricity usage and the associated emissions resulting from energy production.

The last interview with Radici Group revealed an integration of AI within the company's CSR initiatives to increase three main aspects: supply chain traceability, real-time monitoring of the environmental impact and process optimization. The company's approach involves the combination of AI, Internet of Things (IoT) and blockchain technologies that create an integrated digital infrastructure to support dynamic environmental management. According to Respondent 6, AI systems at Radici Group process data collected from various points along the production line to monitor emissions and energy consumption. As stated by Respondent 6: *"We use AI to process data from the production lines, in this way we can monitor emissions and so respect the environmental limits and react if a part of the production line exceeds the limit"* (Interview 6, 03/04/2025). The integration of AI allows the company to detect deviations from standard environmental parameters and respond to mitigate the impacts. At Radici Group AI contributes also to supply chain transparency that is a key component of Radici Group's CSR commitment. This application permits to verify sourcing compliance, ensure responsible material use and provide accurate information to stakeholders regarding the environmental footprint of the company's products. In this way, according to Respondent 6, Radici Group support also lifecycle assessments of the materials, contributing to a better understanding of the total environmental impact. Respondent 6 also emphasized the importance of AI in CSR initiatives because it supports external reporting and stakeholder engagement. By providing real-time data on environmental performance. The communication with all the external stakeholders is transparent and accurate.

Across all companies, the integration of AI applications in CSR initiatives is present and aims to achieve a better environmental performance. Machine learning algorithms are the most adopted technology as reported by Lindex, H&M, Bestseller, Benetton and Radici Group. Other applications are computer vision and spectroscopy adopted by H&M for material sorting, predictive analytics platforms utilized by Gucci and Bestseller for production and logistics planning, and IoT-integrated AI systems in Radici Group and Benetton to monitor environmental data. All respondents described these AI applications as essential components of their current CSR efforts, because they are able to measure the progresses toward environmental goals.

Table 4: AI Applications in CSR initiatives and Implementation Approaches of the Interviewed Companies

Company	AI application in CSR	Implementation Approach
Lindex	Demand forecasting and size prediction to reduce overproduction and waste	Hybrid: Internal deployment + external tech support for AI forecasting tools
H&M	Textile sorting use of AI for recycling and real-time sustainability reporting	Internal AI development + collaboration with suppliers and research institutions
Bestseller	The platform Fabric.ai is used to plan collections accurately and reduce overproduction	Joint development with IBM; operated and refined internally
Gucci	Inventory optimization and transport logistics to reduce emissions waste	Adaptation of centralized Kering tools with brand-level internal customization
Benetton	AI-based energy management system in retail stores to cut energy consumption	Developed with tech providers; operated in-store by internal staff
Radici Group	Real-time monitoring of emissions, resource use and supply chain traceability	Internal development + academic and technical partnerships.

4.3 The Strategic Role of AI implementation in CSR initiatives

The interviews with the six companies demonstrated that the implementation of AI in their Corporate Social Responsibility initiatives derives from a combination of external pressures and internal strategic objectives. Regulatory compliance and stakeholder demands are recognized as drivers by all the companies, but the AI integration in CSR practices is also described as part of an internal strategy to improve environmental performance and efficiency.

Starting from Lindex, Respondent 1 explained that the adoption of AI in CSR initiatives started from the need to reach internal sustainability goals. The company identified waste reduction as a priority and AI was viewed as the best solution to solve it. Respondent 1 stated: *“We started using AI to better predict what customers will buy, in this way we were able to reduce overproduction and solve our main sustainability goal”* (Interview 1, 24/03/2025). Although the increasing regulatory requirements, Respondent 1 emphasized

that the drive to adopt AI in CSR strategies was not reactive, but a proactive strategy to reduce the environmental footprint and temporarily reduce the costs associated with overstocking. For H&M, the AI integration in CSR initiatives plays a dual role, in fact it addresses external demands for transparency and supports internal strategic needs such as circularity and sustainable supply chain management. Respondent 2 explained that the growing importance of an accurate and transparent sustainability reporting was a clear external motivator. In particular, Respondent 2 stated: *“Transparency and sustainability aren’t optional anymore [...] AI was a perfect solution to respond faster to stakeholder needs”* (Interview 2, 26/03/2025). For H&M the integration of AI was a solution to the external stakeholders’ pressures, however Respondent 2 highlighted also the importance that it has in improving efficiency inside the company. The integration of AI in CSR initiatives for H&M was fundamental to support regulatory compliance and company’s internal goals. At Bestseller, the decision to adopt AI in CSR initiatives emerged from the need to address the overproduction problem. Respondent 3 identified AI as an essential tool to align the production with demand and stated: *“In our industry, overproduction is a great issue, so we tried to solve it with the integration of AI”* (Interview 3, 26/03/2025). This brought Bestseller to solve the problem of overproduction, but, according to Respondent 3, the application of AI in CSR practices emerged from the internal necessity to integrate sustainability into core business processes. In particular, Respondent 3 stated: *“The tool was developed not just for sales and overproduction problems, but also to help us in making responsible choices”* (Interview 3, 26/03/2025). So, the integration of their AI tool derives from the need to solve the problem of overproduction but also from the need to be more sustainable in every strategic decision.

For Gucci, the adoption of AI in CSR initiatives does not derive from a particular internal necessity, but it aligns with the group-level sustainability commitments. According to Respondent 4, the company operates within the broader Kering Group ESG framework that shows the total sustainability commitment. Respondent 4 described that the AI tool was presented by the group and integrated in Gucci according to the company’s specific needs. In particular, Gucci’s aim is to reduce emissions and ensure sustainable luxury production. According to this Respondent 4 stated: *“Reducing waste and ensure sustainable products are our priorities, this AI platform is helping us in reaching these*

objectives” (Interview 4, 28/03/2025). This adoption of a group-developed AI tool at the brand level reflects Gucci’s flexible approach to align traditional business operations with more advanced and sustainability-oriented practices. At Benetton, Respondent 5 reported that the implementation of AI in CSR initiatives was driven by the company’s internal focus on improving energy efficiency in its stores. The decision to use an AI-based environmental control system in the main retail stores was based also on the potential for measurable improvements. Respondent 5 stated: *“We started with energy management in our main stores because we could clearly measure the benefits and understand if continue to invest on this application”* (Interview 5, 01/04/2025). The motivation of this strategy was given by the company’s internal need to reduce operational costs and increase sustainability performance. The 20% costs savings that derived from this initiative describes also the strategic importance of the AI application.

Finally, at Radici Group, AI was initially adopted in CSR initiatives to respond to external pressures, but it was also needed for some internal problems. The main needs were to achieve supply chain transparency and real-time environmental monitoring. Respondent 6 explained that the increasing demand from customers and regulation to provide verified data on sustainability performance pushed the company to develop this AI solution. Regarding this, Respondent 6 stated: *“The growing pressure from clients and partners to provide data regarding sustainability, brought us to develop an AI model to respond to this necessity”* (Interview 6, 03/04/2025). Respondent 6 highlighted that through their AI application, the company now is able to reach the two goals of supply chain transparency and real-time monitoring, and this is giving results in terms of ESG indicators.

Across all six companies, it emerged that the external pressures have accelerated the integration of AI in CSR initiatives, but also that an equal strategic internal need brought them to this solution. Companies described their own developed AI applications as tools to achieve measurable progresses in sustainability objectives and internal costs needs.

Table 5: Motivations that brought the Interviewed Companies to adopt AI in CSR initiatives

Company	Motivations for AI in CSR	Stakeholder influence or Internal Drivers
Lindex	Reduce overproduction and the overall environmental footprint; improve efficiency	Mainly autonomous, through internal sustainability goals that drive the adoption of sustainability practices
H&M	Enable circularity, improve recycling systems and increase real-time reporting	Both; driven by stakeholder expectations and internal sustainability innovation
Bestseller	Improve planning accuracy, reduce waste and align product design with demand	Primarily internal strategic initiative, supported by stakeholder trends
Gucci	Limit inventory surplus, lower emissions from logistics and align with group's ESG targets	Internal alignment with group strategy; adapted to meet luxury market standards
Benetton	Reduce store energy consumption and operational waste	Mainly internally driven, aiming at energy efficiency; limited stakeholder pressure
Radici Group	Enhance emissions tracking, support compliance and increase supply chain transparency	Both; strong external compliance pressures and internal leadership in sustainability

4.4 The impact on Competitive Advantage and Firm Performance

From the interviews with the six manufacturing companies, it emerged that the integration of Artificial Intelligence into Corporate Social Responsibility initiatives has contributed to different aspects of competitive advantage and overall firm performance. The specific impacts vary depending on the market positioning and the scope of AI implementation, but all respondents stated that the integration of AI in their CSR initiatives brought to benefits in terms of market differentiation.

Starting with Lindex, according to Respondent 1, the integration of AI into company's CSR initiatives had a direct and measurable impact on the competitive positioning and operational performance. Respondent 1 stated that the improvements in forecasting accuracy and inventory management obtained through their AI application have reduced the occurrence of overproduction and unsold stock, and increased cost efficiency and

environmental objectives. By improving the alignment between production and the real market demand, Lindex has been able to limit the accumulation of unsold products, reducing the financial costs associated with that. Respondent 1 explained that these improvements result in internal operational benefits but also strengthen Lindex's market position as a company recognized for its sustainability efforts. Regarding this, Respondent 1 stated: *"Reducing the amount of unsold products lowers our costs and also reinforce our brand image"* (Interview 1, 24/03/2025). The company sees this as a competitive advantage, in particular in markets where customers are sensible toward sustainability issues. In addition to the waste reduction, the AI application predicts also sizes and stock allocation, in this way the stores are always well furnished. This, according to Respondent 1 contributes to stronger sales performance related to improved shopping experiences for customers and the result is higher revenues and brand loyalty. Respondent 1 described also the fact that Lindex operates in a market that is sensible toward sustainability issues, and through the AI-increased CSR initiatives, the company is able to communicate data-driven results that increase credibility with customers and increase competitive positioning. To conclude, Lindex is having advantages from the application of AI in its CSR initiatives in terms of optimization and sustainability, in this way the overall company's competitive differentiation benefits from this innovation.

At H&M, Respondent 2 explained that the application of AI in CSR initiatives brought to advantages in terms of operational performance. Respondent 2 highlighted that the adoption of their AI technology in textile sorting and sustainability reporting increased the company's positions in circularity and sustainable fashion innovation. Specifically, thanks to the company's use of AI-powered textile sorting systems the efficiency of recycling processes significantly improved. According to Respondent 2: *"Our AI technology permits to sort textiles more effectively by recognizing material types that is fundamental in recycling and achieving circularity"* (Interview 2, 26/03/2025). Respondent 2 reported that the AI-driven system achieved a material recognition rate of 96%, which represents a great improvement over the old manual methods. This circularity initiative gained higher recycling rates and reduced textile wastes thanks to the AI system. From this, according to the respondent, H&M's market positioning increased because they have reached a tangible and effective initiative that is also easy to report to the

different stakeholders. Beyond this recycling initiative, H&M improved also its real-time sustainability reporting. In fact, according to Respondent 2, another AI tool that they have developed allows H&M to maintain high levels of transparency, by communicating real-time sustainability data regarding emissions and other indicators. This increased the H&M's reputation for data accountability. From an internal operational perspective, the application of the AI tools brought to efficiency gains, by automating data collection and data analysis. Respondent 2 noted that the company now is more agile regarding the collection and communication of environmental data, because the AI platform is able to do the work of different people in less time and more efficiently. In addition to this, Respondent 2 highlighted the fact that through a direct AI analysis and communication of sustainability data, there is a total transparency toward stakeholders, because no one is able to modify them. In summary, H&M's AI applications brought to benefits in terms of operational efficiency, circularity and reporting accuracy, contributing to the company's overall competitive advantage.

At Bestseller, Respondent 3 explained that AI is mainly applied through their platform Fabric.ai, which was developed in collaboration with IBM. The application is used in CSR initiatives to reduce overproduction and so optimize the resources used. According to Respondent 3: *"The platform helps us avoid surplus stock, in this way we reduce the environmental impact, and we improve the operational efficiency"* (Interview 3, 26/03/2025). The tool is also able to help in strategic decisions, because it integrates sustainability data when it is used. Respondent 3 explained that their AI platform is also giving insights on customer's preferences based on historical data that permits to the company to anticipate consumer preferences and possible market shifts. Bestseller in this way is able to improve product-market alignment, increase customer satisfaction and reinforce the company's market position. The collaborative development of Fabric.ai with IBM was also described as a competitive advantage itself, because it provides Bestseller a customized tool that aligns sustainability goals and commercial objectives. In summary, the integration of AI into Bestseller's CSR initiatives delivered different benefits and a competitive advantage in terms of efficiency and market responsiveness.

Respondent 4 from Gucci explained that their AI tool, developed within the framework of the Kering Group's centralized digital platform, is used in the company to optimize inventory management and improve logistics. The CSR initiative regards the reduction of the environmental impact related to overproduction and unnecessary transportation emissions. Respondent 4 explained: *"The predictive dashboard that we use, guide us in defining production quantities [...] helping us to reduce overproduction"* (Interview 4, 28/03/2025). In addition to this, when utilized in logistics, the AI application allows Gucci to lower its carbon footprint when used to optimize transport routes. Respondent 4 described that the competitive advantage is generated in the luxury market, where sustainability expectations are rising rapidly among consumers. Gucci is aiming to align the environmental sustainability with the expectations of luxury, in this way their brand reputation is differentiated in a competitive industry. In addition to this, the integration of the AI system helps Gucci in reaching the group-level sustainability goals set by Kering. Gucci's application of AI in CSR initiatives has delivered benefits in terms of logistic efficiency, increased brand reputation and inventory optimization. The integration of AI aligns the expected sustainability goals with Gucci's strategic internal objectives, in this way the company is able to differentiate on the market.

Benetton is adopting a different approach; in fact, the focus of their AI application is on the energy management in its retail spaces. According to Respondent 5, the adoption of an AI system to regulate the overall environment of their main stores brought to good results. The Florence store obtained a 20% reduction in the energy consumption, in this way the environmental impact is reduced and there is an impact also on cost savings. According to Respondent 5: *"The energy savings in our retail stores are a tangible way of how we are reducing the environmental impact"* (Interview 5, 01/04/2025). The respondent described that the competitive advantage gained by Benetton is not only given by the sustainability initiative and the cost savings, but also by the fact that their sustainability approach is visible, since it is adopted in the retail stores. In fact, this initiative is visible for customers that are expecting sustainable business practices. Respondent 5 highlighted that Benetton views AI and sustainability as means of differentiation from competitors and so its investments are going in that direction. Benetton's implementation of AI in its CSR initiative delivered benefits in terms of

energy efficiency, cost reduction and brand differentiation. By achieving measurable results, Benetton is increasing its competitive advantage and the alignment with market expectations.

The interview with Radici Group illustrated that the company's integration of AI in CSR initiatives had a direct impact on competitive positioning and the overall financial performance. Respondent 6 emphasized that the combination of AI and IoT technologies enabled Radici Group to improve real-time monitoring of the environmental impact and increased supply chain transparency. Respondent 6 explained that one of the most important advantages gained is the ability to provide accurate data to external stakeholders. In particular, Respondent 6 explained: *"Our customers and the regulators are asking for verified data on sustainability, through our AI system we are able to provide this information"* (Interview 6, 03/04/2025). In addition to external reporting Respondent 6 highlighted the internal performance benefits of their AI application, particularly in supporting predictive monitoring of the production processes. Radici Group is able to anticipate potential environmental issues related to their production footprint and also avoid costly disruptions. This is possible through the continuous data analysis done through AI. The competitive advantage, according to Respondent 6 is given by the great transparency and environmental responsibility gained through the application of their AI system on all the supply chain and their production processes. Radici Group is able to trace materials throughout the production cycle, providing a track flow of raw materials and finished products, meeting the demand for responsible sourcing. In summary, the application of AI within its CSR initiatives has generated clear benefits for Radici Group in terms of real-time environmental monitoring, supply chain transparency and predictive management. These capabilities increase the company's competitive advantage.

Across all six companies, the integration of AI into CSR initiatives was mainly described as contributing to operational performance and competitive positioning. Respondents reported that the application of AI in CSR initiatives brought improvements in forecasting accuracy, energy efficiency, supply chain transparency, and sustainability reporting. All these factors are increasing the companies' market differentiation. In addition to this, the companies emphasized that these benefits are not related only to regulatory compliance,

but they support strategic goals related to brand reputation, customer trust, and long-term resilience in a market that is giving more and more importance to sustainability issues.

Table 6: Impact on Firm Performance and Competitive Advantage of the implementation of AI in CSR

Company	Impact on Competitive Advantage and Performance
Lindex	Improved forecasting and reduced overproduction and wastes; enhanced brand reputation for efficiency and environmental responsibility
H&M	Higher material recognition in recycling initiatives (96% more precise); improved reporting speed and accuracy; increased leadership in sustainable initiatives
Bestseller	Improved collection planning; reduced surplus; enhanced market responsiveness; brand aligned with responsible production
Gucci	Optimized inventory and logistics; reduced emissions and operational waste; supported sustainable luxury positioning
Benetton	Achieved 20% energy savings in its retail stores; operational cost reduction; improved environmental performance; enhanced responsible brand image
Radici Group	Real-time emissions tracking and traceability improved client trust and regulatory compliance; supported industrial reputation in sustainability

4.5 Challenges and Barriers in the Implementation of AI in CSR practices

The six interviews identified also some challenges and barriers in the implementation of AI in the companies' Corporate Social Responsibility initiatives. The main difficulties were technological, organizational, cultural or data related.

At Lindex, Respondent 1 described the main challenge as related to data quality and availability. The Respondent explained that to integrate an AI model, in particular a machine learning algorithm, data with a high grade of accuracy and completeness are needed. Lindex is using AI for demand forecasting in order to reduce overproduction and wastes, so gain accurate data from customers and market demand is fundamental. Respondent 1 explained: *"Our main problem in the implementation of the system was*

related on how to collect clear data to use” (Interview 1, 24/03/2025). This problem was solved thanks to a hard work done by Lindex’s sales department that analyzed the sales of the past years to get clear data and use them in the AI model. In addition to this, the company is now working on the adaptation of the AI model to work effectively with variable data quality and real-time sales monitoring.

For H&M, which applies AI in textile sorting for recycling and sustainability reporting, the main problem was related to the integration of data in their AI application. H&M did not have too many problems with the AI application to recognize the textile materials, but mainly with the one to communicate sustainability information to stakeholders. The problem derived from the fact that, with a wide network of suppliers, integrate all the data was particularly complex. Respondent 2 stated: *“Get reliable data from all the suppliers and ensuring they are up to date is complicated”* (Interview 2, 26/03/2025). The company to solve this problem developed stronger collaborations with supply chain partners, by investing in supplier training and setting clear expectations regarding sustainable data-sharing. The company also adopted a centralized data platform that is able to harmonize all the data gained from the different suppliers and make them easy to read for the AI platform that then is able to communicate real-time sustainability data. Another problem with the implementation of AI platforms was related to internal employee’s trust on these applications. To achieve a higher grade of internal competence and reliance on AI, H&M implemented training initiatives and encouraged cross-departmental workshops. According to Respondent 2, these initiatives brought to a better understanding and adoption of AI platforms in general.

At Bestseller, where AI via the application Fabric.ai is used for collection planning and minimizing overproduction, the main challenge has been to integrate sustainability data in the model. According to Respondent 3, the application was initially developed to focus on commercial goals, so on reducing costs and increase sales. The challenge for Bestseller was to integrate sustainability and commercial goals in one single app. Respondent 3 explained: *“It’s important that the AI app does not focus only on maximizing sales, we want a sustainable model that balance the two necessities”* (Interview 3, 26/03/2025). To overcome this challenge, Bestseller worked closely with its AI development partner, IBM,

to integrate sustainability metrics directly into the platform's algorithms. The idea of using the same AI app for commercial and sustainability goals led to problems in balancing the two needs and communicate them to the app, but through the collaboration with IBM, Bestseller managed to solve this issue. According to Respondent 3, the app is able to balance the two necessities, and it gives different options to the production's department that has the final decision on what to do. In addition to this, Bestseller works on continuous model updates and monitoring of market trends, to enable their AI app to remain updated with new expectations and changes.

Gucci utilizes AI for inventory management and logistics efficiency, according to Respondent 4, the main challenge in this utilization was the need for the company to adapt the AI tool, developed by Kering, to its own specific needs. Since the AI application was developed at a group level by Kering, it was not simple to adapt it to the specific needs of the Gucci brand. Regarding this, Respondent 4 explained: *"We had to adapt the tool to reflect the uniqueness of our collections [...] our needs were different, but we had just this app"* (Interview 4, 28/03/2025). Gucci addressed this problem by utilizing dedicated internal teams focused on customizing the group platform to their specific needs. These teams collaborated with Kering's central digital department to align tools with Gucci's requirements. Another problem regarded the training of the employee that have to work with the AI tool. To manage the internal adoption and change management, Gucci implemented internal communication and training programs to be sure that the production teams understood how the AI application supports efficiency and sustainability. Respondent 4 described a great effort to integrate the AI tool in the work, since the teams had difficulties in seeing AI as a support for their work.

At Benetton, AI is applied for energy management in its main retail stores. For this application, the main challenges were data harmonization and technical integration across different physical retail environments. Respondent 5 explained: *"To integrate the AI systems in our stores, we needed external partnerships with tech providers"* (Interview 5, 01/04/2025). To have a working AI energy management system, Benetton had to collaborate with external technology partners for the development of the system and adapt it to the different stores. In fact, one of the challenges was implementing a system that is

able to harmonize different types of data for the analysis on the AI platform. The different devices and control systems across the stores created inconsistencies in data inputs, complicating AI's ability to process data in real time. Problems emerged also with the calibration of the sensors to achieve a real-time responsiveness in the physical stores. A correct calibration of the sensor, according to Respondent 5, was crucial to allow the AI system to function and manage energy in real time without errors, such as too high temperature or too low. To overcome these challenges, Benetton adopted a strategy of external collaboration combined with internal upskilling. By working with external tech partners, the company was able to refine the problems while training internal teams to operate and maintain the solution autonomously.

Radici Group is utilizing AI for emissions tracking and supply chain transparency. In these applications the challenge was to manage complex industrial data and ensure data security. Respondent 6 noted: "Since the production process is dynamic, the problem was to align the AI system with real-time changes" (Interview 6, 03/04/2025). The difficulties derived from technicalities with AI programming to manage the large amount of data of the overall production process and the data derived from the supply chain. Radici Group addressed this by collaborating with specific research centers that are working on AI to improve the system's capacity and handle large and dynamic amount of data. Another key problem that emerged from the utilization of an AI technology was the cybersecurity. To ensure a safe data handling, the company invested in advanced cybersecurity measures to increase data traceability and protection. In addition to this, to improve a cross-functional integration of the AI system, Radici Group created interdepartmental working groups to create a close collaboration between IT, sustainability and production teams. This initiative was adopted by the company to integrate from the beginning the AI system and exploit this resource.

In conclusion, each company encountered different challenges in implementing AI for CSR initiatives, but all of them found solutions. The main strategies adopted to solve problems were cross-functional teams, external collaborations, and continuous updates of the AI systems. The findings indicate that the implementation of AI to address

sustainability issues is not easy and that different problems emerge that are mainly technical and organizational.

Table 7: Challenges and Barriers in the implementation of AI applications in CSR initiatives

Company	Challenges and Barriers
Lindex	Limited data availability and inconsistent supplier data; required stronger supplier collaboration and external tech support
H&M	Complex data integration across global suppliers; need to build internal trust in the use of AI insights; addressed through centralized systems and employees training
Bestseller	Ensuring sustainability priorities were included in AI decision models; required continuous updates and model alignment with ESG goals
Gucci	Adapting group-developed AI tools to Gucci specific operations; internal change management and training to align tech with luxury standards
Benetton	Technical issues in sensor calibration and real-time responsiveness; required external tech partnerships and internal upskilling
Radici Group	Managing complex industrial data in real-time; ensuring cybersecurity and cross-functional collaboration between departments; solved through collaborations with specific research centers and cross-departmental teams

4.6 Future Strategies and Investments

From the six interviews, the Respondents evidenced also future investments regarding AI and CSR initiatives. All the companies identified sustainability as an important part of the actual and future strategies, so they want to continue investing on it. All the Respondents described the intentions to develop further their AI applications in CSR through investments focused on increasing efficiency and data precision while reducing the environmental impact.

At Lindex the main future investments in AI will continue to focus on improving forecasting models by integrating more specific market data to further reduce overproduction and wastes. In addition to refining the existing demand prediction systems, Lindex is also exploring a 3D body scanning technology. This AI application is able to reduce returns associated to wrong sizes and reduce the overall environmental impact that is related to the shipment. Respondent 1 explained: *“We are investing in 3D*

body scanners that works directly from our website that are able to allow customers to try on clothes digitally [...] Customers will be able to find the right size from the start and avoid returns that have a great impact on the environmental footprint” (Interview 1, 24/03/2025). Lindex through this investment aims to lower emissions that derive from reverse logistics and minimize unnecessary production. This is also a way to reduce the volume of returned goods that require time and resources to manage.

For H&M the future strategies involve improving their AI capabilities in recycling technologies and expanding the material recognition system. The AI-powered system that is able to recognize and sort different materials that is used by H&M to recycle clothes is getting great investments. Respondent 2 emphasized that H&M wants to improve the precision and scope of the system to increase the recyclability of more complex materials. Respondent 2 stated: *“We want to make the sorting process even smarter, [...] we want to handle more types of textiles and improve recycling rates”* (Interview 2, 26/03/2025). This investment aims to reduce the environmental impact associated with the disposal of old clothes, that would be reused to create new versions. In addition to this, H&M wants to increase its real-time sustainability monitoring systems by integrating data from a broader range of suppliers. In this way H&M aims to improve the visibility and accuracy of environmental reporting across its entire value chain.

The investments of Bestseller are going in the further developing of its proprietary platform: Fabric.ai. The goal of the company is to create a more comprehensive decision-support system that includes expanded sustainability indicators. According to Respondent 3: *“We want that the AI application would be able to include more data related the environmental impact [...] an example is to include the carbon footprint per product”* (Interview 3, 26/03/2025). The objective of the company is to continue to invest in its AI application to have a better environmental impact and be sustainable in all the stages of the production. For this reason, Bestseller is also exploring the possibility of extending the usage of the AI platform to other parts of the supply chain. An example is to include the AI application also in the logistics optimization to further reduce the emissions linked to distribution. For Bestseller the integration of sustainability into all levels of product planning is the main focus for the future investments.

At Gucci, according to Respondent 4, future AI strategies are closely linked with the broader Kering Group's ESG roadmap. The group sets some objectives in terms of ESG to reach in a specified amount of time and each company have to align with the group's vision. Gucci wants to increase its own sustainability initiatives by increasing logistic optimization and refining its demand forecasting models. To reach these objectives, the company will adopt different strategies that include investments in the AI application that they are already using. Respondent 4 highlighted that the company aims to further reduce emissions from product transportation and explained: *"We want to reduce as much as possible the overall emissions, [...] one of the strategies is to optimize the transportation routes through the AI"* (Interview 4, 28/03/2025). This optimization of the transportation routes will include also the product traceability and transparency, in this way Gucci will be able to provide clearer insights on the environmental footprint of its collections. These investments are aimed in reinforcing Gucci's position as a sustainable luxury brand.

For Benetton, future investments are aimed at improving and scaling the AI energy management system that has been successful in its main stores such as the one in Florence. Respondent 5 indicated that the company wants to extend the system across additional stores. This strategy is given by the fact that in the Florence store the company saved 20% of emissions and all the costs related, so the AI application gave good results. Respondent 5 stated: *"We are planning to expand the AI system to more locations, based on the results that we achieved from the pilot project in Florence"* (Interview 5, 01/04/2025). In addition to this expansion, Benetton is also exploring the integration of AI-driven predictive maintenance for store equipment. The aim of this investment is to increase the energy efficiency through an AI application that is able to understand when something is not working well. This is useful also to verify that the main AI energy management system is working effectively and without errors that could bring to costs rather than savings and additional emissions rather than the reduction of them.

Radici Group defined great plans to expand the scope of AI in its production processes. The main objective is to deepening supply chain traceability and, in addition to this, increase the predictive capabilities of the system to control the company's emissions. The

company is already utilizing AI integrated with IoT to reach these objectives, but the goal is to extend its application. Respondent 6 explained: *“We invested in AI to cover the entire lifecycle of our materials, so our main objective is to reach the full potential of this application”* (Interview 6, 03/04/2025). Radici Group wants to develop further its AI application to ensure fully transparent and verifiable data on sustainability performance, accessible to all stakeholders. To reach this objective, the company is working with specialized research centers. The second focus is on improving the predictive accuracy of AI models, Radici Group aims to predict the products’ demand to avoid overproduction and minimize the environmental impact.

Across all six companies, there is a shared commitment in improving the AI’s role in their sustainability strategies. Future investments are mainly focused on refining the existing systems and exploring new advanced technologies such as 3D body scanning. All the companies are planning to continue the investments in AI applications to reduce their environmental impact and increase the operational efficiency.

Table 8: Future Investments and Strategies of the Interviewed Companies in AI applications for CSR

Company	Future Investments and Strategies
Lindex	Further AI development for forecasting; investment in 3D body scanners to reduce returns and environmental impact
H&M	Scale AI textile sorting to handle more materials; enhance real-time monitoring across more suppliers for supply chain transparency
Bestseller	Expand Fabric.ai to include more environmental metrics; extend AI use into logistics optimization
Gucci	Advance logistics optimization; explore AI for product traceability and environmental transparency
Benetton	Expand AI energy management to more stores; explore predictive maintenance for store infrastructure
Radici Group	Enhance lifecycle tracking using AI; deepen AI-IoT integration for supply chain transparency

4.7 Perceived Differences across Countries

From the interviews also perceived differences in the implementation of AI in CSR initiatives between companies and countries emerged. The companies perceive some differences between countries in terms of sustainability ambitions and technology advancements. These differences were described as related to national regulatory environments, cultural attitudes and different levels of digital infrastructures. The respondents evidenced that sustainability has become an important priority in Europe, but the levels of pressures from the governments differ between regions. This pressure influence how and why AI is integrated in CSR initiatives.

Lindex recognized that Sweden is particularly advanced in sustainability practices and public awareness. According to Respondent 1: *“In Sweden, sustainability is not optional, is something expected by customers and the whole society”* (Interview 1, 24/03/2025). Respondent 1 stated that the high level of societal and regulatory pressure towards sustainability encourages companies to invest early in technologies such as AI to meet the expectations. In Lindex CSR initiatives are part of the internal culture and the interview emphasized that this is given also by the fact that all the country is oriented toward sustainability. In addition to this, Respondent 1 noted that some suppliers from other regions sometimes have more difficulties in providing the data needed to analyze the overall supply chain emissions. This creates some geographical inconsistencies because Respondent 1 also pointed out that other suppliers from other regions are more advanced in providing reliable data.

Similarly to Lindex, H&M emphasized the role of the Swedish and Scandinavian leadership in sustainable innovation. Respondent 2 stated: *“Scandinavia is very advanced in sustainability compared to other regions, this gives us a great push to find sustainable solutions in our production”* (Interview 2, 26/03/2025). Respondent 2 observed that the role of the government is fundamental in sustaining sustainable practices and H&M continue to innovate to meet the government and customers expectations. Respondent 2 also observed that other markets are still developing in this area, especially in initiatives such as supply chain transparency and emissions reporting. However, the respondent highlighted that the global consumer expectations toward sustainability are rising rapidly

and also companies that were less prone to sustainability practices are improving and closing the gap with different CSR initiatives.

At Bestseller, that has the headquarter in Denmark, Respondent 3 identified Scandinavia as a region with high sustainability standards and great will to sustain innovations. For these two reasons, Respondent 3 identified Scandinavia as a perfect place where to develop AI applications in CSR initiatives. Regarding this Respondent 3 stated “*The Nordic markets are ahead in terms of openness to digital solutions and sustainability issues*” (Interview 3, 26/03/2025). Bestseller has experienced a faster AI implementation in countries with advanced digital infrastructure and sustainability awareness. Also in this case, the respondent highlighted that supplier locations influence AI effectiveness. In particular, Respondent 3 stated that some of Bestseller suppliers are in regions where digital maturity is lower and this affects the quality of data that the company use in their AI platform. This challenge is being solved through external pressures, such as EU regulations, that are driving improvements in other countries and so across the supply chain.

In contrast to the Scandinavian firms, the Italian companies reported progress in sustainability strategies but still not at the level of the main sustainable countries. Gucci, that operates under the Kering Group, reported that Italy’s progress in sustainability strategies is evolving. In particular, Respondent 4 stated: “*We see growing attention to sustainability in Italy, but also according to the charts we are not yet at the level of the top sustainable countries, such as the Scandinavian*” (Interview 4, 28/03/2025). Respondent 4 explained that while Italian consumers increasingly value sustainability, the national regulatory pressure is more permissive at the moment, to sustain also the small and medium enterprises. Gucci benefits from Kering’s group approach which pushes towards high sustainability standards. Respondent 4 highlighted that Gucci’s approach toward sustainability is intensifying in recent years to reach the standards imposed by the group and reach the consumers that are sustainability-conscious, but the government does not have a great impact on pursuing this strategy.

At Benetton, also based in Italy, Respondent 5 evidenced the regional disparities that are present in both sustainability focus and AI readiness. Regarding this, Respondent 5 stated: *“There are markets like the Northern Europe that are more mature in both digital adoption and sustainability standards, because they are incentivized in reaching these goals [...] in Italy this approach started later and now we are far from them”* (Interview 5, 01/04/2025). The respondent highlighted that these initiatives were important in Northern Europe countries much earlier than in Italy, so the companies had an advantage in terms of time to develop more sophisticated technologies and CSR initiatives. However, despite this, according to Respondent 5, the Italian companies are growing in environmental awareness and digital transformation narrowing the differences. Benetton, to accelerate its progress is leveraging on external partnerships that are helping in reaching high sustainability and digital standards.

Finally, Radici Group, another Italian-based company, observed similar regional contrasts, but Respondent 6 highlighted mainly the differences between Europe and other parts of the world. Respondent 6 explained: *“European customers are much more demanding when it comes to verified sustainability data, but other parts of world, like China, care less about this”* (Interview 6, 03/04/2025). These greater external pressures that are present in Europe motivate Radici Group to advance in their sustainability initiatives. In addition to this, Respondent 6 noted that the market regulation in Europe is more developed than in some non-European countries, which influences the pace of innovations. An example is the regulation regarding products environmental footprints, this drives companies to invest more to find solutions to meet these requirements. To conclude, for Respondent 6, the regulation is helping in pushing companies to find innovative solutions for the environmental problem.

In summary, across the six companies, there is a shared perception that Scandinavia is a leading region in sustainability and digital innovations. The main drivers evidenced from the respondents that brought Scandinavian countries to be leaders were higher customer expectations, stricter regulations and stronger digital infrastructures. The Italian companies stated that the Italian market is evolving with an increasing attention to sustainability and improvements in digitalization, this is possible through external

partnerships and internal strategies focused on achieving these goals. Overall, the companies recognized a global trend toward sustainability and digitalization, and the disparities between countries are working out.

Table 9: Perceived Differences across Countries in the implementation of AI in CSR initiatives

Company	Perceived differences across Countries
Lindex	Scandinavia leads in sustainability awareness and digital maturity; supplier data quality varies by region
H&M	Northern Europe ahead in transparency and innovation; other regions are catching up due to rising consumer demand
Bestseller	Nordic countries show high readiness; digital maturity of suppliers varies across regions
Gucci	Northern Europe more advanced; group-level standards ensure alignment in less mature markets
Benetton	Northern markets more mature in both sustainability and digitalization; growing awareness in Southern Europe
Radici Group	European clients demand stronger verified data; regional regulations shape investment pace

To conclude the chapter, a summary table of the main findings that emerged from the interviews is presented.

Table 10: Summary of the main Findings

Company	AI application in CSR	Implementation Approach	Motivations for AI in CSR	Impact on Competitive Advantage and Performance	Challenges and Barriers	Future Investments and Strategies	Perceived differences across Countries
Index	Demand forecasting and size prediction to reduce overproduction and waste	Hybrid: Internal deployment + external tech support for AI forecasting tools	Reduce overproduction and the overall environmental footprint; improve efficiency	Improved forecasting and reduced overproduction and wastes; enhanced brand reputation for efficiency and environmental responsibility	Limited data availability and inconsistent supplier data; required stronger supplier collaboration and external tech support	Further AI development for forecasting; investment in 3D body scanners to reduce returns and environmental impact	Scandinavia leads in sustainability awareness and digital maturity; supplier data quality varies by region
H&M	Textile sorting use of AI for recycling and real-time sustainability reporting	Internal AI development + collaboration with suppliers and research institutions	Enable circularity, improve recycling systems and increase real-time reporting	Higher material recognition in recycling initiatives (96% more precise); improved reporting speed and accuracy; increased leadership in sustainable initiatives	Complex data integration across global suppliers; need to build internal trust in the use of AI insights; addressed through centralized systems and employees training	Scale AI textile sorting to handle more materials; enhance real-time monitoring across more suppliers for supply chain transparency	Northern Europe ahead in transparency and innovation; other regions are catching up due to rising consumer demand
Bestseller	The platform Fabric.ai is used to plan collections accurately and reduce overproduction	Joint development with IBM; operated and refined internally	Improve planning accuracy, reduce waste and align product design with demand	Improved collection planning; reduced surplus; enhanced market responsiveness; brand aligned with responsible production	Ensuring sustainability priorities were included in AI decision models; required continuous updates and model alignment with ESG goals	Expand Fabric.ai to include more environmental metrics; extend AI use into logistics optimization	Nordic countries show high readiness; digital maturity of suppliers varies across regions
Gucci	Inventory optimization and transport logistics to reduce emissions waste	Adaptation of centralized Kering tools with brand-level internal customization	Limit inventory surplus, lower emissions from logistics and align with group's ESG targets	Optimized inventory and logistics; reduced emissions and operational waste; supported sustainable luxury positioning	Adapting group-developed AI tools to Gucci specific operations; internal change management and training to align tech with luxury standards	Advance logistics optimization; explore AI for product traceability and environmental transparency	Northern Europe more advanced; group-level alignment in less mature markets
Benetton	AI-based energy management system in retail stores to cut energy consumption	Developed with tech providers; operated in-store by internal staff	Reduce store energy consumption and operational waste	Achieved 20% energy savings in its retail stores; operational cost reduction; improved environmental performance; enhanced responsible brand image	Technical issues in sensor calibration and real-time responsiveness; required external tech partnerships and internal upskilling	Expand AI energy management to more stores; explore predictive maintenance for store infrastructure	Northern markets more mature in both sustainability and digitalization; growing awareness in Southern Europe
Radici Group	Real-time monitoring of emissions, resource use and supply chain traceability	Internal development + academic and technical partnerships.	Enhance emissions tracking, support compliance and increase supply chain transparency	Real-time emissions tracking and traceability improved client trust and regulatory compliance; supported industrial reputation in sustainability	Managing complex industrial data in real-time; ensuring cybersecurity and cross-functional collaboration between departments; solved through collaborations with specific research centers and cross-departmental teams	Enhance lifecycle tracking using AI; deepen AI-IoT integration for supply chain transparency	European clients demand stronger verified data; regional regulations shape investment pace

5. Discussion

After the Findings' chapter, it is essential to provide a discussion section where what emerged from the interviews is analyzed through the theoretical framework. In this chapter all the Findings reported in chapter 4 will be reviewed through the framework to arrive to have an answer for the research question.

5.1 From CSR to Strategic CSR: The Role of AI in the Evolution of Corporate Sustainability

The findings revealed a clear transition, among the interviewed companies, from traditional and compliance-oriented Corporate Social Responsibility initiatives to more integrated and strategic CSR models. In these new models of CSR initiatives, sustainability is no longer seen as an obligation but as a key driver for competitive advantage and long-term value. This shift aligns with the theoretical framework part of Strategic CSR. According to Sahu & Pratihari (2015) the strategic CSR explain that firms do not just react to external pressures, but they incorporate CSR initiatives into their core strategy to address societal and environmental goals and contemporary pursue business objectives.

Across all companies, CSR was described as an important part of the corporate operations, not limited just to few departments. This is particularly evident among the Scandinavian companies, where sustainability was reported as being integrated across all business units. Respondent 1 from Lindex reported that sustainability is part of the company's identity and is something that is present across all departments. Similarly, Respondent 2 from H&M explained that sustainability and the CSR initiatives are not something separated from the rest but is something integrated in every function. From these interviews emerged a strategic CSR mindset in which sustainability efforts are coordinated across all the functions and contribute in reaching corporate goals such as circularity, transparency and efficiency.

A more structured and often centralized approach was observed in the Italian companies, particularly in those operating under a group governance model. For example, Gucci, that

is part of the Kering Group, follows group-level ESG standards and adapts its CSR initiatives to the specific needs of a luxury company. So, the firm has some goals to achieve and then is free to choose in which way arrive to those objectives. In companies like Benetton and Radici Group, CSR initiatives are also prioritized, but the integration is often concentrated in specific departments or projects. An example is the Benetton's project in its retail stores to avoid wastes of energy and useless emissions. However, also in these cases where the CSR initiatives are present in specific projects or departments, sustainability is directly aligned with corporate strategy and operational planning. Radici Group, in fact applies CSR principles directly into product lifecycle and includes environmental data in the managerial decisions. According to Atiq & Karatas-Ozkan (2013) this integration of social and environmental responsibilities in the strategy of the companies is part of the strategic CSR approach, where the initiatives are not seen as a one-time project, but they are integrated in the long-term strategy.

This strategic orientation toward CSR initiatives has transformed how companies approach sustainability, but the AI applications brought also to operational efficiency and cost optimization. From the interviews, it emerged that AI applications are the main way in which the companies are integrating CSR initiatives into their strategy. Companies are leveraging on AI applications to embed CSR into operational workflows, resulting in quantifiable cost reductions. So, the integration of CSR initiatives into the overall companies' strategy is a way to gain advantages also in terms of cost reduction and operational efficiency. For example, Benetton reported a 20% decrease in energy consumption at its Florence store due to AI-enabled environmental controls that directly reduced utility costs. Similarly, Bestseller's Fabric.ai was adopted not only to meet sustainability goals but also to increase the accuracy in collection planning, reducing overproduction and minimizing losses from unsold inventory. These examples demonstrate how CSR, when driven by AI, becomes a source of economic value for the companies and not a cost to sustain. This approach reflects exactly the strategic CSR approach evidenced by Sahu & Pratihari (2015), where sustainability initiatives are part of the corporate strategy and are not just a cost to sustain.

In the case of H&M, AI-driven textile sorting and material recognition have enabled more efficient recycling systems that reduced the reliance on new materials and improved resource circularity. Lindex emphasized that AI-supported forecasting systems helped the company in reducing wastes and improving size allocation, this lowered the environmental impact and also returns logistics that represented a cost for the company. These efficiencies highlight how sustainability and economic performance can reinforce each other when CSR is integrated strategically and supported by digital technologies such as AI.

In addition to these initiatives, the interviews showed how AI applications in CSR initiatives brought also to broader corporate identity and purposes. For example, Lindex emphasized a strong commitment to gender equality and women's empowerment, while H&M and Benetton focused on fair labor practices and responsible sourcing. Radici Group and Gucci emphasized worker safety and training, showing a social responsibility in addition to the environmental that is more integrated in the organization. The insights confirm the expansion of CSR initiatives through AI applications beyond simple environmental concerns into a broader strategic perspective that includes also social dimensions.

To conclude, the findings support the concept that the different AI applications utilized by the companies are a strategic enabler of the CSR transformation from a compliance to a strategic perspective. The use of AI reinforces the integration of CSR initiatives in the business functions and supports a long-term sustainability planning, aligning with the core idea of Strategic CSR theory. All the interviewed companies demonstrated a movement from CSR as a compliance mechanism to a strategic function that supports value creation.

5.2 AI as a Strategic Resource: A RBV Perspective

It is important to understand the strategic value of the AI applications in CSR initiatives, the Resource-Based View explains why these technologies are fundamental in the manufacturing companies. The integration of AI applications into CSR initiatives among the interviewed companies aligns with the assumptions of the Resource-Based View.

According to Barney (2001), a firm achieves sustained competitive advantage when it possesses resources that are valuable, rare, inimitable and non-substitutable (VRIN). In this context, the different AI technologies and systems deployed by the six manufacturing companies are used not just as technological tools but as strategic assets to help the firms to create value, increase efficiency and differentiate on the market.

Across all the interviews, it emerged that AI-supported CSR initiatives such as demand forecasting, inventory optimization, real-time emissions tracking and supply chain traceability were shown to generate not only environmental benefits but also operational and financial advantages. These AI applications are developed by the companies mainly through partnerships to reflect the internal capabilities, values and organizational structures of each firm, making them highly context specific. For example, Bestseller's Fabric.ai platform, developed in partnership with IBM, has evolved in a tool internally refined that integrates environmental metrics into collection planning decisions. The platform is based on Bestseller's specific product cycles and sustainability strategy and so it satisfies the RBV condition of resource specificity and integration developed by Barney (2001).

Another example is the one of Radici Group, the company leverages sophisticated combinations of AI and IoT to monitor resource use, emissions and supply chain traceability in real-time. This technology helps Radici Group for internal efficiency and external ESG communication, supporting a regulatory compliance and transparency. The application is essential in forecasting the environmental production impact and anticipate potential risks before they happen. These capabilities are not easy to replicate from other companies, as they depend on unique combinations of technical infrastructures, combination of different experts and cross-functional coordination. The interviews with the six manufacturing companies evidenced that each AI application is different from the others and was implemented in different ways, making them a complex mix of tangible and intangible resources that is not easy to replicate.

Another dimension of value emerges from the multifunctionality of AI applications in CSR initiatives. In different cases, AI systems were shown to increase economic

efficiency and at the same time environmental performances. A numerical example was given by Benetton's AI-based energy management system that resulted in a 20% reduction in energy consumption in its Florence store. This translated in cost savings and measurable environmental outcomes that contribute to Benetton's positioning as a responsible brand. These outcomes are consistent with the Resource-Based Theory's perspective that competitive advantage is not limited to financial metrics, but it can be evaluated also from the ability to address multiple stakeholders' needs more effectively than competitors (Peteraf 1993).

AI technologies gain strategic value also when they are utilized into organizational processes and learning routines, becoming part of the firm's dynamic capabilities. According to Teece et al. (1997), dynamic capabilities represent the firm's ability to integrate and rearrange internal and external competences to address rapid changes in the market's environment. In the case of H&M these capabilities are evident, since their AI application is used for real-time sustainability reporting and increasing recycling through their automated sorting systems. The ability to integrate AI into circular economy strategies reflects a firm-level capability to innovate and respond to the evolving market needs. This integration is a strategic capacity to turn environmental goals into operational practices.

Another important aspect of the RBV framework is the difficulty of imitation in order to achieve a sustainable advantage. All the companies demonstrated that their AI systems are tailored to their specific business models, making them difficult to replicate for competitors. An example of this is given by Gucci, in this case the company had an AI platform created by the group Kering for inventory and logistics optimization. Despite having this core technology created by the group, Gucci decided to modify the AI app to suit its specific needs. This is given by the fact that Gucci's implementation is closely aligned with its luxury brand identity and market positioning that is different from another company of the group. This example demonstrates the specificity of each AI application that are different based on the companies' specific needs. Each of these applications is really difficult to imitate due to the mix of resources that is needed to implement them. Another important aspect that makes AI applications in CSR a resource difficult to imitate

is the cumulative knowledge that companies develop through the implementation process. An example is given by Lindex's AI systems for size prediction and demand forecasting that are based on years of data collection, refinement and internal expertise. This accumulation of organizational learning makes the resource harder to copy, in line with the Resource-Based View perspective.

It is also important to consider that these AI applications are often complemented with other organizational resources, such as supplier relationships or sustainability reporting structures, so usually they are utilized with other tools. The synergy between these elements creates a resource co-specialization, where, according to Kim et al. (2019), the value of a given asset (AI applications) depends on its interactions with the firm-specific capabilities. An example is given by Radici Group's integration of AI with IoT that allows the company to trace emissions and ensure transparency in its sustainability reporting. In this case the AI application is integrated with other resources of the company and together they create more value.

To conclude, from the analysis of the interviews it emerged that AI applications, when integrated in CSR strategies, respect all the RBV criteria. The AI applications are valuable since they help in increasing sustainability and efficiency; rare due to the firm-specific ways it is developed and applied; inimitable because they rely on internal knowledge and data; and non-substitutable as few other tools can offer similar capabilities. In addition to this, the dynamic nature of these AI applications highlights their role as strategic tools to adapt to the evolving market's needs.

5.3 Stakeholder Influence and Institutional Context in Driving AI for CSR

Another important topic that emerged from the findings of this study regards the stakeholder influence in the adoption of AI applications in CSR initiatives. From the findings it can be seen that stakeholder pressures, including mainly customers, investors and policymakers, have played an important role in driving companies toward the adoption of AI to meet sustainability challenges. This confirms the assumptions of

Stakeholder Theory (Freeman et al. 2010), which states that firms must actively manage relationships with a wide range of stakeholders to maintain legitimacy, ensure resources and achieve success on the market. Across the interviewed companies, stakeholder influence, in particular regulation, emerged as a starting point that directly affected the implementation and strategic integration of AI in CSR initiatives.

All the different Respondents emphasized that the adoption of AI technologies to meet CSR initiatives was motivated by the need to respect the growing external expectations for transparency and measurable environmental and social impacts. From the interviews some differences emerged between the Scandinavian and the Italian companies. In Scandinavia, the stakeholder pressure for sustainable processes and products helped the firms in implementing new strategies, but the companies were already adopting sustainable practices. In this case, Scandinavian companies stated that sustainability is part of their culture and that the stakeholder pressure was complementing their approach. In the Italian situation, the three firms highlighted that before the stricter regulation regarding sustainable practices, their approach was less focused on this topic and only after that they started to think about a different approach. So, the two cases were different, in the first case the regulation helped in achieving an already existing sustainable concept, while in the other case the regulation changed completely the way in which the companies are working.

The type of stakeholder exerting pressure varied depending on the sector and market positioning of each company. In the Scandinavian companies, so Lindex, H&M and Bestseller, consumer expectations were identified as a particularly strong driver for increased sustainable practices, since they are very concerned about sustainability. In these cases, AI applications were seen as a mean to increase responsible production processes, improve product traceability and meet the demand for sustainable fashion options. Regarding this, H&M highlighted the importance of providing real-time sustainable data and the fact that AI is giving them the ability to respond to this need. Lindex emphasized the fact that in Scandinavia sustainability is not optional and is expected both from the costumers and the company. So, satisfying consumer expectations for responsible practices is essential not only for reputational reasons but also to

demonstrate the efforts that the companies are putting on that and maintain the market position.

For the Italian companies, so Gucci, Radici Group and Benetton, stakeholder influence was more exerted by regulators and investors. This because the sustainability regulations forced the companies in changing the way in which they operate and the same with investors that are investing more in sustainable companies. In these contexts, the AI solutions were implemented mainly to ensure compliance with the evolving environmental regulations and to meet the demand of environmentally conscious investors without lose in efficiency. From the interviews it emerged that the European environmental policies and the evolving standards for reporting emissions and traceability influenced the decisions to develop AI digital monitoring systems. This approach toward sustainability initiatives derived initially from these necessities to meet stakeholders' necessities, but now the companies have internalized the practices and are implementing actively new sustainable strategies, like the Scandinavian firms.

The findings show that, after adapting to sustainability regulations, all the six companies today are strategically implementing CSR initiatives in their organizational strategies, so they are not just passively responding to regulation. In most of the cases, the AI adoption emerged as an opportunity to adopt CSR strategies in an efficient way and improve brand reputation. H&M and Lindex particularly used stakeholder-driven pressures as a way to position themselves as leaders in sustainable innovation, integrating AI into core decision-making processes such as demand forecasting or textile recycling. This proactive interpretation of stakeholder demands aligns with the Stakeholders Theory's view that effective stakeholder management is not only reactive but involves anticipating expectations and a flexible organizational strategy (Freeman et al. 2010).

Another important point regards the interaction between stakeholder necessities and internal operational goals, this generated synergies that reinforced the strategic role of AI applications in CSR initiatives. The interviewed companies tried to conciliate the external stakeholder expectations with the internal benefits. The investments made in their personal AI applications resulted in good initiatives to meet CSR initiatives and

contemporary reduce wastes, lower operational costs or improve the resource allocation. Bestseller, for example, explained that their Fabric.ai platform enable a better alignment between production and the actual market demand, reducing overproduction costs and increasing the environmental performance. This convergence of stakeholder demands with operational efficiencies reflects Freeman et al. (2010) argument that managing stakeholder relationships can contribute to value creation for the firm.

In conclusion, it can be seen that the findings provide a strong support for the main concept of the Stakeholder Theory: that stakeholder pressures are complementary to corporate decision-making and a fundamental force that shapes the strategic choices. The interviewed companies, actually, are utilizing different AI applications in CSR initiatives and not just to comply with the external demand but to actively use these pressures as opportunities for differentiation and efficiency. These innovations emerge as a strategic response to the evolving stakeholder expectations in an increasingly transparent and sustainable environment.

5.4 Organizational Capabilities and Implementation

Approaches: How companies adopt AI in CSR

Understanding how the interviewed companies adopt AI in their CSR initiatives is a critical point of the study. The adoption of Artificial Intelligence within Corporate Social Responsibility initiatives among the interviewed firms demonstrates an important role of organizational capabilities and strategic decision-making. From the findings it emerged that the companies did not treat their AI applications as a generic solution, but its adoption is approached through careful alignment with internal competencies, operational priorities and sustainability goals. This strategic behavior aligns with the principles of the Resource-Based View which, according to J. Barney (1991), emphasize that a sustainable competitive advantage is built on the firm's ability to develop, integrate and adapt valuable, rare and inimitable resources.

A key distinction observed across the companies concerns the degree to which AI development was internalized or outsourced through partnerships. H&M and Radici

Group demonstrated a strong orientation toward internal development. H&M invested a lot in building its internal AI capabilities, and to do that the company created structures like the “Responsible AI” framework to ensure that technological innovations were ethically governed and directly integrated with the corporate sustainability goals. The main H&M investments were on AI systems for textile sorting and real-time reporting and they were developed internally to increase the operational transparency and ensure compliance with stakeholder expectations. Radici Group, similarly to H&M, emphasized internal expertise in the design and management of the AI application to monitor emissions in real-time and have a transparent supply chain. The difference between H&M and Radici Group is the fact that Radici Group partnered with research institutions to complement internal skills with expert knowledge. These two cases demonstrate that the firms that are pursuing an internalization of AI capabilities are well positioned to maintain control, ensure strategic alignment and protect the resource from the competitors. This approach is strongly aligned with the RBV perspective on a prevalent internal development of the main strategic resources.

However, in other cases the development of AI applications to pursue CSR initiatives is not always possible through only internal capabilities, in those cases a different approach is needed. Some companies can completely outsource the development of the AI application and the adaptation to the CSR initiatives. Other companies, such as Bestseller and Benetton pursued a hybrid approach that combined external expertise with internal strategic control. Bestseller’s collaboration with IBM to develop the Fabric.ai application highlights how external technological capabilities were leveraged to accelerate the development process. Bestseller is utilizing the Fabric.ai application to plan the production and avoid wastes and overproduction, in this way a great number of emissions and also costs is avoided. To achieve a good result in the utilization of this AI platform, however, the technical collaboration to develop the application is not enough, in fact an important role is played by Bestseller’s internal teams that had to use the application once it was developed. The internal teams needed to adapt their work to this new technology and reflect the company’s sustainability strategy. So, the initial partnership to develop the software is important but the internal capabilities to manage the AI application is also fundamental. Benetton, similarly, engaged external technology providers to build their

AI-driven energy management system in their main retail stores, but also invested a lot in upskilling the internal staff to manage autonomously the system across different environments. These hybrid models demonstrate an approach where companies recognize the complexity and rapid evolution of AI technologies, and so they choose to combine the speed of external development with the strategic internal adaptation.

Regarding the adoption of AI in CSR initiatives a difference that emerged between the interviewed companies relates to the maturity of AI integration in the operational processes. The Scandinavian companies, like Lindex and H&M, showed a higher level of AI and sustainability maturity, where AI applications were fully developed and integrated into the operational structures and sustainability reporting. Lindex, that is using AI for demand forecasting and reduce wastes and overproduction, explained that is working on this tool from some years ago, so the system is completely integrated in the company's structure. In contrast, Italian companies like Benetton or Radici Group are still in the early stages of scaling their AI applications across multiple operational areas. For example, Benetton's AI-based energy management system was initially utilized only in the Florence store, with plans for gradual scaling based on the environmental and economic impact. Now, the company expanded the project to other important stores but is not completely fully integrated as it is in the Scandinavian companies. These findings suggests that the adoption of AI applications in CSR initiatives follows an evolutionary path, where initial pilots must be tested and adapted before a full operational integration. Across the interviewed companies all of them are adopting AI solutions in their CSR initiatives but they are at different stages of implementation, where the Scandinavian companies are few steps ahead of the Italian companies.

The findings also show that the type of AI technology selected was closely associated to each firm's operational challenges and sustainability ambitions. Companies like Lindex and Bestseller relied on machine learning algorithms integrated into software to predict demand and optimize inventory management in order to reduce overproduction and the associated environmental waste. Benetton utilized AI platforms connected to sensor networks for environmental data capture and energy optimization aiming to reduce the reduction of greenhouse emissions within its retail stores. H&M utilizes another machine

learning model to have a real-time emissions monitoring and sustainability reporting and an AI sorting system to recycle different textiles. Gucci adapted the Kering's AI platform for its personal inventory optimization and transport logistics to reduce emissions and energy consumption. Radici Group combined machine learning, predictive analytics and IoT systems to enable a real-time production monitoring, emissions control and supply chain transparency. These different approaches highlight that companies do not implement AI in a generic way, but the applications are strategically selected and adapted to fit the sustainability and operational objectives.

In the success of the application of AI in CSR initiatives, according to the interviewed companies, an important role has been played also by the organizational change management. The main example was provided by Gucci that is operating in a larger corporate group, Kering. Gucci reported significant efforts to adapt a centralized AI tool developed by the Kering group to the specific requirements of their brand identity and operational model. The main challenge faced by Gucci was to ensure that the AI system for logistics and inventory optimization were compatible with its brand standards and seasonal production cycles. To address this, internal training programs and communication initiatives across departments were launched to promote a cultural acceptance of the AI platform and a strategic alignment with sustainability initiatives. This example confirms that having an AI technology is not sufficient to develop an advantage, to create a strategic value is important to build together with the technology an organizational acceptance and capability to adapt operational routines and processes.

Another important consideration that emerged from the findings is that companies that adopted AI applications for CSR initiatives were not only prepared technically but also strategically. The AI applications utilized are not just something done to be aligned with the current innovations but are something adopted to reinforce the environmental impact of the company and contemporary increase the operational efficiency. The interviewed companies achieved this alignment and together with the technological investments they invested also in technical infrastructures, talent development, internal governance structures and cross-functional coordination to manage everything in the best possible way.

This comprehensive adoption of AI in CSR initiatives supports the RBV framework that emphasized the importance of align all the company's strategy to the valuable resources.

In conclusion, the findings show that the effective adoption of AI applications in CSR initiatives needs more than just an investment on the technology. It necessitates a development of internal capabilities, careful management of external collaborations and internal resources, a strategic approach toward the operational processes and a cultural alignment with the organization. The interviewed companies understood that the integration of this new technology is dynamic and not just a static tool, in this way they are implementing their own AI applications to achieve a sustainable leadership and competitive advantage. When AI is implemented strategically, becomes a key resource to integrate CSR into the core organizational practices, to support environmental responsibilities and business needs.

5.5 Outcomes and Value Creation through AI-Driven CSR

From the findings of the study, it emerged that the integration of AI applications into CSR initiatives has generated tangible and intangible outcomes for the interviewed companies. This strategy brought to advantages in terms of sustainability performance and also operational efficiency, cost reductions and brand image. These results align with the strategic CSR theory and what Sahu & Pratihari (2015) analyzed in their study, arguing that CSR activities, when incorporated into core corporate strategy, are able to create societal value and contemporary strengthen a firm's competitive position. The findings also align with the Resource-Based View, because they show how AI-enabled CSR initiatives can become specific capabilities for each firm that contribute to sustain a competitive advantage.

The main outcome that derived from the interviews with the companies was the improvement in operational efficiency through the application of AI applications in sustainability practices. For example, Lindex and Bestseller reported that their specific AI systems for demand forecasting and size prediction brought to significant reductions

in overproduction. This result enabled a better inventory management and minimized the environmental waste connected to products not sold. Lindex explained that their AI tool allowed the company to allocate products more accurately across markets and so reduce the need for costly returns and avoid the costs related to manage a big inventory. Similarly, Bestseller, through the utilization of their Fabric.ai app, aligned the production volumes with the actual market demand, in this way they avoided financial and environmental costs associated with excess production. These operational improvements align with the RBV perspective that the internal capabilities are a valuable strategic asset, since they are able to increase efficiency and contemporary the environmental performance.

Another important outcome that derived from the application of AI in CSR initiatives is energy optimization. Through the interviewed companies, Benetton achieved a 20% reduction in energy consumption in its main retail stores. The AI-based energy management system produced both cost savings and significant decrease in the store's carbon footprint. This outcome achieved by Benetton demonstrates how AI applications can directly increase the sustainability of physical retail operations while offering measurable economic benefits. Achieving operational benefits through environmental initiatives reinforced Benetton's position as a socially responsible brand without compromising the financial performance.

The use of AI for real-time environmental monitoring also created new sources of value. An example is given by Radici Group, the company integrated AI with IoT technologies to monitor in real time the emissions and provide verifiable data to all the interested stakeholders. This capability helps the company in complying with the stringent European environmental regulation and contemporarily increasing Radici Group's reputation as a transparent firm. The ability to offer real-time and monitored data has become fundamental in maintaining the trust of the customers. This initiative illustrates how AI-driven CSR initiatives can increase business reliance and customer trust. In the case of H&M, its AI systems enabled the company to improve its material sorting capabilities in the recycling initiatives. Through its AI application the company achieved a 96% accuracy rate in textile recognition, in this way the broader circular economy strategy is better supported. This technological advancement, in fact, improved the recyclability of

materials and reduced the dependency on virgin resources. At the same time, this application helps in positioning H&M as an innovator in sustainable fashion, reinforcing its brand identity. Also Gucci improved its market differentiation and sustainability reputation through its AI system applied in CSR initiatives. The company is able to track and predict transportation logistics in a way to minimize the emissions, in this way Gucci increased both its operational investments and the environmental impact.

From the interviews it emerged that the CSR initiatives that are possible through AI applications contributed to risk mitigation. The companies are able to improve the ability to anticipate regulatory changes and stakeholder demands through AI's predictive analytics. The real-time and historical data collection and the automated reporting allowed the interviewed companies to predict possible trends and adapt rapidly to new market standards. In this way is possible to reduce risks connected to non-compliance penalties, reputational damages or market exclusion. These dynamic capabilities enabled by the strategic use of AI increase the overall organization agility and contribute to the sustainability of a competitive advantage.

From the interviews with the manufacturing companies, an important dimension of the value creation concept emerged. The Respondents highlighted that the integration of AI applications in CSR initiatives incentivized new skills, cross-departmental collaborations and an innovation culture inside the company; these outcomes are part of the internal organizational learning concept. The companies through this innovation gained also internal advantages related to a more innovative and flexible structure. The main example emerged from Benetton and Gucci's upskilling initiatives for managing the AI-based systems, in this way not only the operational performance is improved but also the human capital and internal technological knowledge. These outcomes reinforce the benefits brought by the idea of a CSR-driven innovation that is able to generate also related positive effects across different organizational aspects, supporting not only environmental efforts but also social and economic value creation.

In conclusion, the findings confirm that AI-driven CSR initiatives are bringing multiple form of value for companies, the main are improved operational efficiency, reduced

environmental impact, costs reduction, increased stakeholder trust and brand reputation and a smarter organizational approach. These outcomes show that when CSR initiatives are integrated strategically with AI applications, the result is a source of competitive advantage and not just a compliance-oriented approach. In doing these initiatives, firms did not just respond to external pressures, but proactively sustained their market positioning and success, confirming the interdependence between a sustainable approach and a strategic business performance.

5.6 Strategic Outcomes: The Link Between AI-Driven CSR initiatives, Firm Performance and Competitive Advantage

From the findings of this study, it can be clearly demonstrated that the integration of AI applications in CSR initiatives have a great impact not only on companies' operational processes and environmental impact but also on their overall firm performance and the ability to achieve a competitive advantage. This outcome supports the assumptions of the Resource-Based View Theory and the Competitive Advantage framework which, according to Sugiarno & Novita (2022), posits that a sustained competitive advantage emerges from the possession and strategic utilization of resources and capabilities that are valuable, rare, inimitable and non-substitutable. From the interviews with the six manufacturing companies, it can be seen that AI-driven CSR initiatives have become more than just an instrument for regulation compliance; they have transformed into a strategic resource. The AI applications adopted in CSR initiatives are improving efficiency, increasing reputation and stakeholder trust, and position firms advantageously in their market.

Regarding the operational improvements, AI applications in CSR initiatives brought substantial efficiency gains and cost reductions and contribute to improve the overall firm performance. Two main examples are given by Bestseller and Lindex, the two companies reported measurable outcomes from implementing machine learning tools for demand forecasting and size prediction. These applications helped the firms to optimize the

production and so reduce overproduction, reduce inventory levels and minimize the unsold products, the result is a great benefit for the financial performance and the environmental impact. Lindex emphasized that their specific AI tool enables a smarter allocation of resources across markets, and so reduces logistical costs and increases operational responsiveness. Bestseller has its own AI system called Fabric.ai, through this application the company improves the collection planning accuracy, reduces wastes and aligns production volumes with the real market demand in this way is easier to control the margins associated with production.

Another important outcome that contributes to firm performance and generates a competitive advantage is the energy efficiency related to the utilization of AI applications. The main example is given by the Benetton's AI-based energy management system, which achieved a 20% reduction in energy consumption in its main retail stores. This AI application enabled the company to achieve tangible results in terms of sustainability and financial savings. This dual impact on sustainability and financial aspects is explained through the Strategic CSR framework illustrated by Sahu & Pratihari (2015), where environmental responsibilities and economic value creation are interdependent strategies that reinforce one another.

According to Porter (1985), other two important dimensions of competitive advantage are market differentiation and brand reputation enhancement, the strategic utilization of AI in CSR initiatives includes these two objectives and extend beyond simple operational improvements. From the findings it emerged that companies such as H&M or Radici Group utilized their AI applications to meet and also exceed stakeholder expectations for transparency and traceability. H&M achieved quantifiable results through its AI based material recognition system, that improved the efficiency of its recycling initiatives with an increased 96% in the accuracy rate of the material recognition. Thanks to this innovative solution, the company is able to improve its circular fashion initiatives and. In addition to this, H&M increased also its reputation among the stakeholders as an environmentally friendly firm, creating barriers for competitors less capable of integrating sustainability at such operational and technological depth. Radici Group utilizes a combination of AI and IoT technologies for real-time emissions monitoring to

reduce emissions and increase transparency toward all the interested stakeholders. The company, through this application positioned itself as an industry leader in traceability and ESG compliance, reinforcing its competitiveness in a market where the demand for sustainable practices is increasing. Another example is given by Gucci that adopted the AI application developed by the group Kering to its specific needs. The company reduced the overall emissions related to logistics and production and contemporarily minimized the costs associated to them.

These outcomes evidence that the use of AI applications in CSR initiatives satisfy all the dimensions of the RBV framework. They are valuable, because they improve environmental and operational performance simultaneously; rare, since it is complex to integrate AI effectively into the organization and specifically in sustainability practices; inimitable, due to the unique internal knowledge, the organizational processes and stakeholder relationships that are needed to develop them; and non-substitutable, because there are few alternative approaches that offer equivalent results in terms of transparency, efficiency and strategic reputation. With the integration of AI applications in CSR initiatives, the companies have created dynamic and hard to replicate capabilities that increase their strategy and competitive advantage. In addition to this, the findings suggest that the companies' success in utilizing AI for CSR outcomes depended highly also on their ability to adapt and manage their resources in response to the changing environmental, regulatory and market necessities. The interviewed companies demonstrated an ability to evolve their AI platforms over time to incorporate new data sources, improving predictive algorithms and adapting their systems to new necessities. This approach is reflected in the dynamic capabilities concept evidenced by Teece et al. (1997), that explains the companies' ability to continuously adapt its resources to meet the changing market needs. This dynamic capability approach, utilized by the manufacturing companies in the implementation of AI applications in CSR initiatives, reinforced the ability to adapt to the evolving regulatory, customer and market expectations, offering a clear way to achieve sustainable performance advantages.

Another source of competitive advantage and strategic value that is given by the utilization of AI applications in CSR initiatives is risk mitigation. With the adoption of

these AI systems that are capable of real-time data collection, predictive environmental monitoring and automated reporting, the firms reduced their exposure to compliance risks or market predictions errors. In today's business environment, the ability to have a system capable of predicting the demand of products and contemporary provide real-time emissions data is a source of great competitive advantage. In addition to this, the ability to provide transparent and clear data to all the interested stakeholders is a necessity for capital attraction in an environment that is really careful to environmental necessities.

AI-driven CSR initiatives contribute also to internal organizational learning and innovation, further enhancing the firm performance. From the findings it emerged that the companies needed cross-functional collaborations, upskilling of employees and new forms of organizational integration between departments for the implementation of AI in CSR initiatives. This internal transformation process has reinforced the firms' ability to recognize, assimilate and adapt external and internal knowledge that is an essential capability to increase the long-term competitiveness.

In conclusion, the empirical findings confirm that AI-driven CSR initiatives, when strategically integrated into corporate operations, create value for the firms. In particular, from the interviews the main sources of competitive advantage that emerged are operational efficiencies, improved firm performance, increased market reputation, cost reductions, reduced regulatory and reputational risks and the development of dynamic capabilities. Through the strategic integration of AI applications in CSR practices, the companies have increased their environmental and social impact but also gained in terms of efficiency, sustained competitive advantage and superior firm performance.

5.7 Cross-Country Differences: Sustainability, Digital Readiness and Strategic Adoption of AI

The comparative analysis of Scandinavian and Italian companies in this study reveals some cross-country differences in the integration of AI into CSR initiatives. These differences are given by variations in societal expectations, stakeholder pressures, regulatory environments, culture, and levels of digital infrastructure and organizational

readiness. Despite all the interviewed companies are utilizing AI in their CSR initiatives, the findings suggest that pace, scope and strategic implementation are different and influenced by the regional contexts.

The findings revealed that in Scandinavian companies, so Lindex, H&M and Bestseller, the AI integration into CSR initiatives appeared more advanced and integrated inside the companies. In addition to this, the adoption of these initiatives is driven by a proactive strategic intent rather than just a compliance-oriented approach. Respondents from these companies emphasized sustainability is a crucial part of their cultures and operational environments and that also the consumers and all the society demand for high levels of environmental and societal responsibility. From the findings it emerged that the Scandinavian companies look at sustainability as something that is not optional but is really embedded in the whole society. These cultural expectations created an enabling environment for the early adoption and experimentation of AI technologies to support CSR. The main areas that benefit from these initiatives are circular fashion, demand forecasting, energy reduction and supply chain and emissions transparency. In addition to this favorable culture, the presence of robust digital infrastructures and internal digital maturity facilitated the integration of AI into existing sustainability frameworks. These two main factors, digital readiness and a strong environmental culture, allowed the Scandinavian companies to adopt AI technologies in CSR initiatives rapidly and in advance compared to other nations and differentiating themselves as leaders in sustainable innovation.

In contrast, the Italian companies, so Gucci, Benetton and Radici Group, approached the adoption of AI technologies in CSR initiatives through a more structured and gradual process. Despite CSR initiatives are considered strategically important in all three companies, the interviews revealed that external stakeholder pressures were less intense at the beginning, and also the overall societal sustainability expectations were less embedded compared to the Scandinavian countries. In addition to this, when the first AI technologies came up some years ago, the Italian manufacturing companies were more concentrated to other priorities and did not invest immediately on these new applications. However, the growing importance of sustainability and the help that AI can give

incentivized the Italian companies that, as demonstrated in the study invested in different CSR initiatives. Companies like Gucci, operating in the Kering Group, demonstrated that group-level sustainability strategies can act as an internal driver for innovation even when local institutional pressures are less present. Gucci is operating globally and adheres to global ESG standards that are essential to preserve their market position, so the investments in these CSR initiatives are fundamental for them. Similarly, also Benetton and Radici Group are conscious about the importance of digital tools and sustainability strategies and invested a lot on them. Another problem that the Italian companies have faced in the implementation of AI technologies was the digital readiness of the companies. In particular, great problems emerged in terms of data standardization and internal integration, as the companies was not immediately ready for these new technologies. The AI technologies adopted in CSR initiatives, in Italy, faced a gradual integration process that was slower than the Scandinavian approach, that thanks to its culture and digital readiness reached a faster implementation.

From the findings it emerged that both Scandinavian and Italian companies are adopting AI in CSR initiatives in different ways, the only differences were in the speed of integration that brought Scandinavian firms to a faster and easier approach that positions them as global leaders in sustainability innovations. This advantage is given by a more favorable ecosystem for a rapid and strategic adoption of AI, where the institutional support, strong stakeholder pressures, consumer activism and digital infrastructures helped the companies. The Italian firms are not yet at the Scandinavian levels, but they are advancing steadily by relying on corporate group strategies, external partnerships and targeted applications to bridge the gaps and accelerate the integration of AI in CSR initiatives. These differences and variations across countries highlight that the strategic use of AI in CSR is not uniform but is specific for each institutional context and national readiness for digital and sustainable transformation. These differences align also with the Stakeholder Theory framework where, according to Freeman et al. (2010), different external pressures can affect the strategies of the companies. In this case different approaches and implementation processes were adopted depending on the different pressures.

To conclude, cross-country differences in sustainable maturity, stakeholder expectations, and digital infrastructures influenced significantly the strategies through which the companies integrated AI in their CSR initiatives. Scandinavian companies demonstrated a more proactive use of AI in sustainability strategies as part of their identity, Italian companies, instead, adopted a more adaptive approach, often leveraging external collaborations or group-level governance. These differences, evidence the importance of contextualizing the digital transformation in CSR and recognize that the strategic adoption of AI in CSR initiatives is shaped by different factors, such as the socio-economic environment and the culture, and not only by the internal organization's strategy.

5.8 Overcoming Implementation Challenges and Barriers in the application of AI in CSR and Future Investments

Despite the great advantages that the companies achieved through the integration of AI applications in CSR initiatives, from the findings emerged also some challenges and barriers that the manufacturing firms encountered in the process. These challenges were different for every company since the AI applications are also different, depending on their level of digital maturity, internal capabilities and organizational structure. The main problems that the companies faced in the integration of AI applications in their CSR initiatives were related to technological adaptation, organizational changes, coordination across departments and employees and learning.

Among the interviewed companies, one of the most common challenges reported was the difficulty of data management and integration. The firms that are utilizing mostly machine learning models for market demand forecast or for real-time emissions tracking, such as Lindex or Radici Group, had problems in obtaining high-quality and standardized data across suppliers and operational systems. This problem represented a major obstacle for the effective utilization of the AI systems. In the case of Lindex, for example, to achieve an accurate demand forecasting and sustainability performance assessments, a closer collaboration with suppliers to improve data sharing and consistency was needed. In the

same way, Radici Group emphasized the problem of integrating real-time industrial data across all the production lines and departments. To solve this problem the company needed an increased internal and external coordination to ensure that their AI tool had access to relevant and reliable input data. These challenges that emerged in the data collection and analysis are given by the difficulty to align traditional CSR processes, which were often qualitative and not structured, with the quantitative methods adopted through more complex AI technologies.

Another recurring barrier that derived from the interviews was the lack of internal technical expertise and the governance of AI applications. Companies like Benetton or Gucci reported that utilizing AI in the CSR initiatives required capabilities that were not initially present in their organizations. Benetton, that is utilizing AI applications to reduce energy consumption in its retail stores, had some issues related to sensor calibration, data harmonization across stores and real-time system responsiveness. These issues faced during the implementation in its retail stores, necessitated the involvement of external technology partners. Gucci had problems in adapting the group-level AI platform to its specific needs, in particular to logistics and sustainability practices. The company required large investments in internal training and alignment to ensure that the application is utilized in a proper way by the local teams and to obtain an application that satisfy its specific needs. These challenges evidence the importance of building a proper technical infrastructure that is aligned with the companies' necessities and also to have a good organizational capacity that is able to manage and utilize AI tools in ways that align with CSR goals.

The interviewed companies also reported difficulties in achieving a full cultural acceptance and organizational alignment with the AI-driven changes in sustainability practices. For example, H&M described initial resistance from the production teams that were not familiar with AI or skeptical of automated decision-making in important areas such as sustainability reporting and material sorting or production planning. The company, to overcome this initial resistance, required internal communication campaigns, cross-functional integration and needed to build trust to demonstrate that their AI application was there to support and not to replace human expertise. This experience that

happened also in other interviewed companies such as Gucci, evidences the importance of cultural readiness in adopting AI applications. A key theme to overcome is the fear from the employees to be replaced by the AI applications, but according to the companies, these technologies are there to help in decision-making and not to replace human works. These insights evidence the fact that a successful integration of AI applications in CSR initiatives do not depend only on technical deployment.

To overcome these barriers, the companies analyzed in this study developed different adaptive strategies. One common solution, mainly related to technical problems, was to engage in strategic partnerships with external actors. The main example is given by Bestseller's collaboration with IBM to create the Fabric.ai application, this partnership allowed the company to access a world-class technical knowledge while keeping inside all the internal control over the strategic design and application of the tool. In this way the company keeps the strategic insights, that are not shared with other manufacturing companies and align with the RBV framework to make the internal resources inimitable. Similarly, Benetton collaborated with specialized technology providers to develop its energy optimization systems and align the sensors that did not work in a correct way. In other cases, mainly related to internal problems with the use of the AI application, firms developed internal governance frameworks to guide the strategic use of AI in CSR. H&M's Responsible AI Framework is a clear example of this approach, it was designed to ensure that AI systems' utilization align with the company's sustainability and ethical principles. This internal governance and control reduced the implementation risks but also helped the employees in understanding how to use this new tool and offers a transparent approach to a new technological adoption. So, governance mechanisms emerged as important tools to reduce uncertainty and build a good integration in the utilization of AI.

In addition to these strategies, to overcome the challenges and barriers that emerged, the companies invested also in organizational learning and upskilling to close internal capability gaps. The two main companies that utilized this approach are Benetton and Gucci, they emphasized that AI adoption required significant training efforts, in particular to ensure that the operational teams could manage and interpret Ai outputs, calibrate

systems and respond to real-time insights. These investments in human capital not only addressed the challenges but also contributed to create new knowledge within the company that will be useful to sustain a competitive advantage in the future. Another important aspect to consider is the fact that the gradual and iterative nature of implementation was fundamental to achieve a good result. The interviewed companies approached the AI integration in their CSR strategies as a progressive process, starting with pilot projects or targeted applications, that were expanded after the first results. An example is Benetton that initially tested its AI-based energy management system only in its Florence store; in this way the company was able to adjust technical problems or organizational routines before the expansion in other stores. This iterative approach minimizes risks and allows companies to develop internal expertise over time.

After having understood and overcome the main implementation challenges, the six manufacturing companies decided to continue in investing in such AI applications. This commitment demonstrates the fact that such technologies helped the firms in their CSR strategies, and they gained in both operational and environmental aspects. In addition to the actual strategies, all the firms are programming to continue their investments to improve their systems or, in some cases, to develop new technologies. All the companies decided to continue investing to refine their actual applications and committed to further increase their technological and organizational development in a way that the internal confidence with AI and CSR initiatives is improved. An example is given by H&M that is expanding the capacity of its textile recognition system to include a broader range of materials. Regarding the investments in new AI applications, Lindex is already investing in a new virtual 3D body scanning that would be able to improve product fit prediction and reduce return-related emissions. All these future strategies and investments confirm the fact that the implementation of AI applications in CSR initiatives is bringing value to the companies through increased environmental and operational performances. These planned investments reflect also a proactive and future-oriented mindset in which the barriers are used as inputs for continuous innovation. From these findings it emerged that the companies are developing this new resource, that according to the RBV is creating value and is essential in the actual manufacturing market.

In conclusion, it emerged that the integration of AI in CSR practices presents different technical, structural and cultural challenges, but the companies in this study demonstrated also the ways to deal with these barriers. The combination of external and internal expertise, internal training, governance frameworks and iterative approaches offer different solutions. The other important aspect is that from the challenges, new opportunities have been discovered, and the companies are continuing to invest in AI applications since they are creating value and increasing the overall performance.

6. Conclusion

After having analyzed the findings of the study through the theoretical framework in the discussion chapter, this last section of the thesis will be essential to bring together all the work. Firstly, the research question will be answered, then theoretical contribution and practical implications that derived from this study will be given. Finally, recommendations for policymakers and companies will be provided and the study limitations and future research directions will be presented.

6.1 Answering the Research Question

This thesis aimed to examine how the implementation of Artificial Intelligence applications in Corporate Social Responsibility initiatives influences the overall firm performance in large Italian and Scandinavian manufacturing companies. Through a qualitative and comparative analysis of six companies operating in the fashion and textile sector, the research investigated different aspects: how AI applications are integrated into sustainability practices, the strategic approach behind the utilization of AI resources for CSR initiatives, the barriers encountered and the resulting impact on firm performance and competitive positioning. The companies involved in the study are Lindex, H&M and Bestseller representing the Scandinavian firms, while the Italians are represented by Gucci, Benetton and Radici Group.

From the analysis of the findings, it emerged that the integration of AI applications into CSR initiatives is something that all the companies are trying to do in different ways and is becoming a strategic capability to create value in the environmental and operational dimensions. This strategy is not just a support function or a compliance driven initiative, but is becoming an important driver for performance optimization, by integrating sustainability and operational aspects. The adoption of AI tools in CSR initiatives is bringing to companies wastes reductions, lower resource consumption, efficient energy management and increased data accuracy in reporting, forecasting and decision-making. These operational improvements, that have been achieved through this strategy, resulted in quantifiable performance gains for some companies. For example, Benetton reported

a 20% reduction in energy consumption through their AI energy management system. Another example is given by H&M, that through its AI system to recognize textile materials, achieved a 96% accuracy in material recognition and increased the company's circular economy strategy. Finally, Lindex and Bestseller reported great reductions in overproduction and return rates from customers thanks to their personal machine learning-driven demand forecasting.

These outcomes demonstrate a clear link between the implementation of AI applications in CSR initiatives and firm performance. Through cost reductions and improved resource efficiency, AI applications are helping the companies with the financial outcomes and also their sustainability impact. These results confirm the importance of AI as a strategic resource, as evidenced through the Resource-Based View framework. The studied companies are developing AI applications internally or through strategic partnerships, and they are using them as technological helps in aligning their sustainability initiatives and operational workflows, making them valuable, rare, inimitable and non-substitutable resources. So, these AI systems become sources of sustained competitive advantage, especially in the manufacturing industry where environmental and operational performances are key factors to stay competitive on the market.

Another important role in the adoption of AI applications in CSR initiatives was played by the stakeholders. According to the Stakeholder Theory, companies must respond to the evolving necessities from customers, regulators and investors. The interviewed Scandinavian companies, that operate in a context where societal expectations about sustainability and digitalization are high, were found more proactive and advanced in the AI implementation for CSR initiatives. Respondents evidenced a great internal motivation to achieve better sustainability practices that was reinforced also through external pressures. In these firms AI applications are an important tool that is utilized as a great help in optimize sustainability initiatives. In contrast, Italian companies demonstrated a more structured approach, that was driven mainly by internal group-level sustainability frameworks or industrial compliance needs. These companies are highly committed toward sustainability, but their approach to AI applications in CSR initiatives was influenced more by a less favorable regulatory environment. Despite this, Italian

firms reported clear improvements in environmental performance and operational efficiency, suggesting an alignment with the Scandinavian companies and a good integration of AI in CSR initiatives that is evolving.

An important aspect that emerged from this study is that the impact of AI applications in CSR initiatives extends beyond direct environmental and operational gains. The interviewed companies reported benefits related also to organizational learning, employee upskilling and process innovation that indirectly contribute to the long-term performance. These developments increase the ability to adapt the companies' strategies to the evolving market conditions and environmental changes.

To conclude, the study highlights that the implementation of AI applications in CSR initiatives in the manufacturing sector has a positive impact on firm performance in both Italian and Scandinavian firms, with different implementation approaches. These technologies are able to improve operational efficiency, environmental initiatives and stakeholder engagement. The nature of these benefits varies across companies and countries, since it is influenced by the culture, regulation and organizational contexts. Despite this, AI applications are contributing significantly to the strategic CSR, transforming sustainability from a compliance necessity to a competitive asset integrated in the overall companies' strategy. This result found that the implementation of AI in CSR initiatives represents a shift for manufacturing companies toward an integration of sustainability in the overall strategy.

6.2 Theoretical Contribution and Practical Implications

This thesis offers important contributions to the theoretical understanding of how AI is integrated into CSR initiatives and how this integration affects the overall firm performance and competitive positioning. Through the utilization of empirical data from large manufacturing companies in Italy and Scandinavia, the research contributes also to the existing literature about Resource-Based View, Stakeholder Theory and Strategic CSR.

Regarding the RBV perspective, the findings demonstrate that the application of AI in CSR initiatives represent an opportunity for companies to evolve into valuable, rare, inimitable and non-substitutable resources. In fact, every AI application implemented is different and the application in activities such as demand forecasting, material recognition or energy optimization was not standardized or generic. These applications were adapted to the specific companies' necessities, sustainability strategies and operational environments. The specificity the different necessities contributed to the transformation of AI tools into firm-specific resources capable of delivering sustained performance advantages.

In relation to Stakeholder Theory, the thesis provides empirical results for the idea that the utilization of AI applications in CSR initiatives derive in part by the evolving stakeholder demand. The main stakeholders interested in sustainability practices are customers, regulators and investors. Their influence varied depending on the regional context and the industry structure, for example Scandinavian firms responded to strong external stakeholder expectations on sustainability and transparency. Italian companies, instead, demonstrated a different approach based more on compliance and group-level ESG strategies. These findings contribute to the theory by illustrating how stakeholder pressures create new necessities for the companies, encouraging them to change the internal processes and develop new strategies.

The thesis also contributes to the literature on Strategic CSR by showing that the integration of AI applications helps the companies to integrate sustainability better into their operations and strategies. In this way, CSR initiatives are not treated as separated from the core strategy, but they are part of the value-generating activities, and they are integrated into production planning, logistics and product development. The use of AI applications allowed better results in terms of resource usage and alignment with market expectations and reinforced ethical and environmental commitments. This supports the view of Strategic CSR as a way to create at the same time environmental value and business performance.

From a practical point of view, the thesis reports different implications for business leaders operating in the manufacturing sector. It emerged that the integration of AI applications in CSR initiatives to be successful needs more than just technological investments. Companies need to develop also internal capabilities to manage and interpret Data, build cross-functional structures and establish an ethical and strategic governance for AI applications. In fact, the organizations that are excelling in the utilization of AI applications in sustainability initiatives are those that invested in employee training, innovation processes and partnerships to develop specific applications. The finding also evidenced the importance of adopting an iterative approach for the implementation of AI in CSR initiatives. Most of the companies started with small projects that were later scaled broader across the organization or retail stores. This approach reduced the risks associated with the implementation, increased internal learning and allowed a gradual building of technical and strategic alignment. For these reasons, managers are encouraged to approach the adoption of AI initiatives in CSR strategies as a learning process, where it is necessary to build flexibility and continuous feedback for the implementation strategies.

Finally, this research contributes to the theory and existing literature by demonstrating how the intersection of AI applications and CSR initiatives can generate strategic value. It contributes to the Resource-Based View, as the AI applications are resources that create value for the companies; Stakeholder Theory by analyzing the stakeholder responsiveness; and Strategic CSR by studying how companies transform compliance driven initiatives into strategic approaches. Practically, it shows that firms able to integrate AI with sustainability in a strategic way are better positioned to achieve operational excellence, stakeholder trust and a competitive advantage in a market where digitalization and sustainability are becoming essential.

6.3 Recommendations for Policymakers and Companies

From this study it emerged that the strategic integration of AI applications into CSR initiatives can contribute significantly to the firm performance, stakeholder trust and market competitiveness. The ability to realize these benefits depends on different factors, including contextual, organizational and environmental situations. Based on the

experiences of the interviewed manufacturing companies from Italy and Scandinavia, some recommendations can be made to policymakers and corporate managers looking for the adoption of new technologies for their environmental initiatives.

Starting from companies, a first important recommendation is to use the implementation of AI applications in their CSR initiatives not as a one single approach aimed for just one initiative, but as a strategic transformation process. To implement AI technologies in their companies in a good way, it is necessary to invest in internal capabilities, data infrastructures and cross-functional collaboration mechanisms, in this way companies will ensure an alignment between sustainability goals and long-term value creation. From the findings of this study, it emerged that the integration of AI applications improved not only environmental performance but also operational efficiency and market responsiveness. These results were possible because managers prioritized organizational learning, upskilling of employees to interpret and utilize AI systems, and built an internal culture where digitalization and sustainability are fundamental. In addition to this, manufacturing companies need to adopt a phased approach, where pilot projects could allow experimentations and internal alignment before adopting broader applications. In this way companies are able to minimize risks and build internal capabilities. To overcome technical and resource limitations, the best solution is to adopt partnerships with technology providers or research institutions, to co-develop personal AI applications based on the company's needs.

From a policy perspective, the findings indicate that national institutional environments significantly affect the speed and the ways in which AI is adopted in CSR initiatives. For this reason, policymakers have an important role in creating good conditions for companies to innovate sustainability. This role includes investing in digital infrastructures, mainly in regions that are lagging in technological readiness, and ensure equal access to AI tools and data platforms. For example, in Italy, through greater public investments in training programs and digitalization, the utilization of AI applications in CSR initiatives could be accelerated, particularly among small and medium enterprises that have more troubles in terms of resources and digital readiness. Another important aspect on which regulators should focus is on establishing clear and standardized

sustainability standards that encourage the utilization of real-time and verifiable data. Through these standards, companies will have a clear direction and uncertainty will be reduced, also comparability across industries and countries would benefit from this standardization. In addition to this, the adoption of AI tools for transparency and compliance would be more and more utilized across companies that have clear and transparent data. Public agencies could provide targeted support for pilot projects and innovation ecosystems by bringing together industry leaders, academic institutions and technology developers to collaborate on sustainability challenges.

To conclude, both firms and policymakers should interpret the utilization of AI applications in CSR initiatives as an opportunity for strategic leadership and not only as a compliance mechanism. Companies that are integrating AI and CSR proactively are well positioned in sustainable innovation, while governments that support this transition can increase the overall national climate resilience and competitiveness. In this period, where environmental issues and digitalization are key topics, a collaboration across sectors is essential to achieve meaningful progresses.

6.4 Study Limitations, Ethical Considerations and Future Research Directions

As all academic research, this study presents some limitations that must be taken in consideration. The first aspect to consider is the fact that the research is qualitative, and it relies on a limited number of semi-structured interviews conducted with specific large manufacturing firms in Italy and Scandinavia. This approach provides useful insights in specific contexts, but the generalizability of the results could be limited, in fact other industries or geographical regions could present different characteristics. The Italian and Scandinavian manufacturing contexts could present specific AI applications and CSR strategies based on the culture and the regulation and they could differ from other regions. But at the same time, this specificity of the study offers a good comparative dimension between different contexts.

Another limitation of the study concerns the subjectivity present in qualitative research. The interpretation of the data could be influenced by the researcher, even though a thematic analysis was conducted systematically. In fact, different measures were used to reduce this risk, but a complete objectivity can never be assumed. In addition to this, the availability and openness of participants was different across companies, this could have led to differences in levels of detail in the interviews. Some participants were more involved in CSR initiatives, others in AI applications and other in corporate strategy, this detail could have affected the depth of information obtained by each firm. Ultimately, this study analyzes a single point in time, but CSR strategies and AI technologies are evolving rapidly. An extended research approach over more years could provide more insights on how the AI-CSR integration evolves over time, how firms adapt to changing market necessities and how fast new technologies arise. Such study would offer more dynamic insights.

Based on these limitations, different future research could use this study as a basis to go deeper in analyzing the topic. Firstly, an important area for future research is the quantitative evaluation of the utilization of AI technologies in CSR initiatives. This thesis offers links between AI adoption, CSR outcomes and firm performance but future studies could employ statistical analysis or econometric models to measure the effective strength and causality of these relationships. Future studies could analyze sustainability performance indicators, energy savings or emissions reductions and the effects on the firm's performance. In addition to these possible future studies, another possible future research could expand the comparative dimension of the thesis by including additional contexts, for example other countries outside of Europe. This would provide a broader understanding on how institutional and regulatory differences influence the ability to implement new technologies in sustainability initiatives. Different economic environments could also highlight how the pace and types of AI-CSR integration are affected.

In terms of ethical considerations, the research respected the academic standards for conducting responsible and respectful qualitative studies. At the beginning of all the interviews, the participants were informed about the purpose of the study, how the data

would be used and their right to confidentiality and anonymity. Before each interview the participants agreed on participating to the study and were assured that they could withdraw from the study in any moment without consequences. To protect participant identity, the data presented in the findings has been generalized and anonymized where necessary. In addition to this, all data collected were used only for academic purposes according to data protection and privacy guidelines. The analysis and reporting of the findings remained respectful, balanced and free from personal bias. Finally, given the potential sensitive nature of internal AI applications and CSR strategies, a higher attention was paid to present insights in a way that respects the integrity of participants and organizations.

To conclude, the study provides valuable and original insights into the strategic adoption of AI in CSR initiatives in large manufacturing firms and also on the comparison between Italian and Scandinavian companies. So, it is important to recognize its contextual and methodological boundaries. Future studies, through broader samples and quantitative approaches, can deepen and expand this knowledge, offering important insights in an era where digitalization and sustainability are fundamental. Ethical practices were followed with attention to ensure a transparent research process and the dignity of all participants involved.

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Appendices:

The interview guides used for all interviews and the figures and tables presented in the thesis are attached in below appendices.

Appendix 1: The Interview Guides

Introduction for all interviews:

Before we start with the interview, I would like to introduce the topic, in a way that you know what the thesis is about. My research is about the integration of Artificial Intelligence applications into Corporate Social Responsibility initiatives. In particular, I want to analyze if big manufacturing companies are integrating this new technology into their sustainability initiatives and if they are doing so, in which way this integration represent a benefit for the overall company's performance. The research wants to understand if the AI applications in CSR initiatives represent a good way to increase the sustainable practices in a strategic way, so that the companies through this innovation can treat sustainable practices as a core business strategy and not just as a marginal thing that they are forced to do.

Before we start, I want to ask you a few questions:

- 1) Is it fine for you to record this interview?
- 2) Do you prefer to be mentioned in the thesis, or do you prefer to be anonymized?
- 3) Can I mention the company's name in the thesis?

Semi-Structured Interview Questions: (For each questions some follow-up questions could be done).

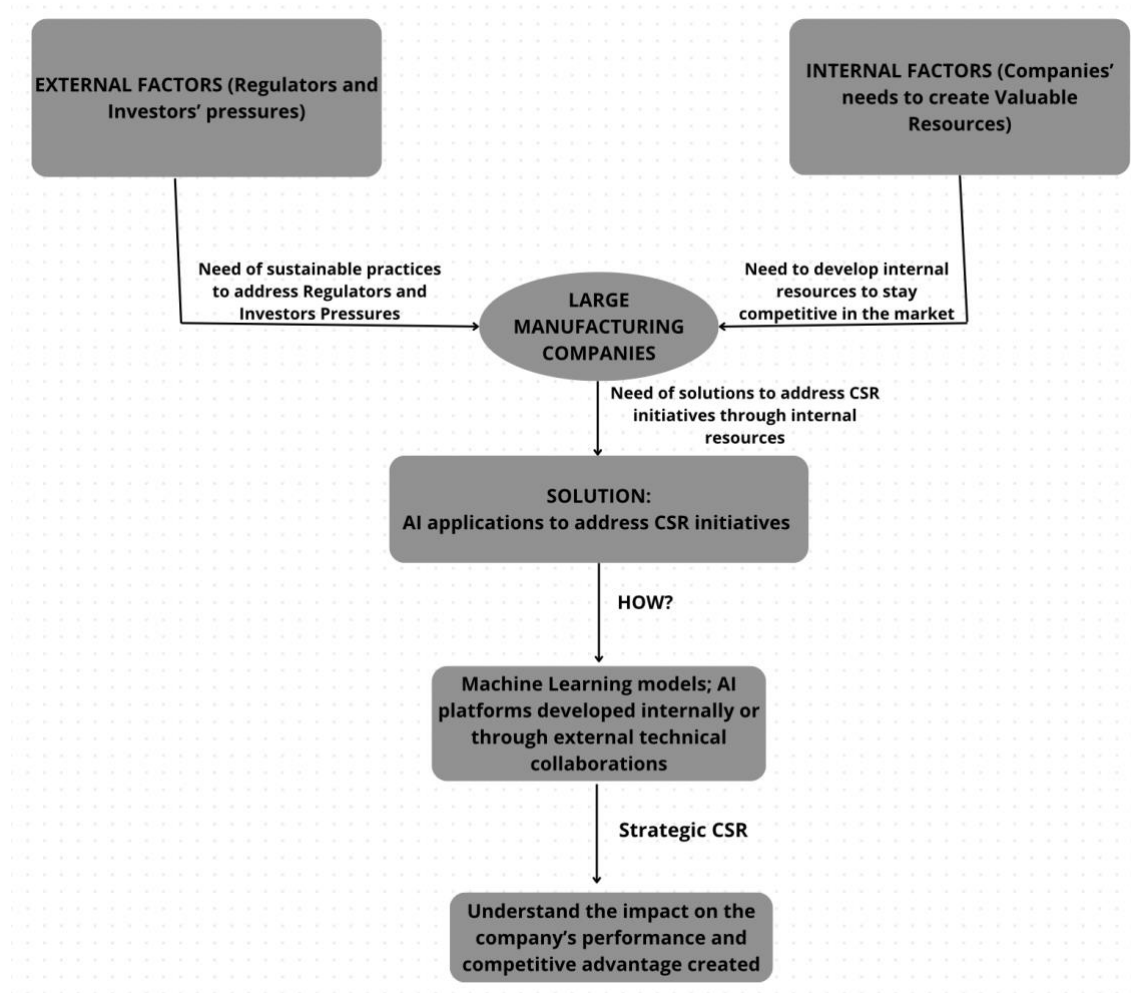
- 1) Can you briefly describe your role in the company and your involvement with CSR initiatives or AI applications?
- 2) How would you describe your company's approach to Corporate Social Responsibility (CSR)?
- 3) What are the main CSR goals or priorities in your company, especially in relation to environmental or social impact?

- 4) How are CSR initiatives typically developed and implemented in your organization?
- 5) What role does technology, in general, play in your CSR strategy?
- 6) Has your company implemented Artificial Intelligence in any CSR initiatives? If yes, can you provide examples?
- 7) Which specific CSR initiatives in your company currently involve AI technologies?
- 8) Could you describe how AI was implemented in these CSR initiatives? (for example: internal development, partnerships, outsourcing)
- 9) What were the main drivers or motivations behind adopting AI in your CSR strategy (for example: regulatory compliance, efficiency, innovation, stakeholder expectations)?
- 10) What kind of AI technologies or tools are used in your CSR strategies (for example: data analytics, automation, AI-driven reporting)?
- 11) How is AI used to monitor, measure, or improve CSR-related performance (for example: emissions reduction, stakeholder engagement, supply chain transparency)?
- 12) Were there specific challenges or needs within CSR that led to considering AI solutions?
- 13) In your view, how has the use of AI in CSR initiatives affected your company's overall performance?
- 14) Have you noticed any changes in operational efficiency, cost savings, or innovation linked to AI in CSR?
- 15) How has the integration of AI in CSR affected relationships with stakeholders, such as customers, employees, investors, or regulators?
- 16) Do you think AI-driven CSR has enhanced your company's competitive advantage? If yes, in what ways?
- 17) Do you consider continuing to invest in AI for CSR initiatives as part of your company's long-term strategy? Why or why not?
- 18) What challenges have you faced in implementing AI in CSR, particularly in terms of resources, skills, or technology?

- 19) How does your company measure the success or outcomes of AI-driven CSR initiatives?
- 20) In your opinion, how does the use of AI in CSR compare between your country and others in your industry?
- 21) How do you see the role of AI evolving in CSR within the next 5–10 years?
- 22) Are there upcoming AI projects or technologies your company is considering for CSR purposes?
- 23) What advice would you give to other manufacturing companies considering the use of AI in CSR initiatives?

Appendix 2: Figures

Figure 1: Study's analytical model developed by the author



Appendix 3: Tables

Table 1: Interviews' insights

Respondent	Job Title	Date and Time	Online or In Person
Respondent 1	Circular Business Innovation Manager	24/03/2025, 45 min.	Online
Respondent 2	Project Manager in the Strategic Sustainability Department	26/03/2025, 60 min.	Online
Respondent 3	Project Manager in E-commerce and Sustainability	26/03/2025, 55 min.	Online
Respondent 4	Sustainable Products & Supply Chain Manager	28/03/2025, 40 min.	In Person
Respondent 5	Sustainability/CSR/ESG/Manager	01/04/2025, 30 min.	Online
Respondent 6	Lead AI Specialist	03/04/2025, 35 min.	Online

Table 2: Researched companies' insights

Company	Description
Lindex	Swedish fashion chain, part of the Stockmann Group, with around 480 stores in 18 countries, offering women's wear and kids' clothing
H&M	Global Swedish fashion retailer known for offering trendy and affordable clothes with thousands of stores in 70 countries.
Bestseller	Danish fashion company with over 2800 stores in 44 countries. It sells clothing and accessories for women, men and kids.
Gucci	Italian luxury fashion house. It offers a wide range of products, from handbags to clothing. It had 529 stores worldwide and is part of the French luxury group Kering.
Benetton	Italian fashion company that operated 3800 stores worldwide. It offers a range of clothing and accessories for men, women and children.
Radici Group	Italian multinational company. It operates in over 20 countries and its focus is on textiles.

Table 3: Type of AI used; AI commitment and CSR Commitment of the Interviewed Companies

Company	Type of AI used	AI Commitment	CSR Commitment
Lindex	Machine Learning models	Medium-High; focused on improving forecasting and reducing waste	High; CSR integrated across all departments and central in the company's culture
H&M	Machine Learning and Computer Vision	High; broad AI integration and development of internal models	High; sustainability integrated in every function and long-term goals set
Bestseller	AI platform (Fabric.ai), Market intelligence tools	High; strategic AI tool used in collection planning	High; fashion FWD strategy guides sustainability and cross-department AI utilization
Gucci	Predictive Analytics, AI platform developed with Kering	Medium; adapted use of group-developed AI tools for inventory and logistics	Medium-High; aligned with Kering's ESG strategy and adapted at brand-level
Benetton	Machine Learning and AI for sensor and data analysis	Medium; focused use of AI in pilot projects	Medium-High; CSR initiatives are part of the brand identity with a focus on social and environmental impact
Radici Group	Machine Learning, Predictive analytics and a combination of AI and IoT	High; multi-system AI deployment with real-time monitoring and traceability	High; CSR initiatives are important mainly toward environmental responsibility

Table 4: AI Applications in CSR initiatives and Implementation Approaches of the Interviewed Companies

Company	AI application in CSR	Implementation Approach
Lindex	Demand forecasting and size prediction to reduce overproduction and waste	Hybrid: Internal deployment + external tech support for AI forecasting tools
H&M	Textile sorting use of AI for recycling and real-time sustainability reporting	Internal AI development + collaboration with suppliers and research institutions
Bestseller	The platform Fabric.ai is used to plan collections accurately and reduce overproduction	Joint development with IBM; operated and refined internally
Gucci	Inventory optimization and transport logistics to reduce emissions waste	Adaptation of centralized Kering tools with brand-level internal customization
Benetton	AI-based energy management system in retail stores to cut energy consumption	Developed with tech providers; operated in-store by internal staff
Radici Group	Real-time monitoring of emissions, resource use and supply chain traceability	Internal development + academic and technical partnerships.

Table 5: Motivations that brought the Interviewed Companies to adopt AI in CSR initiatives

Company	Motivations for AI in CSR	Stakeholder influence or Internal Drivers
Lindex	Reduce overproduction and the overall environmental footprint; improve efficiency	Mainly autonomous, through internal sustainability goals that drive the adoption of sustainability practices
H&M	Enable circularity, improve recycling systems and increase real-time reporting	Both; driven by stakeholder expectations and internal sustainability innovation
Bestseller	Improve planning accuracy, reduce waste and align product design with demand	Primarily internal strategic initiative, supported by stakeholder trends
Gucci	Limit inventory surplus, lower emissions from logistics and align with group's ESG targets	Internal alignment with group strategy; adapted to meet luxury market standards
Benetton	Reduce store energy consumption and operational waste	Mainly internally driven, aiming at energy efficiency; limited stakeholder pressure
Radici Group	Enhance emissions tracking, support compliance and increase supply chain transparency	Both; strong external compliance pressures and internal leadership in sustainability

Table 6: Impact on Firm Performance and Competitive Advantage of the implementation of AI in CSR

Company	Impact on Competitive Advantage and Performance
Lindex	Improved forecasting and reduced overproduction and wastes; enhanced brand reputation for efficiency and environmental responsibility
H&M	Higher material recognition in recycling initiatives (96% more precise); improved reporting speed and accuracy; increased leadership in sustainable initiatives
Bestseller	Improved collection planning; reduced surplus; enhanced market responsiveness; brand aligned with responsible production
Gucci	Optimized inventory and logistics; reduced emissions and operational waste; supported sustainable luxury positioning
Benetton	Achieved 20% energy savings in its retail stores; operational cost reduction; improved environmental performance; enhanced responsible brand image
Radici Group	Real-time emissions tracking and traceability improved client trust and regulatory compliance; supported industrial reputation in sustainability

Table 7: Challenges and Barriers in the implementation of AI applications in CSR initiatives

Company	Challenges and Barriers
Lindex	Limited data availability and inconsistent supplier data; required stronger supplier collaboration and external tech support
H&M	Complex data integration across global suppliers; need to build internal trust in the use of AI insights; addressed through centralized systems and employees training
Bestseller	Ensuring sustainability priorities were included in AI decision models; required continuous updates and model alignment with ESG goals
Gucci	Adapting group-developed AI tools to Gucci specific operations; internal change management and training to align tech with luxury standards
Benetton	Technical issues in sensor calibration and real-time responsiveness; required external tech partnerships and internal upskilling
Radici Group	Managing complex industrial data in real-time; ensuring cybersecurity and cross-functional collaboration between departments; solved through collaborations with specific research centers and cross-departmental teams

Table 8: Future Investments and Strategies of the Interviewed Companies in AI applications for CSR

Company	Future Investments and Strategies
Lindex	Further AI development for forecasting; investment in 3D body scanners to reduce returns and environmental impact
H&M	Scale AI textile sorting to handle more materials; enhance real-time monitoring across more suppliers for supply chain transparency
Bestseller	Expand Fabric.ai to include more environmental metrics; extend AI use into logistics optimization
Gucci	Advance logistics optimization; explore AI for product traceability and environmental transparency
Benetton	Expand AI energy management to more stores; explore predictive maintenance for store infrastructure
Radici Group	Enhance lifecycle tracking using AI; deepen AI-IoT integration for supply chain transparency

Table 9: Perceived Differences across Countries in the implementation of AI in CSR initiatives

Company	Perceived differences across Countries
Lindex	Scandinavia leads in sustainability awareness and digital maturity; supplier data quality varies by region
H&M	Northern Europe ahead in transparency and innovation; other regions are catching up due to rising consumer demand
Bestseller	Nordic countries show high readiness; digital maturity of suppliers varies across regions
Gucci	Northern Europe more advanced; group-level standards ensure alignment in less mature markets
Benetton	Northern markets more mature in both sustainability and digitalization; growing awareness in Southern Europe
Radici Group	European clients demand stronger verified data; regional regulations shape investment pace

Table 10: Summary of the main Findings

Company	AI application in CSR	Implementation Approach	Motivations for AI in CSR	Impact on Competitive Advantage and Performance	Challenges and Barriers	Future Investments and Strategies	Perceived differences across Countries
Lindex	Demand forecasting and size prediction to reduce overproduction and waste	Hybrid: Internal deployment + external tech support for AI forecasting tools	Reduce overproduction and the overall environmental footprint; improve efficiency	Improved forecasting and reduced overproduction and wastes; enhanced brand reputation for efficiency and environmental responsibility	Limited data availability and inconsistent supplier data; required stronger supplier collaboration and external tech support	Further AI development for forecasting; investment in 3D body scanners to reduce returns and environmental impact	Scandinavia leads in sustainability awareness and digital maturity; supplier data quality varies by region
H&M	Textile sorting use of AI for recycling and real-time sustainability reporting	Internal AI development + collaboration with suppliers and research institutions	Enable circularity, improve recycling systems and increase real-time reporting	Higher material recognition in recycling initiatives (96% more precise); improved reporting speed and accuracy; increased leadership in sustainable initiatives	Complex data integration across global suppliers; need to build internal trust in the use of AI insights; addressed through centralized systems and employees training	Scale AI textile sorting to handle more materials; enhance real-time monitoring across more suppliers for supply chain transparency	Northern Europe ahead in transparency and innovation; other regions are catching up due to rising consumer demand
Bestseller	The platform Fabric.ai is used to plan collections accurately and reduce overproduction	Joint development with IBM; operated and refined internally	Improve planning accuracy, reduce waste and align product design with demand	Improved collection planning; reduced surplus; enhanced market responsiveness; brand aligned with responsible production	Ensuring sustainability priorities were included in AI decision models; required continuous updates and model alignment with ESG goals	Expand Fabric.ai to include more environmental metrics; extend AI use into logistics optimization	Nordic countries show high readiness; digital maturity of suppliers varies across regions
Gucci	Inventory optimization and transport logistics to reduce emissions waste	Adaptation of centralized Kering tools with brand-level internal customization	Limit inventory surplus, lower emissions from logistics and align with group's ESG targets	Optimized inventory and logistics; reduced emissions and operational waste; supported sustainable luxury positioning	Adapting group-developed AI tools to Gucci specific operations; internal change management and training to align tech with luxury standards	Advance logistics optimization; explore AI for product traceability and environmental transparency	Northern Europe more advanced; group-level standards ensure alignment in less mature markets
Benetton	AI-based energy management system in retail stores to cut energy consumption	Developed with tech providers; operated in-store by internal staff	Reduce store energy consumption and operational waste	Achieved 20% energy savings in its retail stores; operational cost reduction; improved environmental performance; enhanced responsible brand image	Technical issues in sensor calibration and real-time responsiveness; required external tech partnerships and internal upskilling	Expand AI energy management to more stores; explore predictive maintenance for store infrastructure	Northern markets more mature in both sustainability and digitalization; growing awareness in Southern Europe
Radici Group	Real-time monitoring of emissions, resource use and supply chain traceability	Internal development + academic and technical partnerships.	Enhance emissions tracking, support compliance and increase supply chain transparency	Real-time emissions tracking and traceability improved client trust and regulatory compliance; supported industrial reputation in sustainability	Managing complex industrial data in real-time; ensuring cybersecurity and cross-functional collaboration between departments; solved through collaborations with specific research centers and cross-departmental teams	Enhance lifecycle tracking using AI; deepen AI-IoT integration for supply chain transparency	European clients demand stronger verified data; regional regulations shape investment pace