

*Department of Economics and Finance*

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**Unlocking Sustainable Futures:  
Exploring the Nexus of Open Innovation, ESG Principles, and SDGs with  
European Case Studies of Implementation in Business Models**

Prof. Alberto Di Minin

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SUPERVISOR

Zahiruddin Khan (256231)

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CANDIDATE

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To my family and my lifelong friends, also to come.  
To my hero, the dreamers, believers, and trailblazers,  
to the relentless pursuit of wisdom and happiness,  
the unwavering belief in possibilities,  
and the commitment to making every moment count.

Words can work miracles.

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With boundless gratitude,  
be better, be honourable.

Z.K.

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# General Introduction

## Abstract

Just as Heraclitus' hand never dips twice into the same river, companies find themselves having to face a constantly evolving world. The global landscape of business and innovation is undergoing a profound transformation, driven by the imperatives of sustainability and the pursuit of the United Nations' Sustainable Development Goals (SDGs). This transformation has ushered in an era where open innovation, Environmental, Social, and Governance (ESG) principles, and the SDGs converge to shape the future of enterprises, large and small. However, within this intersection lies a burgeoning research gap that necessitates in-depth exploration. This thesis embarks on a comprehensive investigation into the synergies and implications of open innovation, ESG principles, and the SDGs related to European SMEs and two real-world examples. By elaborating a two-dimensional Sustainable Innovation Matrix (SIM), this research endeavours to offer an understanding of this multifaceted relationship and its profound implications, notably within the European context.

## Purpose of the thesis

This study has a two-fold objective. Firstly, it seeks to identify and describe the ESG principles, SDGs, open innovation practices (OIP) and business models utilised by firms within the context open innovation (OI) field, with a specific emphasis on small and medium-sized enterprises (SMEs).

Secondly, it aims to examine the possible correlation between the innovation performance of OI business models and the achievement of the United Nations' SDGs with sustainability practices.

## Literature Review

We explored the "state of the art" of the foundational principles underpinning open innovation, ESG integration, and the SDGs. With the guidance of Henry Chesbrough's bibliography and prominent scholar's papers, we explored the historical evolution of open innovation, the various forms it can assume, and its far-reaching implications for businesses and society, highlighting their relevance and potential as a unifying force for societal progress. The synthesis of these three domains forms the theoretical backdrop upon which the subsequent chapters are built.

## Methods

The research methodology adopted to explore and dissect the intricate relationships between open innovation, ESG principles, and the SDGs within the context of SMEs has a mixed-methods approach. A thorough examination of the existing literature was conducted to review the studies on open innovation, SDGs and OI

in small and medium-sized enterprises (SMEs). The selected articles were classified under different themes and analysed accordingly to comprehensively understand the subject matter.

The approach blended qualitative and quantitative analysis through bibliographic references, case studies, and two empirical research on SMEs as illustrative case studies (Fairphone and WAMI) to provide a nuanced understanding of these intersections.

The thesis expounds on data collection methods, analytical frameworks, and the selection criteria for elaborating a matrix. An assessment matrix (SIM) has been devised to evaluate the intersection between the open business models' level of disruption and sustainable development goals (SDGs) achievement grade within the context of small and medium-sized enterprises (SMEs). A three-step process was performed. The matrix collects data on SMEs' sustainability practices, their engagement with SDGs, their industry, and general assumptions proxies. A scoring system then positions SMEs on the two dimensions of sustainability and open innovation. To streamline the innovation process, Von Geibler suggests a four-stage approach that employs the SDG-Check tool to assess an innovator's sustainability orientation in the initial stages of product and service development. Additionally, based on the extent of radical change and external collaborations and partnerships, SME business model innovation is classified using the two-dimensional framework SIM.

It is through this methodological lens that the empirical chapters derive their rigour and analytical depth in order to implement an understanding of the relationships.

## Expected Outcomes

Anticipated outcomes are multifaceted. Empirically, this thesis is expected to showcase the diverse ways in which European firms are aligning their practices with the SDGs, guided by ESG principles and open business models to innovate. The case studies within offer real-world exemplars of firms that have successfully integrated these domains into their business models, with tangible societal and environmental impacts. Theoretically, this research advances the discourse surrounding the role of open innovation as an enabler of sustainable development goals and the practical manifestations of ESG principles in corporate strategies. In reality, from the results in the literature and from broader analyses of case studies, it is not possible to claim that there is a positive correlation between the two aspects.

## Conclusion

The study offers an original and comprehensive view of how firms, especially SMEs, can navigate the dynamic landscape of open innovation, ESG principles, and the SDGs, thereby fostering sustainable and open business models. It presents both practical and theoretical contributions, slightly extending the current understanding of the interplay between these domains and shedding light on the uncharted territories of SMEs. However, it is imperative to acknowledge potential limitations, notably the still rapidly evolving nature of these young domains and the contextual specificity of the unexplored landscape of European SMEs, with an intrinsic and

structural lack of data. As we conclude this research, we invite future scholars to explore the evolving role of open innovation in advancing sustainable development and uncover novel strategies for firms to embrace ESG principles to pursue the SDGs. In doing so, we envision a future where the synergies of open innovation, ESG principles, and the SDGs become a hallmark of responsible and impactful business practices, propelling us closer to a sustainable and equitable global society.

### Keywords

Open Innovation (OI); United Nations' Sustainable Development Goals (SDGs); Environmental, Social, and Governance (ESG); EU small- and medium-sized enterprises (SMEs).



# Chapter 1: Principles: Guiding Forces in History and Contemporary Context

## Introduction

Throughout human history, principles have shaped our actions, decisions, and the very fabric of societies. In an era marked by unprecedented interconnectedness and complex global challenges, the significance of principles as guiding forces cannot be overstated. This chapter explores the concept of principles, their historical importance, and their relevance in contemporary contexts. Additionally, we will discuss Ray Dalio's influential book, "Principles," and examine how principles guide firms, particularly in the context of Open Innovation, Environmental, Social, and Governance (ESG) practices, and the United Nations' Sustainable Development Goals (SDGs), which are the main focus and objectives of the thesis.

## 1.1 Understanding Principles

Principles are fundamental beliefs, values, or guidelines that govern our thoughts, actions, and behaviours. Principles act as guiding forces that shape our understanding of what is right and fair and help us navigate complex situations. They serve as moral compasses, providing a fixed point, a polar star, a framework for decision-making, ethical conduct, and establishing societal and organisational norms.

- **Establishing a Strong Organisational Culture:** in the context of a firm, principles play a vital role in shaping its culture, defining its goals, and determining its actions. The relationship between principles and corporate success, as well as the overall functioning of an organisation, is a crucial aspect to consider. Understanding this relationship can help guide decision-making and drive positive outcomes for the company. Principles are instrumental in shaping the culture of a firm. They define the shared values, beliefs, and expectations that guide the behaviour and attitudes of employees towards the firm's purpose. Well-defined and communicated principles create a cohesive and positive work environment, fostering employee engagement, loyalty, and a sense of belonging.
- **Guiding Decision-Making:** principles provide a framework for decision-making within a firm. They help leaders and employees evaluate options and make choices that align with the organisation's values and long-term goals. By adhering to principles, firms can ensure consistency and fairness in decision-making processes, fostering trust and integrity both internally and externally in all operational and strategic tasks.
- **Building Trust and Reputation:** a firm that upholds strong principles earns the trust and respect of its stakeholders, including customers, employees, shareholders, and the community. By demonstrating integrity, transparency, and ethical behaviour, a firm can establish a solid reputation, which is essential

for long-term success. Principles form the foundation of ethical conduct and social responsibility, helping a firm build meaningful relationships with its stakeholders by enhancing the bond of trust.

- **Enhancing Performance and Innovation:** principles act as motivators and drivers for high performance within a firm. When employees are aligned with the principles of the organisation, they are more likely to be motivated, engaged, and committed to achieving the firm's goals. Moreover, principles encourage innovation by promoting a culture of openness, learning, and adaptability, allowing firms to stay competitive in a rapidly changing business landscape.
- **Ensuring Long-Term Sustainability:** principles are essential for ensuring the long-term sustainability of a firm. By embracing principles such as environmental stewardship, social responsibility, and sound governance practices, a firm can mitigate risks, anticipate challenges, and proactively adapt to changing market conditions. Principles provide a framework for responsible decision-making, helping firms balance short-term profitability with long-term sustainability. It is pertinent to acknowledge that the notion of sustainability goes beyond just environmental initiatives but rather encompasses all aspects of a company's future viability. Corporate sustainability is anchored on three pillars, namely, environmental, social responsibility, and economic sustainability. To promote their environmental sustainability, companies can deploy measures such as reducing their carbon footprint and minimising wasteful practices. The pillar of social responsibility involves practices that benefit not only the company's employees and consumers but also the larger community. Furthermore, the economic or governance pillar is concerned with maintaining truthful and transparent accounting practices as well as compliance with regulations.

## 1.2 Principles in Historical Context

This section delves into the historical context of principles in the context of firms, exploring their evolution and impact on various aspects such as governance, labour practices, and corporate social responsibility.

Principles have been central in human history, guiding and ruling societies across civilisations. From ancient philosophical teachings to religious doctrines and legal frameworks, principles have shaped the course of human actions. For example, the principles of justice and equality influenced the establishment of legal systems and the fight for civil rights, influencing the employees' conditions, for instance. Principles of governance and democracy guided the formation of nations and the pursuit of accountable leadership. Throughout history, regulations have been instrumental in promoting societal progress, challenging oppressive systems, and fostering human development.

By examining historical examples, we can gain insight into the significance of principles in shaping the relationship between firms and society.

### 1.2.1 Principles in Governance

#### The Guild System and Ethical Standards

In medieval Europe, guilds emerged as associations of artisans and craftsmen, guided by principles that emphasised quality, fair pricing, and ethical conduct. These principles helped ensure consumer protection, maintain professional standards, and regulate competition within the guilds. The guild system demonstrated how principles can establish a foundation of trust, reliability, and accountability within firms.

#### The Industrial Revolution and Labour Rights

The Industrial Revolution brought about significant changes in working conditions and labour practices. Principles of fairness and workers' rights emerged as a response to the exploitation and harsh conditions faced by labourers. Pioneering figures like Robert Owen and trade union movements advocated for principles such as fair wages, safe working conditions, and reasonable working hours. These principles laid the groundwork for the establishment of labour laws and labour rights movements, transforming the relationship between firms and their employees.

### 1.2.2 Principles in Corporate Social Responsibility

#### The Bournville Village Trust and Olivetti's Welfare Policy

In the early 20<sup>th</sup> century, the Cadbury Chocolate Company established the Bournville Village Trust near Birmingham (UK), a pioneering example of corporate social responsibility. The trust aimed to provide housing, education, and recreational facilities for Cadbury employees, promoting their welfare and well-being. The principles of social responsibility embedded in the Bournville Village Trust influenced subsequent practices of firms engaging in philanthropy and community development initiatives. Another brilliant and pioneering example of a successful corporate and community welfare system, extensive and inclusive, is the Olivetti village in Ivrea (Italy), which will not find equals in the history of Italian private enterprise. During the first half of the 20<sup>th</sup> century, the Olivetti factory was guided by Adriano Olivetti, who wanted to ensure more safety for its factory and for workers, more freedom, and increased well-being by building a canteen, a library and other facilities for workers, including the provision of housing and granting education and cultural initiatives. Adriano was inspired by Christian personalism and socialist reformism. A man who used to sincerely believe in man, in his *divine flame*, in his possibility of elevation and ransom. He gave credit, space and concrete opportunities to all workers, in particular to young talents. Additionally, Olivetti made a deliberate choice to allocate a substantial portion of his factory's profits towards the betterment of the workers and surrounding communities despite facing opposition from his family. Rather than prioritising excessive dividends and salaries for shareholders and managers, this decision ultimately led to a significant increase in

the value of Olivetti's shares. In fact, from 1924 to 1960, the value of Olivetti shares rose by approximately 22 times in real terms, as noted by Professor Giovanni Maggia. His dreamy eyes and iron will have built a long-lasting model that will inspire entrepreneurs for several years. His scientific and humanistic approach underlined his capacity to think like a mathematician and feel and act like a philanthropist. This is considered a key feature to pursuing a successful innovation pathway by Andrea Prencipe and Massimo Sideri in their book *L'innovatore Rampante* (2022), in which they consider Italo Calvino as the synergistic and distinctive union of a humanist with a scientific approach, also due to his family background and childhood education.

### The Rise of Sustainability Principles

In recent decades, the recognition of environmental concerns and social impact has driven the adoption of sustainability principles by firms. Historical events such as the environmental movement in the 1960s and the United Nations' publication of the Brundtland Report in 1987 highlighting the concept of sustainable development have shaped the understanding of corporate responsibility. Firms now integrate principles of sustainability into their operations, addressing environmental challenges, promoting social equity, and embracing ethical business practices.

#### 1.2.3 Principles in Ethical Business Conduct

##### The Cadbury Report and Corporate Governance

The Cadbury Report, published in 1992, addressed concerns about corporate governance and emphasised principles of transparency, accountability, and ethical behaviour in firms. The report influenced subsequent corporate governance codes worldwide, highlighting the importance of principles in establishing responsible business practices and maintaining stakeholder trust.

##### The Global Reporting Initiative (GRI)

The establishment of the Global Reporting Initiative in 1997 marked a significant development in the integration of principles into corporate reporting. GRI's principles provide guidance on sustainability reporting, encouraging firms to disclose their social, environmental, and economic impacts transparently. The GRI principles have fostered a culture of accountability and responsible disclosure, enhancing the relationship between firms and their stakeholders.

#### 1.3 Ray Dalio's "Principles"

Ray Dalio's book *Principles* is a significant contribution to the understanding and application of principles in contemporary contexts. Dalio emphasises the importance of clearly articulated principles as the foundation for decision-making and organisational culture. Drawing from his experience as a successful investor and

entrepreneur with the foundation and management of the biggest hedge fund in the world, Bridgewater Associates, Dalio underscores the role of principles in driving personal and professional growth, fostering collaboration, and achieving meaningful results.

To maintain brevity and clarity., this section explores only some of the most prominent principles discussed by Dalio and examines how they relate to the overall functioning and success of a firm.

- **Establishing a Culture of Radical Truth and Transparency:** one of the core principles emphasised by Dalio is the importance of creating a culture of radical truth and transparency within a firm. This involves promoting open and honest communication and encouraging employees to express their ideas and concerns freely. By fostering an environment where everyone feels comfortable speaking up, firms can benefit from diverse perspectives, identify potential risks, and drive innovation. Furthermore, this principle encourages the sharing of feedback, enabling continuous improvement and growth within the organisation.
- **Embracing a Meritocratic Approach:** Dalio highlights the significance of a meritocratic approach, where individuals are rewarded based on their performance and contribution. By establishing a system that values competence and accountability, firms can motivate employees to strive for excellence. Meritocracy encourages a sense of fairness and equal opportunity, creating an environment where individuals are driven to excel and contribute to the overall success of the firm.
- **Utilising Radical Open-Mindedness:** another principle put forth by Dalio is the practice of radical open-mindedness. This involves actively seeking out diverse perspectives, challenging one's own assumptions, and remaining receptive to new ideas. By fostering an environment where open-mindedness is valued, firms can promote a culture of continuous learning and improvement. This principle allows organisations to adapt to changing market dynamics, embrace innovation, and stay ahead of the competition.
- **Emphasising the Importance of Systems Thinking:** Dalio emphasises the significance of systems thinking in his book, encouraging firms to view their operations as interconnected systems. By understanding how different parts of the organisation are not islands but interact and affect each other, firms can make more informed decisions that take into account the broader impact. Systems thinking enables firms to identify areas for optimisation with synergies and cost reductions, anticipate potential risks, and design effective strategies that align with the overall goals of the organisation.
- **Applying Principles in Practice:** while principles provide a framework for decision-making and behaviour, Dalio emphasises the importance of translating principles into practical actions with an

entrepreneurial mindset of the execution approach. It is not enough to merely articulate principles; they must be actively applied and integrated into the day-to-day operations of the firm. Firms should establish processes and mechanisms that allow principles to be consistently upheld and practised at all levels of the organisation.

## 1.4 Principles Guiding Firms and the SDGs

Guiding principles play a vital role in helping organisations navigate Open Innovation, ESG practices, and SDGs. By adopting these principles, companies can promote a culture of innovation, utilise external knowledge, and more effectively tackle complex challenges.

Open Innovation is a model that emphasises collaboration and knowledge exchange among stakeholders and organisations, and it thrives on values such as transparency, inclusivity, and creating shared value. We will delve deeper into it in the upcoming chapter.

### 1.4.1 Environmental, Social, Governance (ESG) Practices

ESG is an acronym developed in a 2004 report by 20 financial institutions in response to a call from Kofi Annan, Secretary-General of the United Nations. The ESG principles offer a structure for companies to incorporate environmental protection, social responsibility, and good governance practices into their daily operations. By following these principles, companies can make decisions that take into account the long-term effects on the planet, individuals, and communities, ultimately promoting sustainable and ethical business practices. ESG principles go beyond traditional financial metrics and encourage companies to consider their environmental impact, social responsibilities, and governance practices to benefit the wider society and environment beyond just financial gains. According to Bloomberg, companies that implement ESG principles are more likely to attract investors and customers who value ethical and sustainable practices, ultimately leading to long-term success and positive impact.

- **Environmental Aspect of ESG:** the "E" in ESG represents the environmental aspect, which focuses on a company's impact on the environment. It involves assessing and minimising the firm's carbon footprint, energy consumption, waste generation, and resource use. Companies committed to ESG principles prioritise environmental sustainability by adopting eco-friendly practices, investing in renewable energy sources, and setting emission reduction targets. By demonstrating environmental stewardship, firms can mitigate risks associated with climate change, contribute to a greener future, and appeal to environmentally conscious stakeholders.
- **Social Aspect of ESG:** the "S" in ESG stands for social, highlighting the importance of a company's impact on society and its stakeholders. Social aspects encompass a wide range of considerations,

including human rights, labour practices, diversity and inclusion, community engagement, and consumer protection. Companies that uphold ESG principles prioritise fair labour practices, support employee well-being, promote diversity in their workforce, and engage with local communities through philanthropy and responsible sourcing. By prioritising social considerations, firms can build stronger relationships with stakeholders, enhance their brand reputation, and contribute positively to the communities in which they operate.

- **Governance Aspect of ESG:** the "G" in ESG refers to governance, which focuses on the quality of a company's management, decision-making processes, and overall corporate governance structure. Transparent and accountable governance practices are fundamental to sustainable business operations. ESG principles advocate for the establishment of strong corporate governance frameworks, independent boards, ethical business conduct, and fair treatment of shareholders. By maintaining robust governance practices, companies can instil investor confidence, reduce the risk of fraud and corruption, and promote long-term stability and profitability.

#### 1.4.2 The Significance of ESG Principles for Business

Embracing ESG principles offers numerous benefits for businesses in today's dynamic and socially conscious landscape, including improved financial performance, risk mitigation, enhanced reputation, access to capital, and the opportunity to drive positive social and environmental impact. Therefore, embracing ESG is not just a corporate responsibility but also a strategic advantage in an increasingly conscious and sustainable business landscape. We will briefly explore some of the key takeaways in terms of benefits.

- **Enhanced Financial Performance:** according to Bloomberg Markets Intelligence, companies that prioritise ESG practices often experience improved financial performance over the long term. By considering environmental and social factors, such as resource efficiency, waste reduction, and employee well-being, companies can reduce operational costs, increase productivity, and attract socially responsible investors.
- **Risk Mitigation:** embracing ESG practices can help companies identify and mitigate potential material risks. By proactively addressing environmental and social risks, such as climate change, supply chain disruptions, and labour issues, companies can build resilience and protect their operations from future challenges.
- **Access to Capital:** increasingly, investors are integrating ESG criteria into their investment decisions. Companies with strong ESG practices are more likely to attract a broader pool of investors, including

those focused on sustainable and responsible investments. This expanded investor base can lead to increased access to capital and lower borrowing costs.

- **Improved Brand Reputation:** consumers and stakeholders are increasingly conscious of a company's impact on the environment and society. By demonstrating a commitment to sustainable and ethical practices, companies can enhance their brand reputation and gain the trust of customers, employees, investors, and other stakeholders.
- **Talent Attraction and Retention:** employees are increasingly seeking to work for companies with strong values and a commitment to social and environmental responsibility. Embracing ESG practices can help companies attract and retain top talent, fostering a positive work culture and increasing employee engagement.
- **Innovation and Competitive Advantage:** ESG practices can drive innovation by encouraging companies to develop sustainable products, services, and business models. By anticipating future sustainability trends and consumer preferences, companies can gain a competitive advantage and position themselves as leaders in their industries.
- **Increased Market Opportunities:** the growing emphasis on sustainability has led to new market opportunities, such as green technologies, renewable energy, and sustainable products. Companies that adopt ESG practices can tap into these emerging markets and diversify their revenue streams.
- **Regulatory Compliance:** many governments and regulatory authorities are imposing stricter environmental and social regulations. Companies that proactively adopt ESG practices can stay ahead of evolving regulations, avoiding potential compliance issues and associated costs.
- **Resilience to Crises:** firms with robust ESG practices are often better equipped to navigate and recover from crises. Sustainability-focused strategies can help companies respond effectively to unforeseen challenges, such as pandemics, natural disasters, or social disruptions.
- **Positive Impact on Society and Environment:** beyond the business benefits, embracing ESG practices allows companies to contribute positively to society and the environment. By reducing their environmental footprint and promoting social responsibility, companies can play a vital role in addressing global challenges and driving positive change.



### 1.4.3 UN's SDGs

The United Nations adopted the 2030 Agenda for Sustainable Development in September 2015, focusing on urgent environmental, economic, and social issues that must be addressed by 2030. The SDGs, a set of 17 objectives established by the United Nations, can be seen as principles guiding firms' contributions to sustainable development. The SDGs are a compass for firms to integrate sustainability principles into their core business models, operations, and stakeholder relationships, guiding ethical decision-making, establishing societal norms, and driving organisational success to create a more just, sustainable, and prosperous world. As we navigate the present challenges and strive for a better future, firms can align their strategies and practices with the SDGs and commit to addressing pressing global challenges that aim to promote a more inclusive, resilient, and sustainable world by tackling them holistically. Partnerships among governments, international organisations, civil society, and the private sector are essential for achieving all 17 SDGs of the 2030 Agenda (Sachs et al., 2019).

The SDGs encompass many objectives, including poverty eradication, quality education, gender equality, climate action, and sustainable cities. These goals reflect the interconnectedness of sustainability's social, economic, and environmental dimensions.

Figure 1 – The UN's Sustainable Development Goals



Here is a list of the 17 Sustainable Development Goals (SDGs), along with brief explanations of each goal:

1. **No Poverty:** this goal aims to eradicate extreme poverty and reduce overall poverty levels. It focuses on ensuring that all individuals have access to basic services, social protection, and sustainable livelihood opportunities. It involves addressing income inequality, promoting economic growth, and providing social safety nets for the most vulnerable populations.
2. **Zero Hunger:** the second goal seeks to end hunger, achieve food security, improve nutrition, and promote sustainable agriculture. It aims to ensure that everyone has access to safe, nutritious, and sufficient food at all times. This includes increasing agricultural productivity, improving farming practices, promoting sustainable food systems, and reducing food waste.
3. **Good Health and Well-being:** this goal focuses on ensuring healthy lives and promoting well-being for all individuals. It aims to reduce maternal and child mortality, combat major diseases such as HIV/AIDS, malaria, and non-communicable diseases, and improve mental health services. It also aims to strengthen health systems, ensure access to essential healthcare services, and promote universal health coverage.
4. **Quality Education:** the fourth goal emphasises the importance of inclusive and equitable quality education for all. It aims to ensure that individuals have access to free, quality primary and secondary education, as well as affordable and accessible technical and vocational training and higher education. This goal promotes lifelong learning opportunities and the acquisition of relevant skills for employment and sustainable development.
5. **Gender Equality:** this goal aims to achieve gender equality and empower all women and girls. It addresses gender-based discrimination, violence, and harmful practices. The goal focuses on ensuring equal access to education, economic opportunities, and participation in decision-making processes. It calls for the elimination of gender disparities and the promotion of women's empowerment and rights.
6. **Clean Water and Sanitation:** goal six focuses on ensuring the availability and sustainable management of water and sanitation for all. It aims to provide access to clean drinking water, improve sanitation facilities, and promote hygiene practices. This goal also addresses water scarcity, water pollution, and water resource management to ensure the sustainable use of water resources.

7. **Affordable and Clean Energy:** this goal emphasises the need for affordable, reliable, sustainable, and modern energy for all. It calls for the increased use of renewable energy sources, improvement in energy efficiency, and universal access to electricity. The goal also promotes investments in clean energy technologies and infrastructure to combat climate change and reduce reliance on fossil fuels.
8. **Decent Work and Economic Growth:** goal eight focuses on promoting sustained, inclusive, and sustainable economic growth, full and productive employment and decent work for all. It aims to create quality jobs, foster entrepreneurship, and promote sustainable economic development. This includes addressing issues such as youth unemployment, labour rights, and the informal economy.
9. **Industry, Innovation, and Infrastructure:** this goal aims to build resilient infrastructure, promote inclusive and sustainable industrialisation, and foster innovation. It focuses on developing sustainable and resilient infrastructure, promoting technological innovation, and enhancing access to information and communication technologies (ICT). The goal also emphasises the importance of sustainable industrial practices and fostering entrepreneurship.
10. **Reduced Inequalities:** goal ten addresses reducing inequalities within and among countries. It aims to promote social, economic, and political inclusion for all individuals, irrespective of their income, gender, disability, race, or other characteristics. The goal calls for measures to empower marginalised groups, address income inequality, ensure equal opportunities, and promote social cohesion.
11. **Sustainable Cities and Communities:** this goal focuses on making cities and human settlements inclusive, safe, resilient, and sustainable. It aims to ensure access to adequate and affordable housing, promote sustainable urban planning and development, and improve transportation systems. The goal also emphasises the preservation of cultural heritage, the provision of basic services, and the promotion of sustainable and efficient resource use in urban areas.
12. **Responsible Consumption and Production:** goal twelve highlights the importance of ensuring sustainable consumption and production patterns. It calls for the efficient use of resources, reducing waste generation, and promoting sustainable practices throughout the entire life cycle of products and services. The goal also aims to raise awareness about sustainable lifestyles, sustainable public procurement, and corporate sustainability practices.
13. **Climate Action:** this goal emphasises taking urgent action to combat climate change and its impacts. It focuses on mitigating greenhouse gas emissions, adapting to climate change, and promoting resilience

in the face of climate-related challenges. The goal calls for international cooperation, increased climate finance, and the integration of climate change measures into policies and planning.

14. Life Below Water: goal fourteen aims to conserve and sustainably use the oceans, seas, and marine resources for sustainable development. It focuses on reducing marine pollution, protecting marine ecosystems, and promoting sustainable fishing practices. The goal addresses issues such as ocean acidification, marine biodiversity loss, and illegal fishing activities.
15. Life on Land: this goal seeks to protect, restore, and promote the sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt biodiversity loss, and encourage land restoration. It emphasises the conservation of biodiversity, the restoration of degraded land, and the promotion of sustainable land management practices.
16. Peace, Justice, and Strong Institutions: goal sixteen promotes peaceful and inclusive societies for sustainable development, provides access to justice for all, and builds effective, accountable, and inclusive institutions at all levels. It aims to reduce violence, promote the rule of law, ensure access to justice, and combat corruption and illicit financial flows.
17. Partnerships for the Goals: the final goal highlights the importance of global partnerships and collaboration to achieve the SDGs. It calls for strengthening the means of implementation and revitalising the global partnership for sustainable development. The goal emphasises the mobilisation of resources, technology transfer, capacity building, and knowledge sharing to support the achievement of the SDGs.

These goals collectively address various social, economic, and environmental challenges, emphasising the need for transformative actions and collaborative efforts to achieve sustainable development for present and future generations.

## 1.5 A European Perspective: The Synergy between the UN's SDGs, the Next Generation EU and European Green Deal, Advancing Sustainable Development and Climate Action

Apart from the United Nations' Sustainable Development Goals, also the Next Generation EU and the European Green Deal constitute three ambitious and interconnected initiatives that hold immense potential in addressing global challenges. The SDGs provide a comprehensive framework for sustainable development and poverty eradication worldwide, while the Next Generation EU serves as a recovery and resilience plan to overcome the COVID-19 crisis. The European Green Deal outlines the EU's strategy to transition to a climate-

neutral continent by 2050. This paragraph examines the intricate relationships between these initiatives, emphasising how their synergy can accelerate progress towards a more sustainable and climate-resilient future from a European point of view.

### 1.5.1 Aligning Objectives: A Shared Vision for a Sustainable Future

The SDGs, Next Generation EU, and the European Green Deal all share a common goal of promoting sustainable development, social inclusion, and climate action and constitute a mutual reinforcement to promote sustainable development, mitigate climate change, and build a greener, more inclusive Europe. For instance, Goal 7 of the SDGs targets ensuring access to affordable, reliable, sustainable, and modern energy for all. The European Green Deal's emphasis on clean energy transitions, energy efficiency, and renewable energy aligns with this goal, aiming to reduce greenhouse gas emissions and reliance on fossil fuels.

In response to the COVID-19 pandemic, the Next Generation EU was created to provide significant financial support to EU member states for economic recovery and transformation towards a greener and more digital economy. Next Generation EU centres around the Recovery and Resilience Facility, a program designed to offer grants and loans to support reforms and investments in EU Member States. The total funding available amounts to € 723.8 billion in current prices in 2023. Of this amount, € 338 billion is being provided as grants to Member States, while € 385.8 billion is being allocated as loans to individual Member States. These loans will be repaid by the Member States themselves. In cases where a Member State does not require the full amount of loans available, the excess funds will be directed towards REPower EU, a program aimed at accelerating the EU's transition to green energy and reducing its reliance on Russian gas. The distribution of Recovery and Resilience funds will be based on Member States' national plans, which outline reforms and investments that aim to make EU economies greener, more digital, and more resilient. Additionally, a fraction of the Next Generation EU funds will be used for improving existing EU programs, like the Green Deal.

Introduced on the 11<sup>th</sup> of December 2019, the European Green Deal is the EU's strategy to achieve climate neutrality, with a focus on principles such as a circular economy, preserving biodiversity, and ensuring a just transition. In this regard, during the year 2021, negotiations took place with the aim of elevating the level of ambition among major emitters. The European Union has established a goal of presenting a comprehensive plan which responsibly increased the Union's target for the year 2030 to 55%. This plan has been informed by social, economic, and environmental impact assessments, ensuring fairness and promoting innovation, competitiveness, and job creation.

Here are some major points of action of the Green Deal, near to the SDGs.

- Energy Transition: The European Green Deal's commitment to decarbonising the energy sector aligns with Goal 7 (Affordable and Clean Energy) of the SDGs. By investing in renewable energy sources,

energy efficiency, and grid infrastructure, the EU seeks to achieve a sustainable and secure energy future, reducing greenhouse gas emissions and combating climate change.

- **Circular Economy:** The European Green Deal's focus on creating a circular economy, minimising waste, and promoting sustainable consumption and production echoes Goal 12 (Responsible Consumption and Production) of the SDGs. This approach aims to reduce resource depletion, foster resource efficiency, and mitigate environmental impacts, contributing to sustainable development and climate mitigation.
- **Biodiversity Conservation:** The European Green Deal's commitment to halting biodiversity loss and restoring ecosystems aligns with Goal 15 (Life on Land) of the SDGs. By implementing measures to protect biodiversity and enhance ecological resilience, the EU aims to safeguard natural resources, combat climate change, and support sustainable livelihoods.

The funding provided by the Next Generation EU can be strategically allocated to advance the European Green Deal's initiatives, such as increasing renewable energy capacity, retrofitting buildings for energy efficiency, and investing in sustainable mobility and public transportation. This coordinated approach accelerates progress towards achieving the SDGs and enhances the EU's climate goals.

### 1.5.2 Just and Inclusive Transition: A Guiding Principle for Change

An essential component of the European Green Deal is the Just Transition Mechanism, which ensures that the transition to a climate-neutral economy is fair, inclusive, and leaves no one behind. This aligns with the core principle of the SDGs to achieve sustainable development in an equitable manner. The Next Generation EU can be used to support regions and communities that may be disproportionately affected by the transition, providing financial assistance and investments in reskilling and upskilling programs. By addressing social and economic disparities, the EU can create a pathway towards sustainable development that benefits all citizens and aligns with the principles of the SDGs.

### 1.5.3 International Leadership and Collaboration

The SDGs are a global call for action, and the European Green Deal reflects the EU's leadership in addressing climate change. By committing to climate neutrality by 2050, the EU sets a bold example for other nations to follow, encouraging international collaboration to achieve the Paris Agreement's objectives. The Next Generation EU not only strengthens the EU's internal efforts but also enables the EU to support other countries in their sustainable development and climate mitigation endeavours. This alignment between the SDGs, the

European Green Deal, and the Next Generation EU fosters cooperation on a global scale, advancing the collective goal of creating a sustainable and resilient world.

## 1.6 Conclusion

Principles are the guiding beliefs that define the culture, behaviour, and decision-making processes within a firm. They provide a framework for ethical conduct, shape organisational culture, and influence the long-term success and sustainability of a firm. By adhering to strong principles, firms can build trust, enhance their reputation, foster innovation, and create a positive impact on society. Understanding and upholding principles is not only a moral imperative but also a strategic advantage in today's dynamic and socially conscious business environment.

Throughout history, principles have played a vital role in shaping the relationship between firms and society. From guilds in medieval times to the modern focus on corporate social responsibility, principles have evolved to address ethical, social, and environmental concerns. The historical context showcases how principles influence governance, labour practices, corporate social responsibility, and ethical business conduct. By embracing and upholding principles, firms can build trust, contribute to societal well-being, and ensure sustainable success. Understanding the historical evolution of principles in the firm context provides valuable insights for navigating contemporary challenges and fostering responsible and ethical business practices.

In his book *Principles*, Ray Dalio highlights the significance of principles in driving the success of a firm. By establishing a culture of radical truth and transparency, embracing meritocracy, practising radical open-mindedness, and applying systems thinking, firms can foster a positive work environment, drive innovation, and achieve sustainable growth. The key is to ensure that principles are not only articulated but also integrated into the firm's practices and decision-making processes. By adhering to these principles, firms can create a strong foundation for long-term success and navigate the complexities of the business landscape with clarity and purpose.

The principles discussed in relation to the 17 UN Sustainable Development Goals (SDGs) can guide firms in their pursuit of sustainable practices and responsible business conduct. Principles such as transparency, accountability, inclusivity, and innovation play a crucial role in aligning a firm's operations with the SDGs. When firms integrate these principles into their strategies, decision-making processes, and stakeholder engagements, they can drive positive change and make meaningful contributions towards the SDGs.

Adopting a principle-driven approach helps firms establish a strong ethical foundation and a sustainable competitive advantage. By upholding principles such as good governance, respect for human rights, responsible consumption and production, and social and environmental stewardship, firms can build trust among stakeholders, attract and retain talent, mitigate risks, and foster long-term success.

Moreover, embracing the SDGs and their underlying principles offers firms a strategic lens through which they can identify new business opportunities. The SDGs provide a roadmap for addressing global challenges,

and firms can innovate and develop sustainable products, services, and business models that align with the SDGs. By aligning their strategies with the SDGs, firms can tap into growing market demands for sustainable solutions, gain a competitive edge, and contribute to positive societal and environmental outcomes.

Incorporating the principles of the SDGs into a firm's operations requires commitment, collaboration, and continuous improvement. It necessitates a holistic approach that considers the interdependencies among various goals and integrates sustainability considerations across all levels and functions of the organisation. Firms can engage in partnerships and collaborations with other stakeholders, including governments, civil society organisations, and communities, to maximise their impact and contribute to collective efforts in achieving the SDGs.

The interconnections between the UN's SDGs, the Next Generation EU, and the European Green Deal present a unique opportunity to accelerate sustainable development and climate action. By aligning recovery efforts with sustainability objectives, the EU can leverage its financial resources to foster transformative change and amplify the impact of these initiatives. Emphasising just and inclusive transition ensures that the benefits of sustainable development reach all citizens, in line with the core principles of the SDGs. Moreover, the EU's commitment to climate neutrality and global leadership inspires international cooperation, encouraging collaborative efforts towards achieving a sustainable and climate-resilient future for generations to come.

Innovation is one of the key aspects for a firm to pursue and adapt to the ethical, social, and environmental concerns within the SDGs. In the next chapter, we will describe Open Innovation within the general context of innovation processes, its main features and the new frontiers in order to broaden the perspective from both managerial and technical viewpoints.



## Chapter 2: Open Innovation: History, Definition, Technical Overview, Open Business Models, and New Frontiers

### 2.1 Introduction to Open Innovation

In the fast-paced and interconnected world of today's business landscape, innovation is the lifeblood of sustained growth and competitive advantage. Traditional closed innovation models, where organisations rely solely on their internal resources and capabilities, are facing challenges in keeping up with the accelerating pace of change. As a response to this dynamic environment, the concept of Open Innovation has emerged as a paradigm-shifting approach to foster creativity, collaboration, and knowledge sharing across organisational boundaries. This second chapter delves into the fundamental principles and mechanisms of Open Innovation, providing a comprehensive overview of its historical development, key characteristics, and applicability in various industries, as well as the new frontiers. By exploring the technical aspects, open business models, and the new frontiers of Open Innovation, this chapter aims to lay the foundation for understanding how Open Innovation can drive business success and contribute to addressing contemporary societal challenges, such as sustainable development and the United Nations' Sustainable Development Goals (SDGs). Embracing Open Innovation can empower organisations to unlock the full potential of external knowledge and resources, opening doors to new opportunities and transformative possibilities in the pursuit of innovation excellence.

### 2.2 History and Definition of Open Innovation

The concept of open innovation was first introduced by Henry Chesbrough, a prominent scholar and professor at the University of California, Berkeley. Chesbrough proposed “open innovation” in the early 2000s as an alternative to the traditional closed innovation paradigm.

The closed innovation paradigm posits that a company's success in innovation is dependent on its control over every aspect of its product development cycle, spanning from ideation to production, marketing, distribution, servicing, financing, and support. This concept originated in the early 20th century, a time when academic and government institutions were not involved in the commercial application of science, leaving other corporations to take charge of new product development. These companies became self-sufficient, with limited communication directed externally to other companies or universities. However, over the years, various factors have paved the way for open innovation paradigms, including the increasing availability and mobility of skilled workers, the growth of the venture capital market, external options for dormant ideas and, lastly, the increasing capability of external suppliers. These factors have created a new knowledge market, where knowledge is not proprietary to the company and resides in employees, suppliers, customers, competitors, and universities. Failure to utilise internal knowledge may result in its exploitation by others. While both closed

and open innovation paradigms can generate innovation, there is an ongoing debate on which paradigm will gain dominance in the future.

Open innovation challenges the notion that organisations should rely solely on their internal resources and ideas for innovation. Instead, it suggests that firms can leverage external sources, such as collaboration with partners, customers, and competitors, to drive innovation. The externalisation and internalisation of knowledge flows characterise open innovation. It involves integrating both inbound and outbound practices. Inbound practices refer to utilising external ideas and technologies within an organisation, while outbound methods involve the external commercialisation of internal thoughts and technologies.

*“Not all the smart people work for you”.*

- Bill Joy, founder of Sun Microsystems, currently VC

The fundamental concept of open innovation is to recognise that great ideas and solutions can come from a variety of sources beyond the boundaries of an organisation. Firms embracing openness and collaboration can tap into a broader pool of knowledge, resources, and expertise, outsourcing them to accelerate innovation efforts.

The concept of the innovation funnel has a significant history in the literature of innovation management. It has been predominantly employed within the framework of closed innovation by Chandlerian, where companies organise research, development, and commercialisation processes within their corporate boundaries. Chesbrough, on the other hand, utilises a funnel with some holes (Fig. 1), the open innovation funnel, as a central concept to develop some crucial insights about open innovation. The funnel is not only an intriguing concept that summarises and visualises the key lessons of open innovation, but it also has the potential to connect open innovation to existing management and theories. Hereby, we utilise specific constituent parts of the open innovation funnel (Grönlund et al., 2010) as a starting point to illustrate the concept.

Firstly, at the right side of the innovation funnel, the terms “new market” and “current market” pertain to a company's business model. At the core of open innovation is the idea of utilising business model thinking. Internal knowledge that does not align with a company's business model will be either sold or out-licensed, while external knowledge that complements the model will be brought in to create new products or businesses. To understand open innovation properly, it needs to be integrated into a company's overall strategy. Despite this, very few publications have explored the connection between a company's overall strategy, innovation strategy, and open innovation, with Chesbrough and Appleyard's work in 2007 being a notable exception.

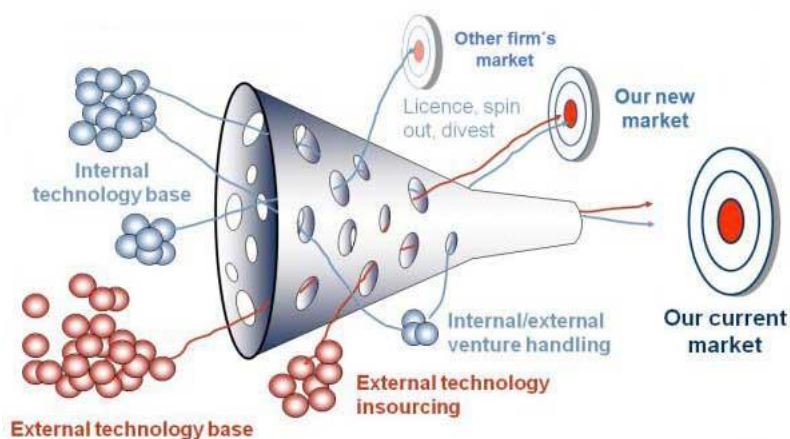
Secondly, there are arrow lines that cross the boundary of the organisation symbol. These lines represent different inter-organizational agreements. The purpose of these agreements is either to bring new ideas and technologies into the organisation's processes or to profit from unused technologies. The organisation gains knowledge through research agreements, co-development deals, corporate venturing, in-licensing agreements, or outright acquisitions. Additionally, companies may gain access to communities of users or experts, or they may rely on specialised intermediaries. Enterprises often disseminate their knowledge via partnerships, licensing agreements, and the creation of new companies. When a company adopts an open innovation approach, it must weigh the options of developing knowledge in-house, collaborating with others, or selling or licensing it. This decision-making process involves choosing whether to develop technology internally or externally through partnerships. Further research is necessary to explore the relationship between the make-buy-ally decision-making process and open innovation. It is imperative to consider how collaborating with external innovation partners can alter the organisation and boundaries of a company. Choosing the appropriate sourcing methods is critical to successful open innovation, and this decision depends on the level of uncertainty surrounding the technology and market, as well as the type of knowledge involved. The arrows in the figure illustrate the transactions occurring between organisations.

Thirdly, at the core of our business operations lies the vital function of R&D projects, represented by the dots inside and outside the funnel. These projects are born as mere ideas and gradually transform into new products, necessitating a diverse range of resources and capabilities. While some of these resources are available within our organisation, others must be sourced externally. Open innovation plays a pivotal role in driving this process and is closely aligned with the resource-based view (Barney, 1986, 1991; Wernerfelt, 1984) and knowledge-based view (Grant, 1996) of our organisation. While these views primarily focus on internal development, we recognise the importance of external competencies. To this end, we employ frameworks such as the relational-based view (Dyer & Singh, 1998) to access external resources and the knowledge-based view to manage inter-organizational relationships effectively. These frameworks have been successfully applied to several aspects of our business, including strategic alliances, external corporate venturing, and start-up acquisitions.

Finally, one effective method for managing the open innovation funnel is through the utilisation of a Stage-Gate process. While traditionally used for closed innovation processes, this approach can also be adapted for new product development procedures in an open innovation context. Given the high-risk nature of innovation, it is crucial to proceed with caution and take small, reversible steps before making larger financial commitments. The Stage-Gate process is designed to reduce technological and market uncertainties early on in the process and encourages companies to postpone significant investments until the level of uncertainty has decreased. In essence, the open innovation funnel can be seen as a carefully staged decision-making process, which can be analysed utilising the real options theory perspective (Vanhaverbeke et al., 2008).

Collaborating with external partners in the early stages of the decision-making process can prove conducive to generating a wider range of options. This approach can enable companies to arrive at better-informed decisions when considering investments in external technology during later stages of the process. As noted by Van de Vrande et al. (2009a), the innovation funnel framework can help identify various points where open innovation intersects with established management literature.

Figure 2 – The Open Innovation funnel.



Stolen with pride from Prof. Henry Chesbrough, UC Berkeley.

Open Innovation: Renewing Growth from Industrial R&D, 10<sup>th</sup> Annual Innovation Convergence, Minneapolis Sept. 27, 2004.

At the essence of the funnel is the concept that there is an outsourcing of competencies outside the borders of a firm. Venture capital represents a prime illustration of open innovation as it fosters collaboration, knowledge sharing, and external engagement. Venture capital firms act as intermediaries between innovative start-ups and external investors seeking high-growth opportunities, providing financial assistance, mentorship, and facilitating access to their networks. They actively participate in the innovation ecosystem, creating a collaborative environment for new ideas to thrive. Start-ups benefit from venture capitalists' expertise, resources, and market insights, enabling them to scale their innovations and bring their products or services to the market more effectively. This symbiotic relationship epitomises the core of open innovation, where diverse stakeholders converge to share knowledge, jointly driving the development and commercialisation of cutting-edge technologies and business models. Venture capital plays a pivotal role in accelerating innovation, promoting risk-taking, and igniting entrepreneurial ecosystems, ultimately contributing to economic growth and the advancement of society as a whole.

### 2.3 Technical Overview of Open Innovation

During the development of the open innovation concept, Prof. Henry Chesbrough identified five key elements:

1. Networking is a crucial aspect of open innovation, enabling internal knowledge to be commercialised and external knowledge to be utilised.

2. Collaboration is a formalised type of networking that involves partners, universities, competitors, and users. In recent times, a rise in collaborative projects with competitors occurred.
3. “Corporate Entrepreneurship” refers to different methods of marketing ideas, such as corporate venturing, start-ups, and spin-offs.
4. Proactive Intellectual Property Management involves more than just using intellectual property defensively to protect researchers’ ability to work on technology. Instead, it involves buying and selling intellectual property, which is important in helping markets develop by turning ideas into marketable products.
5. Research and development (R&D) are still crucial for gaining a competitive edge in the marketplace and for building a company's ability to absorb and use new knowledge. This is also known as absorptive capacity, as explained by Vallat in 2009.

In addition, Jacqueline Vallat presented a more thorough comprehension of open innovation by delineating it according to the following components, which were extrapolated from Chesbrough's original five elements. The updated definition of open innovation is grounded in these fundamental components.

1. Building comprehensive linkages that encompass all stakeholders involved in the process of advancement, including enterprises, educational institutions, research organisations, governmental bodies, consumers, and consumer groups, is indispensable for fostering transparent collaboration and generating positive outcomes across the ecosystem. This approach slightly transcends Chesbrough's original vision, as it allows for various forms of collaboration among multiple parties, with a focus on creating overall value rather than exclusively benefiting individual firms.
2. Consumer involvement and centrality: innovation that prioritises the needs of the user is imperative for successful service convergence. It is crucial to involve the user as a starting point in identifying technological needs and as the ultimate goal for achieving service convergence. To achieve this, a “service pull” model of innovation should be followed, where the user's role is of prime importance. Hence, innovation must be a collaborative effort between the industry or provider of service and the consumer, with the aim of co-creation. In addition, crowdsourcing can be effectively used to gather valuable ideas from communities and optimally utilise societal capital.
3. In order to maximise the potential of networking and user engagement, it is imperative to establish efficient and effective platforms that facilitate the exchange of ideas from diverse communities. These platforms serve as a means of fostering interaction between service providers and users and are increasingly becoming a vital component of the future of service provision. They afford users the opportunity to coordinate between various services and customise them to suit their unique needs.

Furthermore, in the realm of open innovation research, scholars have identified two primary categories that share fundamental similarities despite being referred to by various names. These categories include discovery

and exploitation, inbound and outbound, and inside-out and outside-in. The common thread among these terms is the direction of innovation, whether it originates from external sources or from within the company itself. In this regard, there are four main approaches that a firm can have:

- Revealing

One type of open innovation is known as non-pecuniary outbound innovation or revealing innovation. This occurs when a company shares its resources with partners unreservedly without the expectation of an immediate financial gain. Instead, this type of innovation benefits the company in the long term by helping to create new business models.

The rapid pace of technological advancement is a significant benefit of the open innovation method. The prevalence of Web 2.0 and its subsequent advancements have played a significant role in promoting the distribution of open innovation. The Internet has provided new possibilities that have lifted many barriers, allowing for increased access to information, reduced communication costs, and the ability for SMEs to participate in the global arena. In the publication by Chesbrough & Prencipe (2008), it is suggested that the continuous advancements in internet and social networking technologies present companies with an opportunity to engage with multiple sources and attain unparalleled levels of insight. This, in turn, enables companies to incorporate their customers, suppliers, and other partners at the core of their product development process. To achieve this, companies can leverage online idea management or community participation in product development. This is a testament to the transformative power of technology in fostering greater collaboration and innovation in business. By investing in technology, contributors can expedite development and decrease costs per user. For instance, the British steel industry experienced substantial progress during the 19th century due to the free exchange of inventions among competitors. In contrast, Watt's steam engine remained unchanged for two decades during patent protection. Only after the technology became universally available did further development occur.

Relying solely on traditional intellectual property (IP) mechanisms like patents, trademarks, or copyright protection is not enough for companies to take advantage of open innovation. Instead, a more informal approach should be adopted, such as prioritising time to market, gaining a leadership advantage, or establishing a lock-in. However, freely sharing information with third parties does not guarantee successful innovation. Some companies choose to disclose a portion of their information for societal benefit, encouraging collaboration without legal arrangements. While a lack of robust IP protection can unite the efforts of numerous contributors and achieve a cumulative effect, competitors may exploit freely available technology, especially if they have more resources and superior production facilities. Large companies have sophisticated decision-making systems to determine which knowledge to protect and which to reveal. However, this can be challenging for Small and Medium Enterprises (SMEs) who often lack the resources to formalise the process. When considering a strategy for open innovation, companies should balance between disclosing and safeguarding IP based on the conditions in their industry.

- Selling

“If you do not use it, you might lose it. [...] So, why don't you commercialise it?”

- Henry Chesbrough, *the father of open innovation*

Another type of open innovation is pecuniary outbound innovation or selling innovation. In this case, a company commercialises its inventions and technology by selling or licensing them to third parties.

In order to augment their revenue, companies can consider leveraging previously unused technologies. Many companies have amassed a significant number of patents over time as part of their patent development policy. However, these patents were not commercialised as they did not align with the company's core business or strategy. By selling or licensing these patents, a company can increase its returns on research and development (R&D). Traditional notions of technology management need to be expanded for companies that fund research generating spillovers to develop a better business model to commercialise their spill-over technologies (Chesbrough and Rosenbloom, 2002, p. 550). Licensing inventions and technologies have become more popular, with some companies making it a strategic priority (Fosfuri, 2006). Despite these advancements, numerous barriers still exist that hinder IP trade. One possible solution to this problem is a common IP exchange operating under a shared set of rules. However, an inherent disadvantage of this approach is the *disclosure paradox*, where inventors are hesitant to reveal information about their invention to potential buyers out of fear that the buyer will use their invention without paying. On the other hand, buyers are reluctant to pay for an invention without having all the pertinent information, which is normal purchasing behaviour. This situation can create a gap in technology development and is an example of patent protection working against the common good of society. Additionally, the high costs of technology transfer, which can be up to 70% if the potential of the technology market is not fully realised (Gambardella et al., 2007), present another challenge associated with the trade of IP. Companies also face difficulties in determining the appropriate value for their inventions due to a mental paradigm that is biased toward technology, hindering proper commercialisation (Chesbrough and Rosenbloom, 2002). Many companies are willing to license their technology but lack a well-defined strategy for commercialising their inventions outside their own company (Lichtenthaler & Ernst, 2007). One way to overcome the *disclosure paradox* is for the seller to hold a formal IPR before negotiating technology licensing. However, this approach can increase the costs associated with IP transfer.

- Sourcing

Non-pecuniary inbound innovation, or sourcing innovation, is yet another type of open innovation. In this scenario, companies leverage available external knowledge as a source of internal innovation. Prior to embarking on any internal R&D project, companies should survey the external environment for existing solutions. Thus, internal R&D serves as a tool for absorbing external ideas to fulfil inner needs.

Extensive research has demonstrated that the acquisition of external information is essential for successful innovation (Rothwell, 1994, p. 19). The concept of openness was further defined by Laursen and Salter (2004, p. 1204) as the number of external knowledge sources utilised by a company in its innovative endeavours. The literature on open innovation underscores the importance of leveraging the inventions of others and suggests that the more open a company is, the more opportunities it has for innovation. However, it is essential to note that human attention is limited, and excessive research can lead to inefficiencies in the research process (Katila & Ahuja, 2002). Research conducted on British manufacturing firms has revealed that a broad and in-depth search for innovation can result in a decline in innovation performance during later periods (Laursen & Salter, 2005). As a result, companies should determine a point beyond which external search should cease, and they should begin developing their own innovations based on the industry in which they operate.

- Acquiring

In order to gain new ideas from external sources, businesses can engage in licensing or other methods of compensation for knowledge. This is referred to as pecuniary inbound innovation.

In terms of procuring technology, adopting a stable and predictable approach offers distinct advantages. Companies can have confidence in their knowledge of what they are paying for. However, closing deals for intellectual property (IP) poses a significant challenge, as it requires a certain level of expertise. It is crucial for companies to maintain control over certain aspects of their innovation networks. The process of identifying which innovations to acquire can prove challenging, as technology that is too far removed from a company's accustomed practices may be difficult to incorporate into its innovation pipeline, while knowledge that is too similar may not significantly impact innovativeness (Sapienza et al., 2004). Accordingly, companies must strive to strike the right balance between the knowledge domain of the innovation being acquired and its potential for reuse in a new product. Although previous research has tended to focus on specific types of open innovation, only a few have taken a holistic approach to the issue (Van de Vrande et al., 2009). Contingent to the industry and its stage of development, companies must carefully select the most appropriate form of open innovation for their specific business model. In certain instances, a strategic approach might involve blending various open innovation methods, as exemplified by Procter & Gamble's Connect + Develop initiative (Dodgson, Gann & Salter, 2006).

Table 1 – Open Innovation matrix

	<b>Inbound</b>	<b>outbound</b>
<i>pecuniary</i>	Acquiring	Selling
<i>non-pecuniary</i>	Sourcing	Revealing



The technical aspect of open innovation encompasses the processes, methods, and tools that enable organisations to implement open innovation strategies effectively. These aspects provide a comprehensive understanding of the technical underpinnings of open innovation and highlight the importance of actively seeking external ideas, engaging in collaborative partnerships, and managing intellectual property to leverage the full potential of open innovation. By effectively implementing these technical elements, organisations can harness the power of collective intelligence, access diverse expertise, and accelerate innovation outcomes. Key components of the technical overview include idea generation and acquisition, collaboration and co-creation, and intellectual property management.

### 2.3.1 Idea Generation and Acquisition

In open innovation, idea generation and acquisition involve actively seeking external ideas, insights, and technologies to complement and enhance internal innovation efforts. Organisations can tap into the collective intelligence of a broader network of individuals, including customers, suppliers, research institutions, and even competitors, to source innovative ideas. By leveraging external sources, organisations can gain access to diverse perspectives, expertise, and novel solutions that may have yet to be possible through internal efforts alone. Idea generation methods can include open innovation contests, crowdsourcing platforms, hackathons, and collaborative research projects, sparking creativity and cross-fertilisation of concepts. This approach promotes a collaborative and inclusive culture of innovation and expands the potential for breakthrough ideas and a more comprehensive exploration of potential solutions to complex problems and challenges. One of the primary advantages of idea generation in open innovation is the abundance of fresh and novel perspectives. When organisations embrace external contributions, they break free from the limitations of internal thinking and gain access to unique insights from customers, users, and partners. This diversity of viewpoints can lead to breakthrough ideas that may have been overlooked or never considered within the confines of the organisation's walls.

Open innovation also facilitates a more iterative and continuous ideation process. In traditional closed innovation, the organisation's internal R&D teams might be limited by time, resources, and expertise. However, by embracing external contributions, open innovation allows for continuous input and feedback. This iterative approach enables rapid refinement of ideas and the ability to adapt to changing market needs and emerging trends, ensuring that innovations remain relevant and competitive.

Furthermore, open innovation encourages risk-taking and experimentation. By involving external stakeholders, organisations gain access to a broader pool of potential users and early adopters who are more willing to participate in trials and experiments. This openness to experimentation allows for rapid prototyping and the testing of multiple ideas simultaneously, accelerating the innovation process.

Beyond the immediate benefits of idea generation, open innovation has long-term advantages as well. By engaging external partners and collaborators, organisations can build strategic relationships that extend far

beyond the initial ideation phase. These partnerships can lead to co-development, co-marketing, and co-commercialization opportunities, enabling firms to leverage shared resources and capabilities for mutual success.

### 2.3.2 Collaboration and Co-creation

Collaboration and co-creation are essential aspects of open innovation. Organisations engage in partnerships, joint ventures, and research collaborations with external entities to co-create innovative solutions. Collaboration involves the exchange of knowledge, resources, and expertise to develop new products, services, or technologies jointly. Co-creation emphasises the active involvement of external stakeholders, such as customers or users, in the innovation process. By collaborating and co-creating with external partners, organisations can leverage their complementary strengths and capabilities, reduce time-to-market, share risks and costs, and create value that goes beyond what they could achieve individually. Unlike traditional closed innovation models, which rely predominantly on internal expertise, open innovation actively involves external stakeholders, fostering a collaborative environment where diverse perspectives converge to address challenges and seize opportunities.

Collaboration in open innovation is exemplified by the active engagement of organisations with external partners, customers, suppliers, research institutions, and even competitors. By forging strategic alliances and partnerships, organisations gain access to a broader spectrum of knowledge, resources, and capabilities. This collaboration facilitates the exchange of ideas, best practices, and industry insights, enriching the collective pool of expertise and enhancing the quality of innovative solutions.

Moreover, open innovation embraces co-creation, where multiple stakeholders actively participate in the creation and development of new products, services, or processes. Co-creation activities such as workshops, innovation challenges, and joint research projects stimulate collective problem-solving and generate innovative ideas that address real-world needs.

The collaborative and co-creative nature of open innovation not only accelerates the innovation process but also promotes a culture of trust and mutual benefit among participating organisations. By embracing open collaboration, organisations can share risks, costs, and knowledge, ultimately fostering a spirit of shared success and collective advancement not bound by geographical constraints. Digital platforms and virtual collaboration tools enable seamless communication and cooperation among participants from diverse locations and backgrounds, transcending boundaries and facilitating global interactions.

By integrating collaboration and co-creation into their innovation strategies, organisations can leverage external expertise, overcome internal biases, and cultivate an environment of collective ownership. This approach increases the chances of developing ground-breaking innovations that resonate with end-users and deliver meaningful value to the market.

### 2.3.3 Intellectual Property Management

Intellectual property (IP) management is a crucial element in open innovation. In the closed models, the idea is that the firm owns IP in the fortress of a legal right, being considered a non-shareable internal resource. In the open models, there is an inclusive approach of exchange inside-out or outside-in through licensing or buying intellectual property in order to use it instead of trying to generate it internally or from scratch.

As organisations engage in external collaborations and share knowledge, they need to carefully manage their intellectual assets to protect their competitive advantage and ensure a fair and equitable distribution of benefits. This involves establishing clear agreements and contracts that define ownership, rights, and responsibilities regarding intellectual property generated through collaborative efforts. Organisations must navigate legal frameworks, licensing agreements, and confidentiality agreements to strike a balance between protecting their IP and fostering an open and collaborative environment. Effective IP management promotes trust, facilitates knowledge sharing, and encourages innovation while safeguarding the rights and interests of all parties involved.

## 2.4 Open Business Models

Open business models are a specific application of the broader concept of open innovation. In the ever-evolving landscape of innovation, embracing open business models, as proposed by Henry Chesbrough in his influential book “Open Business Models: How to Thrive in the New Innovation Landscape”, has become a catalyst for organisations seeking sustainable success. Traditional closed innovation models often restrict companies from relying solely on their internal capabilities, limiting their potential for breakthrough innovations. In contrast, open business models encourage organisations to actively collaborate with external stakeholders, creating a fertile ground for co-creation and knowledge exchange.

Open innovation often goes hand in hand with adopting available business models. Open business models involve rethinking traditional value creation, distribution, and capture approaches. They emphasise collaboration, sharing, and the creation of ecosystems that bring together multiple stakeholders.

One illustrative example of the application of open business models is found in the tech industry. Companies like Google, through its Android operating system, exemplify open innovation by allowing external developers to contribute and build applications on their platform. This open approach has led to a vast and diverse ecosystem of applications, driving user engagement and expanding Google’s reach beyond what could have been achieved solely through internal development efforts.

In the healthcare sector, pharmaceutical companies are adopting open business models to accelerate drug discovery and development. Collaborative research projects with academic institutions and start-ups facilitate the pooling of resources and expertise, expediting the journey from the laboratory to the market. This open

approach not only speeds up the innovation process but also allows for a broader perspective on tackling complex health challenges.

Another compelling example of open business models can be found in the automotive industry, where car manufacturers are collaborating with tech companies to develop autonomous driving technologies. By embracing open innovation, automakers can tap into the expertise of technology firms, benefiting from their knowledge of artificial intelligence, sensors, and connectivity. This collaboration fosters the creation of cutting-edge autonomous driving systems, driving the industry towards a safer and more sustainable future. The present thesis scrutinises the manifold applications of open business models and utilises Chesbrough's principles as a framework to navigate the constantly evolving innovation landscape and attain triumph in the synergic application of SDGs goals.

There exist various open business models which may be adopted, including but not limited to:

- Platform-based Models

Platform-based models are a type of open business model that leverages digital platforms to create ecosystems where multiple actors can interact, exchange resources, and co-create value. These platforms serve as intermediaries, facilitating collaboration and innovation. Examples of platform-based models include Uber, Airbnb, and Amazon. These platforms provide the infrastructure, tools, and marketplaces that enable individuals, developers, users, and partners to connect and collaborate. Platform-based models have transformed various industries, disrupting traditional business models and unlocking new opportunities for value creation.

- Licensing and Royalty Models

Licensing and royalty models involve organisations monetising their innovations by licensing their technologies or intellectual property to external parties. By licensing their innovations, organisations can benefit from additional revenue streams while the licensees gain access to valuable technologies or intellectual property. This approach allows for the wider diffusion and commercialisation of innovations, fostering further collaboration and driving economic growth. Licensing and royalty models can be particularly beneficial in industries such as technology, where intellectual property plays a significant role.

- User Innovation Communities

Engaging users as co-creators and involving them in the innovation process is a key aspect of open business models. User innovation communities are a type of open business model where users actively contribute their ideas, expertise, and feedback to the innovation process. Examples of user innovation communities include open-source software communities like Linux or user-driven product development forums such as LEGO

Ideas. These communities enable users to participate in the creation and improvement of products and services, fostering a sense of ownership, collaboration, and innovation. User innovation communities can lead to the development of innovative solutions that align closely with user needs and preferences.

## 2.5 “Why open up now? The changing economics of innovation”

*“The future ain't what it used to be”.*

- Lorenzo Pietro “Yogi” Berra, Major League Baseball catcher.

The West, intended as the developed countries, is seeing a progressive deterioration of structured corporate research. That is, of the large R&D laboratories of the twentieth century, little or nothing remains as large companies are converting them or diverting them to other countries where labour has lower costs. Not even the hope of start-ups is decisive in stopping the haemorrhage of research, pressed by a growing crisis of online business and the venture capital market. Furthermore, the increase in technology development costs has combined with the shortening of the product life cycle and with the possibility of quickly finding useful and cheap knowledge and technologies scattered among both large and small companies. With these assumptions, it is clear to understand how much ideas and their development can be the *new century's raw material*. Within this picture, the flow of ideas work has also varied. The growing *innovation division of labour* (Chesbrough, 2013) is the real twist in the flow. According to Chesbrough, this is a system in which one party takes care of generating the idea but does not place it directly on the market. A second party buys or associates with the idea and eventually capitalises on it by bringing it to market. Companies that adopt open business models are able to enter this flow and, therefore, obtain the benefits of a portion of that value since they can, at least partially, outsource the idea-generation process. Henry Chesbrough highlights the significant potential for cost savings that can be achieved through open innovation and open business models. Embracing openness and collaboration with external partners can lead to streamlined processes, reduced research and development (R&D) costs, and more efficient resource utilisation. By tapping into the collective intelligence of a broader ecosystem, firms can access a diverse array of ideas and expertise without incurring the full burden of internal development efforts. For example, open innovation contests and crowdsourcing platforms enable companies to access a global talent pool, allowing them to identify innovative solutions without the need for extensive in-house R&D. Additionally, open business models that involve partnerships and collaborations can lead to cost-sharing arrangements, shared infrastructure, and access to external resources, all of which contribute to overall cost efficiency. Furthermore, corporate cross-pollination can occur between different industries, as in the case of P&G and the musical Chicago in relation to licensing (Chesbrough, 2006). This opens up a wider range of opportunities: an idea that is not very useful for a particular company can find greater usefulness in another, even in another sector, between companies or through the *markets for ideas* and technologies

(Natalicchio, 2014). By leveraging the principles of open innovation and open business models, organisations can achieve substantial cost savings while driving innovation and gaining a competitive edge in the new innovation landscape.

## 2.6 New Frontiers of Open Innovation

*“In theory, there is no difference between theory and practice. In practice, there is”.*

- Lorenzo Pietro “Yogi” Berra, Major League Baseball catcher.

As the field of open innovation continues to evolve, new frontiers are emerging. This section explores the impact of the digital age and sustainability on open innovation practices, emphasising the role of digital platforms, collaboration, and the integration of sustainability objectives. Furthermore, it discusses the emergence of open innovation ecosystems as vibrant networks that foster collaboration, knowledge exchange, and resource sharing. These new frontiers of open innovation create exciting opportunities for organisations to drive innovation, enhance competitiveness, and contribute to societal and environmental well-being. Some of the notable areas of exploration include the following.

### 2.6.1 Open Innovation in the Digital Age

The digital age has revolutionised open innovation practices. Technological advancements, particularly in digital platforms, have enabled global collaboration, data sharing, and the development of new business models. The digital transformation has accelerated the speed and scale of open innovation, allowing organisations to tap into a global network of talent, resources, and knowledge. Digital platforms provide the infrastructure and tools necessary for open innovation to thrive, enabling virtual collaboration, crowdsourcing, and co-creation. Organisations can leverage the power of big data, artificial intelligence, and cloud computing to enhance open innovation efforts and drive transformative outcomes.

### 2.6.2 Open Innovation and Sustainability

The integration of open innovation principles with sustainability objectives is a crucial frontier in the field. Open innovation can play a vital role in addressing complex sustainability challenges, such as climate change, resource scarcity, and social inequality. By promoting collaboration, knowledge sharing, and the development of sustainable solutions, open innovation can drive the transition to a more sustainable and inclusive future. Organisations can engage stakeholders, including customers, suppliers, NGOs, and communities, in the innovation process to collectively tackle sustainability issues. Open innovation fosters the exchange of ideas,

expertise, and resources, enabling the co-creation of innovative solutions that align with environmental and social goals.

### 2.6.3 Open Innovation Ecosystems

Open innovation ecosystems are dynamic networks of organisations, start-ups, academia, government bodies, and other stakeholders collaborating to drive innovation. These ecosystems create an environment conducive to open innovation, fostering collaboration, knowledge exchange, and resource sharing. Open innovation ecosystems enable organisations to tap into diverse expertise, access new markets, and leverage shared resources. They provide platforms and initiatives, such as innovation hubs, accelerators, and research consortia, that facilitate collaboration and the development of new ideas and ventures. Open innovation ecosystems cultivate an innovation-driven culture, strengthen regional economies, and foster the growth of start-ups and small and medium-sized enterprises (SMEs).

Partnerships and alliances are not limited to internal R&D efforts but involve tapping into external expertise, knowledge, and resources to drive innovation, especially in the context of sustainable development and the achievement of the Sustainable Development Goals (SDGs).

Open innovation partnerships represent a departure from traditional closed innovation models. They involve collaborations between a wide range of stakeholders, including corporations, start-ups, academic institutions, governments, and non-profit organisations. Several key aspects characterise these partnerships:

- **Shared Objectives:** open innovation partnerships are established with shared objectives related to sustainability and the SDGs. Partners align their efforts to address pressing global challenges, such as climate change, poverty reduction, or access to clean energy.
- **Resource Sharing:** partners contribute a diverse set of resources, which may include financial resources, technological expertise, research capabilities, and market access. These pooled resources enable collaborative problem-solving and innovation.
- **Co-Creation:** collaboration is not limited to sharing resources but extends to co-creating solutions. Partners work together to develop innovative products, services, and technologies that contribute to sustainable development.
- **Risk Sharing:** open innovation partnerships distribute risks and rewards among participants. This encourages experimentation and the pursuit of high-impact projects, as the burden of risk is shared collectively.

Open innovation partnerships come in various forms, each serving specific purposes:

- **Public-Private Partnerships (PPPs):** these collaborations involve government entities partnering with private companies. PPPs are instrumental in developing sustainable infrastructure, deploying new technologies, and implementing policies that support sustainability.



- **Academic-Industry Collaborations:** universities and research institutions collaborate with corporations to advance sustainable technologies and conduct research that can be applied to address sustainability challenges.
- **Corporate-Start-up Alliances:** established corporations often partner with innovative start-ups to infuse fresh ideas, agile practices, and disruptive technologies into their sustainability efforts.
- **Cross-Sector Partnerships:** collaboration across sectors, such as technology, healthcare, finance, and energy, enables holistic approaches to sustainability challenges. These partnerships leverage the expertise and resources of various industries to create comprehensive solutions.

## 2.7 Conclusion

This chapter has provided an overview of open innovation, starting with its history and definition. Henry Chesbrough, a renowned scholar and professor at the University of California, Berkeley, introduced the idea of open innovation. In 2003, Chesbrough posited this idea as an alternative to the traditional approach of closed innovation (*Open Innovation: The New Imperative for Creating and Profiting from Technology*, 2003).

The open innovation funnel is a graphic representation that illustrates the process of open innovation, starting from the broad exploration of external ideas and progressively narrowing down to the selection and implementation of the most promising ones. It serves as a visual interpretation of how open innovation fosters collaboration and knowledge exchange with a diverse array of stakeholders, leading to the identification and development of innovative solutions.

Despite the different names, there are two categories that share many similarities, including discovery and exploitation, inbound and outbound, and inside-out and outside-in. They express the direction of innovation, whether it originates from external sources or from within the company itself, and we can categorise four main approaches of a firm towards open innovation: Acquiring, Selling, Sourcing, and Revealing.

We have explored the technical aspects of open innovation, including idea generation, collaboration, and intellectual property management. The open innovation process for generating ideas is a powerful and transformative approach that leverages the collective intelligence of a diverse ecosystem. By embracing external inputs, organisations are able to tap into fresh perspectives, foster collaboration and knowledge sharing, and promote continuous innovation. This inclusive methodology not only leads to the development of more innovative and competitive solutions but also presents opportunities for strategic partnerships and collaborative growth over the long term. In a rapidly evolving and interconnected world, open innovation provides a compelling avenue for staying ahead of the innovation curve and addressing the ever-evolving needs of customers and society. Idea generation in open innovation thrives on the diversity and inclusivity of the approaches it embraces. Open innovation contests, crowdsourcing platforms, hackathons, and collaborative research projects all serve as powerful mechanisms to engage external stakeholders, inspire creativity and drive collaborative problem-solving. By leveraging the collective intelligence and creativity of



a broader ecosystem, organisations can uncover ground-breaking ideas and transformative solutions that have the potential to reshape industries and positively impact society as a whole. These open innovation practices reflect the belief that the power of collective ideation far exceeds that of any individual, making it a pivotal aspect of driving innovation in the modern world.

Innovation is also a product of collaboration and co-creation, two essential components of open innovation. When organisations engage external stakeholders, they gain access to new sources of creativity and knowledge. By adopting a collaborative approach and undertaking co-creation activities, innovative solutions can be developed to address real-world problems and yield positive societal impact. This new model of open innovation emphasises working together to achieve outcomes that surpass what any individual or organisation could accomplish independently.

We also treated the intellectual property management concept. In the open models, IP is a shareable resource, making a firm able to license it to others or buy it from outside the organisation's borders.

The chapter has also delved into the concept of open business models and the new frontiers of open innovation, such as the digital age and sustainability. Open business models, as championed by Henry Chesbrough, have proven instrumental in transforming industries and driving sustainable success. By breaking down traditional barriers and embracing external collaboration, organisations unlock a wealth of ideas, technologies, and expertise that fuel innovation and competitive advantage. The examples provided illustrate how open business models empower companies to leverage collective intelligence, broaden their market presence, and address complex challenges more effectively. As this thesis explores the diverse applications of open business models, the principles laid out by Chesbrough serve as a guiding light, illuminating the path towards thriving in the new innovation landscape.

Finally, open innovation is evolving with a focus on digital platforms and sustainability as new frontiers. Collaboration and open innovation ecosystems are key to driving innovation, improving competitiveness, and contributing to society and the environment.

The subsequent chapters will delve further into the application of open innovation in the context of ESG and the SDGs, focusing on European firms and their practices.

## Chapter 3: Sustainable Development Goals (SDGs) and their Relation to Open Innovation: A Perspective on the European Situation

In the first chapter, it was noted that the Sustainable Development Goals (SDGs) established by the United Nations represent a comprehensive framework for addressing global challenges and promoting sustainable development. At the same time, open innovation has emerged as a transformative approach to driving innovation and value creation in the modern business landscape. This chapter delves into the analysis of the relationship between open innovation and the SDGs, exploring how open innovation practices can align with and contribute to the achievement of the SDGs. Additionally, the chapter concludes with insights into how the European context presents unique opportunities and challenges in leveraging open innovation to address sustainable development goals.

### 3.1. The Alignment of Open Innovation with the SDGs

Open innovation represents a strategic and operational framework that closely aligns with the overarching objectives and principles of the Sustainable Development Goals (SDGs). The SDGs, adopted by the United Nations, encompass 17 interrelated goals designed to address global challenges, including poverty, inequality, climate change, environmental degradation, and social justice. Here, we explore how open innovation principles and practices align with and contribute to the achievement of the SDGs:

**Collaboration for Inclusive Solutions:** one of the fundamental principles of open innovation is collaboration, and the SDGs similarly emphasise the importance of global collaboration to tackle complex global issues. Open innovation invites diverse stakeholders, such as customers, suppliers, research institutions, and start-ups, to actively participate in the innovation process. By fostering inclusive and diverse collaborations, open innovation contributes to the creation of solutions that address societal challenges in a more holistic and equitable manner.

**Leveraging External Expertise:** open innovation encourages organisations to tap into external sources of knowledge and expertise, which is directly aligned with the SDGs' emphasis on leveraging the collective intelligence of the global community. External stakeholders bring unique perspectives and insights that can be harnessed to develop innovative solutions for sustainable development. Whether it is co-creating technologies for clean energy, healthcare access, or poverty reduction, open innovation amplifies the impact of external expertise on achieving SDG targets.

**Accelerating Innovation for SDGs:** the SDGs set ambitious targets with a relatively tight timeframe. Open innovation practices, such as hackathons, open-source software development, and crowdsourcing, can expedite the innovation process. These approaches encourage rapid prototyping and experimentation, enabling

organisations to respond swiftly to pressing societal challenges. By accelerating innovation cycles, open innovation contributes to timely progress towards SDG goals.

**Knowledge Sharing and Transparency:** open innovation champions the sharing of knowledge, data, and resources among stakeholders. This culture of knowledge exchange aligns with the transparency and information-sharing objectives of the SDGs. Open data initiatives, for instance, provide accessible data that policymakers, researchers, and innovators can use to inform evidence-based decision-making and monitor progress towards SDG outcomes.

**Market-Driven Solutions:** many SDGs require market-driven solutions to ensure sustainability and scalability. Open innovation practices often involve market-oriented approaches, including licensing, partnerships, and co-development agreements. By engaging with external partners, organisations can accelerate the commercialisation and dissemination of innovations that address SDG-related challenges.

Nestlé, a Swiss-based multinational food and beverage company, has embraced open innovation to align with SDG 2 (Zero Hunger), which focuses on eradicating hunger, achieving food security, improving nutrition, and promoting sustainable agriculture. Nestlé has initiated various open innovation efforts, including collaboration with start-ups and technology partners to develop sustainable agricultural practices. For example, Nestlé partnered with the Swiss Federal Institute of Technology (EPFL) to explore advanced technologies for precision agriculture, leading to improved crop yields, reduced resource consumption, and enhanced food security. This open innovation approach directly contributes to SDG 2's objectives by addressing global food challenges through sustainable and innovative solutions.

According to Tom Wagner, Head of R&D Accelerator programme, Nestlé provides both internal and external entrepreneurs with all the necessary resources and support to bring their innovative ideas to life. Their state-of-the-art facilities, including analytical labs, experimental kitchens, and prototyping and production facilities, allow entrepreneurs to test their products under real market conditions.

### 3.2. Open Innovation for Social Impact and Environmental Sustainability

Open innovation serves as a potent catalyst for generating significant social impact and effectively addressing the social challenges embedded within the Sustainable Development Goals (SDGs). Moreover, environmental sustainability is a key pillar of the SDGs, and open innovation can play a vital role in addressing environmental challenges. Collaborative research projects, technology-sharing partnerships, and open-source initiatives can accelerate the development and dissemination of eco-friendly technologies and practices, contributing to climate action and the preservation of natural resources. Following, we explore some key points of the two subjects.

**Inclusivity and Accessibility:** open innovation inherently promotes inclusivity and accessibility by involving a broad spectrum of stakeholders in the innovation process. This inclusivity aligns with the SDGs' aim to leave no one behind. Through initiatives like open innovation challenges and co-creation workshops, individuals from diverse backgrounds, including marginalised communities, can actively participate in solving critical societal challenges. This leads to solutions that are more equitable and considerate of the needs of all, advancing goals related to social equality (SDG 10) and reducing inequalities (SDG 5).

**Addressing Healthcare Disparities:** open innovation has demonstrated its potential to address healthcare disparities and improve access to quality healthcare, a pivotal aspect of SDG 3 (Good Health and Well-being). Collaborative healthcare innovation platforms, telemedicine solutions, and community-driven healthcare projects exemplify how open innovation can expand access to healthcare services, particularly in underserved regions. Such initiatives empower individuals and communities to take charge of their health and well-being.

**Poverty Alleviation and Economic Empowerment:** several SDGs are intricately linked to poverty reduction (SDG 1) and economic empowerment (SDG 8). Open innovation fosters the development of innovative solutions, business models, and livelihood opportunities that can lift individuals and communities out of poverty. For instance, social entrepreneurship ventures that emerge from open innovation efforts often create sustainable income-generating activities and contribute to poverty alleviation efforts.

**Education for All:** quality education (SDG 4) is a cornerstone of sustainable development. Open innovation in education includes open educational resources, online learning platforms, and collaborative educational initiatives. These efforts not only enhance access to education but also improve its quality and relevance. Open education initiatives empower learners of all ages and backgrounds to acquire knowledge and skills, aligning with the SDG's commitment to inclusive and equitable education.

**Social Innovation Ecosystems:** open innovation practices contribute to the development of vibrant social innovation ecosystems. These ecosystems are catalysts for social entrepreneurs and innovators to address diverse social challenges, from clean energy adoption (SDG 7) to environmental conservation (SDG 15). Through co-working spaces, incubators, and collaborative networks, open innovation fosters an environment where social enterprises can thrive and create positive societal impact.

**Disaster Response and Resilience:** open innovation plays a pivotal role in disaster response and building community resilience (SDG 11). Crowdsourcing platforms and real-time data sharing enable rapid response and recovery efforts during crises. Open innovation allows communities to collaborate with experts, governments, and humanitarian organisations to develop innovative disaster preparedness and response strategies.

Next, we will review some cases of European firms regarding this matter.

Siemens, a German multinational conglomerate, exemplifies how open innovation can drive social impact by addressing SDG 7 (Affordable and Clean Energy) and SDG 9 (Industry, Innovation, and Infrastructure). Siemens has developed a dynamic innovation ecosystem that collaborates with start-ups, universities, and

research institutions to address energy and infrastructure challenges. For instance, Siemens' partnership with the European Institute of Innovation and Technology (EIT) InnoEnergy has led to the development of innovative clean energy solutions. These solutions, such as advanced wind turbines and energy-efficient technologies, contribute to affordable and clean energy access while promoting innovation and infrastructure development, aligning with SDGs 7 and 9.

Kendra Rauschenberger, General Partner of Siemens Energy Ventures, reported that the firm's top priority is to accelerate its impact. According to the General Partner, becoming part of EIT InnoEnergy's ecosystem and engaging with its broad portfolio of cleantech start-ups will further help Siemens achieve the goal and make significant progress towards their mission.

The profitable effects of open innovation are also reported on the other side of the collaboration. In support of this statement, Christian Müller, a Member of the Executive Board of EIT InnoEnergy, adds that collaboration with a prominent global leader in energy transition presents a unique and valuable opportunity to advance the ventures and contribute to the energy transition effort in a remarkable and accelerated way.

Furthermore, Novartis, a Swiss multinational pharmaceutical company, demonstrates a commitment to open innovation for social impact through initiatives like *Novartis Open Labs*, part of the Federated Innovation @MIND. These labs provide external researchers and organisations with access to Novartis' compound libraries and expertise, fostering collaborative research to address health challenges. Novartis' open innovation approach aligns with SDG 3 (Good Health and Well-being) by facilitating research into novel treatments and enhancing access to medicines for various diseases, including neglected tropical diseases, in order to promote good health and well-being. The goal is to create a collaborative environment among 32 companies to accelerate the development of new products, processes, and services that contribute to the economic recovery of the country. Novartis is involved in three areas of focus: Value-Based Health Care, Open Data & Digital, and Sustainability & Circular Economy. These workstreams bring together not only companies but also the academic world, training and research institutes to share resources, knowledge, and technologies and co-create innovative solutions.

Bosch, a German multinational engineering and technology company, actively participates in open innovation ecosystems to advance industry, innovation, and infrastructure (SDG 9). Bosch collaborates with start-ups, universities, and research institutions through initiatives like the *Bosch Start-up Grow Platform* to drive innovation in various domains, including mobility and smart cities. By leveraging these ecosystems, Bosch accelerates the development of innovative solutions that contribute to sustainable industrial growth and infrastructure development. At present, the Bosch Incubator's growth platform has over 275 Intrapreneurs who are actively identifying and exploring fresh markets and business avenues. As a fully owned subsidiary of the Bosch Group, the platform enables and promotes the scaling and funding of innovative business models that arise within internal divisions and entities.

### 3.3. Leveraging Open Data for Sustainable Development

Open data plays a crucial role in driving open innovation for the SDGs. By making relevant data openly accessible, organisations can facilitate data-driven decision-making and foster a culture of transparency and accountability. Open data initiatives can enable data sharing across sectors and borders, supporting evidence-based policymaking and progress monitoring towards SDG targets.

The Open Data Institute (ODI) is a non-profit company founded in 2012 by the inventor of the web, Sir Tim Berners-Lee, and AI expert Sir Nigel Shadbolt, that collaborates with businesses and governments to establish an open, transparent and reliable data ecosystem. According to Liz Carolan, International Development Manager at ODI, implementing an Open Data initiative is ultimately about carrying out a piece of cultural and institutional change. When establishing an initiative, there are five key factors to consider to ensure its success. One of the essential elements we have observed in many successful initiatives is a clear leadership mandate. It is crucial to ensure that the implementation team receives unwavering support from the highest levels of the organisation during times of resistance to change. This support will enable them to navigate through the challenges they face and emerge successful in their efforts.

Secondly, the significance of the demand for data cannot be overlooked. It is imperative to invest time, energy, and capital into publishing data only if there is a potential market of individuals who are willing and capable of utilising it to create value-added services, products, and innovative ideas.

The third point pertains to engagement, specifically, how to foster engagement with potential data users from the outset. In successful initiatives within civil society, the private sector, and academia, there are structured methods for obtaining feedback and engaging with users. It is essential to create avenues for engagement and feedback with possible data users from the external world.

Furthermore, when implementing an Open Data initiative, it is important to consider the cultural change aspects as well. While technical aspects may seem like the primary focus, it is crucial to recognise that these are challenges that have already been addressed by the community. It is the cultural change that presents the most significant obstacles and holds the key to success. Therefore, focusing on cultural change will ensure that the initiative is successful and yields the desired outcomes.

Lastly, successful initiatives share a common characteristic, which is planning the staging of their initiative from the very beginning. Many processes in the past have focused on publishing a large quantity of data without considering the impact it will have or the specific sectors or datasets it will target. However, as our thinking has evolved, we have learned that building engagement around specific sectors or datasets and focusing on impact is a much stronger way to ensure that an initiative is successful.

An important remark is a shift regarding the interpretation of demand and supply of data in the market. According to Carolan, embracing the notion of Open Data entails a departure from our conventional perception

of the data market. Formerly, institutions such as the government were perceived as data suppliers, while other organisations were deemed data consumers. However, in today's landscape, we recognise that the government, civil society, and private sector all play dual roles as both data suppliers and data consumers.

Also, in this section, we shall examine several instances where companies have successfully utilised open data and innovative models to enhance their operations. These case studies offer valuable insights into the ways in which businesses can achieve growth and progress by embracing cutting-edge strategies.

Vattenfall, a Swedish utility company, collaborates with start-ups, research institutions, and governments to develop renewable energy solutions. This aligns with SDG 7 by promoting affordable and clean energy towards fossil freedom. Vattenfall actively engages in open innovation to advance wind, solar, and hydroelectric power projects, contributing to the transition to sustainable energy sources. The company has launched two open data initiatives known as Fish-AI and Capercaillie. Fish-AI utilises image recognition technology to count and examine fish that are travelling in fish ladders past hydroelectric dams. According to Mia Zdybek, a Vattenfall Research & Development Data Scientist, assessing the biodiversity of rivers is vital in understanding the ecological implications of hydropower production. To minimise the adverse effects on the local ecosystem, hydropower dams are typically outfitted with a fish ladder, allowing fish to swim upstream and bypass the dam. This is just one of the many measures implemented to promote environmental sustainability.

Accurately counting the number of fish passing through the fish ladder and monitoring the river's biological state is essential. Biologists can achieve this through manual counting or with camera equipment. While traditional infrared cameras have been used in the past, advancements in AI and camera technology now allow for more precise and comprehensive information to be captured with digital cameras. The obtained data can then be automatically processed and analysed using image recognition, saving time and providing additional insights into the animals' behaviour. Our biology experts have been able to identify the proportion of wild versus farmed fish passing through the hydropower dam and detect various diseases, including fungi, affecting these fish.

Siemens *MindSphere* is an open, cloud-based Internet of Things (IoT) operating system that connects industrial equipment and devices. Siemens has cultivated the *MindSphere* ecosystem, inviting developers, start-ups, and industry players to build applications and solutions on its platform. This collaborative approach aligns with SDG 9 by promoting industry, innovation, and infrastructure development through the Insights Hub (IH) Monitor for asset monitoring, IH OEE for manufacturing performance and efficiency, IH Quality Prediction for improvement of quality inspections and rework processes, IH Asset Health & Maintenance for industrial equipment manufacturers and operators looking to streamline their main processes among others. By embracing external expertise and encouraging ecosystem partners to develop IoT solutions, Siemens contributes to the advancement of industrial technology.

ABB, a Swedish-Swiss multinational corporation of electrical equipment manufacturing, offers *ABB Ability Collaborative Operations*, an industrial Internet of Things (IIoT) platform. ABB collaborates with customers and partners within its ecosystem to provide real-time data analytics and predictive maintenance for industrial processes. ABB's digital platform is at the forefront of cutting-edge technology and offers seamless operation across a range of industries. From the user's device to the edge and cloud, the platform's secure data collection provides valuable insights through advanced analytics. It also consolidates data from multiple sites to prioritise asset and performance issues for proactive improvements across the enterprise. Customers have complete access to data at every level, and ABB's expert team is available around the clock to remotely monitor and provide real-time recommendations to resolve issues from *Collaborative Operations Centres*. This collaborative model aligns with SDG 9 by enhancing industrial infrastructure and fostering innovation in the manufacturing sector. ABB's open approach is aimed at enabling customers and partners to optimise their operations, reducing downtime, and improving resource efficiency.

#### 3.4. Open Innovation Challenges in the European Context

*“The European problem is not an economic problem, but a political one: we pay the economic cost of the absence of a political Europe. [...] A European community of energy, the natural environment and research should be created on the model of the European Coal and Steel Community (CECA), which was, in fact, the forerunner of the European Union in 1951”.*

- Jean-Paul Fitoussi, interview, 2007

The European landscape presents a rich tapestry of opportunities and complexities when it comes to open innovation for Sustainable Development Goals (SDGs) and has demonstrated a commitment to the UN goals by becoming a prominent proponent of open innovation practices. European firms and institutions are embracing open innovation as a means to drive sustainable development while fostering economic growth. The European innovation ecosystem benefits from vibrant start-up communities, research institutions, and supportive government policies that enable open collaboration and knowledge exchange. This diversity is both a strength and a challenge. The European Union, with its 27 member states, showcases a spectrum of regulatory frameworks, innovation ecosystems, and technological readiness levels. This diversity can sometimes hinder the harmonisation of open innovation practices across the continent. Different legal systems, intellectual property regulations, and data protection laws create a complex mosaic that innovators and organisations must navigate.

One significant challenge is managing intellectual property rights (IPR) in a landscape characterised by diverse legal traditions. While open innovation encourages the sharing of ideas and technologies, the protection of



intellectual property remains a concern. Striking the right balance between collaboration and safeguarding intellectual assets can be challenging.

Data protection regulations, including the General Data Protection Regulation (GDPR), also add complexity. Innovators must be cautious about data sharing and ensure compliance with stringent privacy standards, which can sometimes limit the free flow of information essential for open innovation.

*“Within our mandate, the ECB is ready to do whatever it takes to preserve the euro.  
And believe me, it will be enough”.*

- Mario Draghi, speech at the Global Investment Conference, London, 2012

Despite these challenges, the European Union has made substantial efforts to foster open innovation through initiatives like Horizon Europe and the European Green Deal, among others.

The European Innovation Council, for instance, plays a pivotal role in catalysing innovation by providing funding and support to ground-breaking projects. The EIC's Green Deal call, part of the European Green Deal, emphasises sustainability-focused open innovation. It funds projects that aim to address critical societal and environmental challenges, aligning with several SDGs.

These initiatives aim to pool resources, fund collaborative projects, and create supportive ecosystems for innovation in alignment with SDGs. However, ensuring equitable access to the benefits of innovation across all member states remains a challenge.

In order to overcome these challenges, there is a pressing need for standardised open innovation practices that can accommodate the continent's diversity. Encouraging cross-border collaboration, simplifying regulatory hurdles, and facilitating knowledge exchange are essential steps. Additionally, fostering a culture of openness and collaboration among European firms and research institutions is pivotal. This entails promoting a shared commitment to sustainable development and the realisation of SDGs while navigating the intricate web of regulations that characterises the European context.

Real-life examples showcase the ongoing efforts within Europe to tackle these challenges:

- **OpenAI's Collaboration with European Institutions:** OpenAI, a leading AI research organisation, has initiated partnerships with European research institutions. These collaborations aim to advance artificial intelligence technologies while adhering to European data protection standards. OpenAI's approach demonstrates the importance of balancing innovation and data privacy in the European context.
- **InnoEnergy's Innovation Ecosystem:** InnoEnergy, a European innovation ecosystem, focuses on sustainable energy solutions. By bringing together start-ups, corporations, and research institutions, it

fosters open innovation to address clean energy challenges. This initiative aligns with SDG 7 (Affordable and Clean Energy) and exemplifies collaborative efforts in sustainable innovation.

### 3.5. Conclusion

The deep analysis of the relationship between open innovation and the SDGs underscores the significant role open innovation plays in achieving sustainable development objectives. By embracing openness, collaboration, and inclusivity, organisations can align their innovation practices with the SDGs, contributing to social, economic, and environmental progress. In the European context, the convergence of open innovation and sustainable development presents a wealth of opportunities for transformative change and showcases the region's potential to lead in driving innovation for a more sustainable future. By leveraging the principles of open innovation, European firms and institutions can foster impactful partnerships and collaborative efforts to address the global challenges outlined in the SDGs, shaping a future where innovation drives progress towards a more sustainable and equitable world.

The core principles of open innovation align closely with the aspirations of the SDGs. Open innovation emphasises collaboration, knowledge exchange, and inclusivity, which are essential for addressing complex challenges encompassed by the SDGs. By actively involving external stakeholders such as customers, suppliers, NGOs, and research institutions, organisations can access diverse expertise and ideas, which serve as powerful catalysts for making progress toward the SDGs, contributing to a more sustainable, equitable, and prosperous future for all. Effective implementation of the SDGs necessitates strong multi-stakeholder partnerships, and open innovation provides a framework for fostering such collaborations. Public-private partnerships, academia-industry collaborations, and cross-sector initiatives can harness the collective capabilities of diverse stakeholders, a global network of problem-solvers working towards common sustainable development goals, fostering the development of technologies and solutions that promote social equality, poverty alleviation, and access to quality education and healthcare.

These real-case examples from European firms like Nestlé, Bosch, Siemens and others demonstrate how open innovation practices are actively applied to align with specific SDGs and generate social impact, environmental sustainability and several other goals. These firms leverage collaboration, external partnerships, and innovative solutions to contribute to sustainable development goals and address global challenges.

The European Union has actively supported the SDGs and aims to lead the way in their implementation. The region has shown a solid commitment to sustainable development and open innovation in the European situation. European countries have implemented policies and initiatives that promote collaboration, knowledge sharing, and social entrepreneurship, fostering an environment conducive to open innovation. The Horizon Europe program, for instance, focuses on research and innovation for sustainable development, emphasising collaboration and cross-sectoral partnerships.

European firms have also embraced open innovation to address the SDGs. Many companies engage with stakeholders, including customers, suppliers, and civil society, to co-create sustainable solutions. Collaborative platforms and innovation networks have emerged across Europe, facilitating knowledge exchange and enabling the development of sustainable business models. Examples include public-private partnerships for renewable energy, circular economy initiatives, and social innovation projects tackling societal challenges. Despite progress, challenges remain in fully harnessing the potential of open innovation for sustainable development in Europe. Intellectual property concerns, regulatory barriers, and the need for cross-border collaboration can pose hurdles. However, European firms' diverse expertise and global networks provide a strong foundation to address these challenges and capitalise on open innovation's potential to advance the SDGs. The European Innovation Council, along with innovative projects and initiatives, strives to overcome these challenges and advance open innovation practices that contribute to the realisation of SDGs. By navigating this complex landscape, Europe is poised to be a hub of sustainable open innovation, addressing global challenges in collaboration with diverse stakeholders across the continent.

## Chapter 4: European firms with SDG focus, an analysis of their open business models.

*“I have found that it is the small everyday deed of ordinary folks that keep the darkness at bay.*

*Small acts of kindness and love”.*

— J.R.R. Tolkien, *The Hobbit*

Small and medium-sized enterprises (SMEs) are a vital component of many economies worldwide, particularly in Europe. These companies play a crucial part in driving innovation, fostering economic growth, and contributing to the achievement of Sustainable Development Goals (SDGs). This chapter delves into the participation of SMEs in open innovation business models, their role within the innovation ecosystem, and their contributions to sustainable development. We will also explore the concept of Proof of Concepts (PoCs) that SMEs can utilise to validate their innovations. To bring these principles to life, we will examine European SMEs/start-ups that have embraced open business models and are focused on advancing a single SDG with utmost dedication.

### 4.1 SMEs and Open Innovation: the big business of small companies

Small businesses are an essential component of the innovation ecosystem, playing a vital role in driving employment rates and economic growth. They constitute around 90% of businesses and over 50% of occupations worldwide. In emerging economies, formal SMEs can contribute up to 40% of national income (GDP), a figure that considerably increases when informal SMEs are taken into account. As the global workforce grows, an estimated 600 million jobs will be needed by 2030, making the development of SMEs a top priority for many governments. In these markets, SMEs generate the most formal jobs, creating 7 out of every 10 new positions. This valuable contribution has garnered recognition from both innovation scholars and governments, who now acknowledge the necessity for targeted policy measures to facilitate small business sector development. Small- and Medium-Sized Enterprises (SMEs) are business entities that maintain revenues, assets, or a number of employees below a certain threshold, depending on the country of operation. In determining the classification of a business as small or midsize, specific size criteria are considered, and sometimes, the industry in which the business operates is also considered.

The European Commission defines small and medium-sized enterprises (SMEs) as companies with fewer than 50 and 250 employees, respectively. Micro-companies, on the other hand, employ up to 10 employees. According to the World Bank, 99.8 % of all businesses are SMEs in the EU. An estimated 100 million workers are employed in SMEs, which contribute to 65% of the overall employment (Eurostat, 2021) and are responsible for generating more than half of the EU's gross domestic product (GDP). The Commission periodically reviews and monitors the implementation of SME definition.

Table 2 – SMEs definition according to the European Commission (last review on the 25<sup>th</sup> of October 2021)

<b>Company Category</b>	<b>Staff Headcount</b>	<b>Turnover</b>	<b>Balance Sheet total</b>
<i>Medium-sized</i>	< 250	≤ € 50 millions	≤ € 43 millions
<i>Small-sized</i>	< 50	≤ € 10 millions	≤ € 10 millions
<i>Micro-sized</i>	< 10	≤ € 2 millions	≤ € 2 millions

Based on the table provided above, it is evident that SMEs display a high level of heterogeneity that ranges from sole proprietorships to manufacturing companies with up to 250 employees who specialise in exporting. Nevertheless, they share specific characteristics that distinguish them from larger firms:

1. SMEs typically operate within a specific geographic and product niche and have limited diversification.
2. They experience constraints in accessing crucial resources, such as funding, knowledge, abilities, and staff.
3. Small and medium-sized enterprises often have a single owner-manager who plays a significant role in shaping the company's direction and culture.
4. SMEs have a restricted impact on the broader business atmosphere, such as through lobbying or advocacy efforts, as well as on their supply chains, and this means they have both low bargaining power but also a very low level of data and analysis to optimise the operations and the P&L.

The distinctive features of small and medium-sized enterprises (SMEs) hold a vital position in shaping their stance towards sustainability. These traits, namely the primary and tertiary characteristics, bring about a wide range of responses to the sustainability transition, owing to the specific niche of each SME and the owner's management methodology. However, these defining characteristics also render SMEs as potential agents of sustainable innovations. As per the OECD's research, smaller enterprises can effectively capitalise on market opportunities that are often overlooked by more established and larger firms, thanks to the dissimilar market incentive structures of the two types of firms.

While policy support endeavours to ease fiscal and administrative burdens and provide financial aid, it often neglects the challenges that SMEs encounter in their innovation pursuits.

To overcome resource limitations, SMEs implement open innovation strategies, which involve breaking down organisational barriers and collaborating on research and development initiatives.

#### 4.1.1 Engaging in Open Innovation and the PoCs

Open innovation (OI) is not solely the domain of large corporations. SMEs are increasingly recognising the value of open innovation in driving their competitiveness and growth. They engage in open innovation by collaborating with external partners such as research institutions, larger corporations, start-ups, and even competitors. These collaborations enable SMEs to access new ideas, technologies, and resources, often critical for staying competitive in rapidly evolving markets. The interest in Open Innovation has been steadily growing among scholars, practitioners, and policymakers in the SME community, particularly in the European Union (EU). Despite this, there are still numerous aspects of this phenomenon that remain unexplored. For example, there is a need for new metrics to effectively monitor OI efforts (West et al., 2014), and additional studies are necessary to comprehend better how OI can be leveraged to design public policies (Santos, 2015).

According to the study of Antonios Livieratos on the basis of a unique dataset of 106 case studies of innovative SMEs, the initiation of Open Innovation (OI) strategies is not solely driven by the anticipation of economic gains. Instead, it is the notion of “attention capital” that serves as the foundational consideration when contemplating engagement in OI partnerships. A paradox emerges in this context: SMEs often embrace OI as a means to compensate for resource limitations, yet it is precisely these constraints that instil hesitation in pursuing attention-intensive OI collaborations, even when the potential returns are substantial. Furthermore, the realm of OI involving communities and crowds presents a novel frontier for SMEs. Given its novelty, SMEs may exhibit reluctance in venturing into such OI initiatives despite empirical evidence from the research illustrating the significant success achieved by the analysed SMEs through collaborative endeavours of this nature (Livieratos et al., 2022).

We will not delve into the SME innovation process for the scope of this study, but we will examine one key aspect. One of the critical strategies SMEs pursue to innovate is through the use of Proof of Concepts (PoCs). They are prototypes or pilot projects designed to demonstrate the feasibility and potential of a new product, service, or technology. PoCs serve as a crucial step in the innovation process, providing evidence that an idea can be translated into a practical, viable and marketable solution before full-scale implementation. For SMEs, PoCs are essential for attracting investors, securing partnerships, and validating their innovations before scaling up.

SMEs face inherent risks in innovation. PoCs offer a structured approach to risk mitigation by allowing SMEs to test their ideas in a controlled environment, reducing the uncertainty associated with new ventures. By

validating their concepts through PoCs, SMEs can make informed decisions about resource allocation and market entry strategies. Following, we briefly analyse some of their most relevant benefits:

- **Risk Mitigation:** one of the foremost challenges SMEs face in pursuing innovation is the fear of failure, especially when allocating resources to unproven ideas. PoCs act as a safety net by allowing SMEs to test the waters before diving in. They help identify potential pitfalls and challenges, reducing the overall risk associated with innovation projects.
- **Resource Efficiency:** SMEs typically operate with limited resources, both in terms of finances and manpower. PoCs provide a cost-effective means to assess whether an innovation is worth investing further resources into. Rather than committing substantial resources upfront, SMEs can allocate a smaller budget to a PoC, making innovation more accessible.
- **Decision Making:** PoCs generate empirical evidence that aids decision-making. SMEs can make informed choices based on the outcomes of these experiments, helping them select the most promising innovations to pursue and allocate resources wisely.
- **Stakeholder Confidence:** stakeholders, including investors, customers, and employees, often need tangible proof of an innovation's potential before they fully commit. Successful PoCs instil confidence in stakeholders and encourage their support for further development.
- **Learning and Adaptation:** innovation is an iterative process that requires learning and adaptation. PoCs provide valuable insights into what works and what doesn't, allowing SMEs to refine and improve their innovations iteratively. This iterative approach enhances the chances of ultimate success.
- **Competitive Advantage:** in today's competitive business landscape, innovation is often the key to gaining a competitive edge. SMEs that leverage PoCs effectively can introduce new products, services, or processes more swiftly, positioning themselves as market leaders or disruptors.

#### 4.1.2 The Vital Role of SMEs and Start-ups in the Innovation Ecosystem

SMEs serve as essential components of the innovation ecosystem. They are agile and flexible, allowing them to adapt to market changes and technological advancements swiftly. SMEs often act as innovation catalysts by bringing novel ideas to the forefront and pushing the boundaries of existing technologies. In open innovation ecosystems, SMEs contribute to idea generation, technology development, and market experimentation.

First and foremost, SMEs are known for their agility and ability to quickly adapt to changing market dynamics. Unlike more giant corporations, SMEs often have flat hierarchies and shorter decision-making processes, allowing them to respond swiftly to emerging trends and opportunities. This agility enables SMEs to experiment with new ideas and technologies, making them natural innovators. They serve as testbeds for novel concepts and can rapidly prototype and iterate on innovations.

One of the most significant contributions of SMEs to the innovation ecosystem is their capacity for disruptive innovation. SMEs are more willing to take risks and challenge the status quo, which is essential for pushing the boundaries of technology and business models. They are known for introducing ground-breaking solutions that can disrupt established industries. Think of start-ups that have revolutionised sectors like transportation (Uber), hospitality (Airbnb), and healthcare (Telemedicine start-ups). These innovations have not only transformed industries but have also led to the creation of entirely new markets.

SMEs are also hubs of creativity and entrepreneurship. They attract individuals with diverse skill sets and innovative mindsets who are motivated to bring their ideas to life. These start-ups and SMEs foster a culture of innovation, often characterised by collaboration, experimentation, and a willingness to learn from failures. This culture not only benefits the SMEs themselves but also spills over into the broader innovation ecosystem, influencing more giant corporations and institutions.

Moreover, SMEs are instrumental in bridging the gap between research and commercialisation. They serve as a critical link between academic research and practical application. Universities and research institutions generate ground-breaking ideas and technologies, but it is often SMEs that take these innovations to market. Through collaborations and technology transfer agreements, SMEs help translate research into tangible products and services that can benefit society.

SMEs also contribute to regional innovation clusters. Innovation rarely occurs in isolation but thrives in environments where knowledge, talent, and resources converge. SMEs often cluster in innovation hubs or technology parks, creating a hotbed of creativity and innovation. These clusters attract talent and investment, further stimulating innovation and economic growth in the region. Silicon Valley in the United States and Silicon Alley in New York City are prime examples of such innovation clusters.

Furthermore, SMEs are essential for job creation, particularly in high-growth sectors. As they scale and expand, they hire more talent, driving down unemployment rates and stimulating economic activity. In this way, SMEs not only contribute to innovation but also to overall socio-economic development, filling market gaps and niche opportunities and creating *blue oceans* by disrupting traditional markets. While larger



corporations tend to focus on mass markets, smaller entities can cater to specialised segments. SMEs and start-ups are uniquely positioned to identify and capitalise on niche market opportunities and unmet needs. By doing so, they not only create value for these niche markets but also inspire larger players to explore similar avenues. This competition fuels innovation by pushing companies to differentiate themselves through unique offerings.

## 4.2 Sustainability Management of European SMEs and Their Dedication to SDGs

The contribution of SMEs to the achievement of the SDGs is of strategic importance due to their positioning and the quantitative implications of the impact they can have on the European and global scenario.

Below, we will see as an example the case of carbon dioxide (CO<sub>2</sub>) and greenhouse gas emissions, the reductions of which are a priority for goal number 13, “Climate Action”, one of the most studied and long-run influencing scenarios.

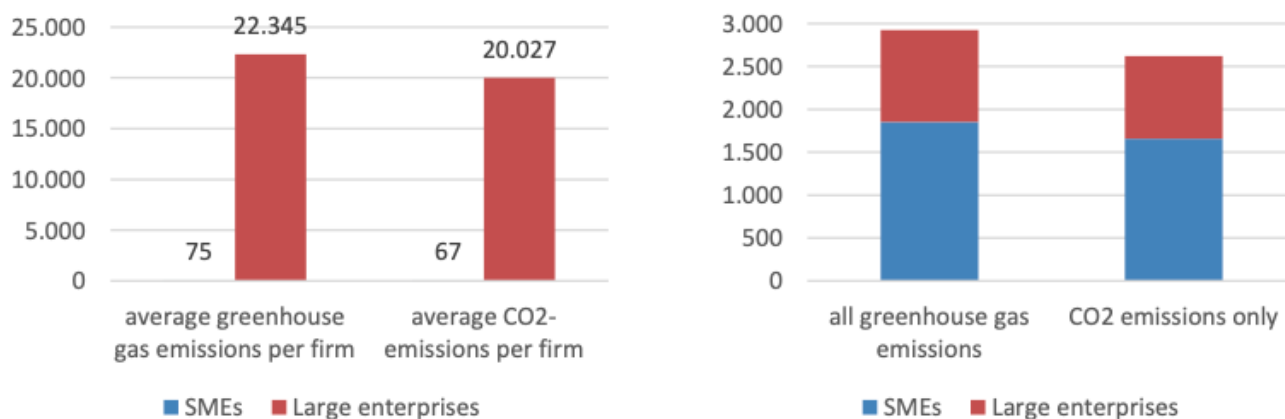
Unfortunately, quantitative data regarding the environmental impact of small and medium-sized enterprises (SMEs) is limited, primarily because environmental statistics are typically aggregated at the national or sectoral levels rather than for individual businesses. As a result, estimating the environmental footprint of SMEs by size class is often necessary due to the lack of specific data. In this discussion, we will primarily focus on the carbon dioxide and greenhouse gas emissions associated with SMEs.

Before 2014, there was the Environmental Impact Database for SMEs (EIDSME), which provided estimates for such emissions. These estimates were generated by combining environmental statistics with data on the structure of businesses, using the assumption that environmental pollution is proportional to the number of employees. This approach allowed for the allocation of environmental pollution at both the aggregate and sectoral levels to different enterprises based on their size classes.

Other research of the EU Commission partially updates the EIDSME database for CO<sub>2</sub> emissions, incorporating more recent data to refine these estimates.

According to these data, an SME emits 67 tons of CO<sub>2</sub> and 75 tons of greenhouse gases (defined as N<sub>2</sub>O, CH<sub>4</sub>, HFC, PFC, SF<sub>6</sub> and NF<sub>3</sub> in CO<sub>2</sub> equivalent) on average, which represents a relatively insignificant value compared to the average emissions of large companies, with a range between 20,027 and 22,345. But counterintuitively, their total contribution accounts for 63.3% of all CO<sub>2</sub> and greenhouse gas emissions. This finding is consistent with the EIDSME estimate of 64%.

Figure 3 – Graph with EU emissions, in tons (on the left) and million tons (on the right), 2018



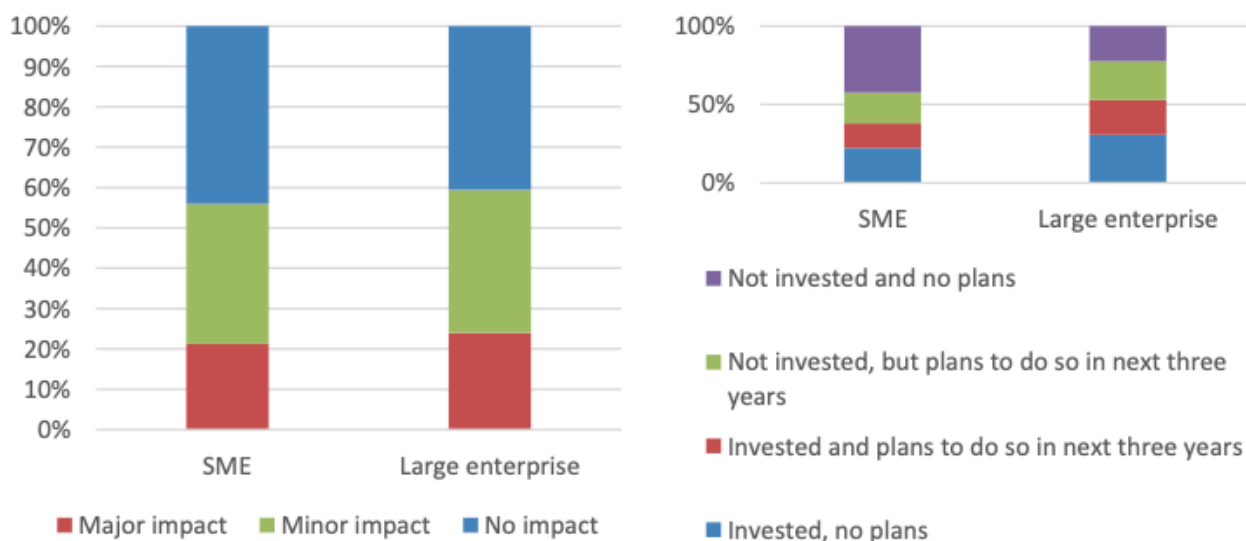
Source: DIW-Econ calculations, based on Eurostat Structural Business Statistics [SBS\_SC\_SCA\_R2] and Air emissions accounts [ENV\_AC\_AINAH\_R2]

The emissions from SMEs, in relation to their size and contribution, demonstrate variations across sectors. These discrepancies arise from a combination of factors, including the inherent CO<sub>2</sub> emission intensity of each sector and the prevalence of SMEs within them. Sectors such as manufacturing, electricity, gas, steam, air conditioning supply, and transportation and storage typically have the highest emissions. Conversely, service sectors generally exhibit significantly lower emissions. Notably, SMEs are more commonly found in sectors characterised by lower CO<sub>2</sub> emissions, which partly elucidates why SMEs tend to have lower emission levels compared to larger firms.

Climate change and related policies impact SMEs in several ways, including compliance costs, rising energy expenses due to carbon taxes, shifting consumer demands, and the direct effects of climate change. These challenges also present opportunities for SMEs, such as resource efficiency measures that can reduce production costs. While both SMEs and larger enterprises are feeling the effects of climate change, SMEs tend to lag in terms of investments.

At present, a small majority of both SMEs and larger enterprises have encountered varying degrees of climate change effects (as depicted in Figure 4, left). Additionally, most SMEs and large companies have either made investments or have intentions to do so in order to address the repercussions of climate change and reduce emissions (as shown in Figure 4, right). Nevertheless, despite both SMEs and large corporations grappling with current climate challenges, SMEs are falling behind their larger counterparts in terms of concrete investment actions and future investment plans.

Figure 4 – Current impact of climate change (left) and climate investment plans (right)



Source: EIB Investment Survey, 2020

This discrepancy starts with SMEs being less likely to monitor their CO<sub>2</sub> emissions, especially micro-enterprises. The reasons for this lag can be attributed to a perception of lower urgency among SMEs and barriers to investment. Large enterprises generally view the sustainability transition more positively.

To address climate change, some SMEs are adopting strategies like OI to reduce their carbon footprint and achieve climate neutrality, leveraging external collaborations and expensive research that can be out of budget range. However, these efforts are less extensive than those of larger enterprises. The obstacles perceived by SMEs and large enterprises are similar, with financing costs and regulatory uncertainties being prominent concerns.

In summary, while SMEs and larger enterprises have nuanced differences in their perceptions of climate change, addressing issues like access to financing and regulatory uncertainties is essential to support SMEs in their sustainability transition amid the urgent need for decarbonisation to meet EU climate goals.

#### 4.2.1 Challenges

The transition to sustainability presents a formidable challenge for businesses across the board, including SMEs. Specifically, they face unique challenges and opportunities stemming from the distinctive characteristics that set them apart from larger enterprises. These challenges encompass limitations in terms of human resources, restricted access to financial resources, and a concentration on niche markets both in product offerings and geographical scope. These inherent traits significantly influence how SMEs approach the sustainability transition. For instance, the limited access to funding constrains SMEs' ability to invest in cleaner technologies. Simultaneously, their focus on niche markets means that the sustainability journey of each SME is highly individualistic, contingent on the specific market where the SME operates.

## 4.2.2 Evaluation Methods

Our assumptions find support in various enterprise surveys, including Eurobarometer surveys, which offer comprehensive coverage of SMEs throughout the EU. The European Investment Bank Investment Survey, which encompasses financial and investment aspects, also provides representative coverage of EU SMEs. Additionally, the *Business Environment and Enterprise Performance Survey* (BEEPS), while limited to specific EU Member States in Eastern Europe and Mediterranean regions (Greece, Italy, Cyprus, Portugal and Malta), offers extensive thematic coverage, including aspects such as labour, finance, and the business environment. Notably, from 2018, BEEPS has integrated a green economy module centred on environmental standards and practices.

## 4.3 SIM: the Sustainable Innovation Matrix

To better understand the intricate interplay between SMEs, open innovation, and the pursuit of SDGs, a two-dimensional SDG-OI matrix can be a valuable tool. Following, we describe this tool, its limitations and our approach.

### 4.3.1 Axes Dimensions and Quadrants

#### Horizontal Dimension: SDG Achievement Level

The horizontal dimension of our matrix is dedicated to assessing the “SDG Achievement Level”. This axis measures the extent to which a particular SME contributes to the fulfilment of the SDGs. SMEs operate across diverse sectors and industries, making their impact on the SDGs variable. Some SMEs may align their core operations with specific SDGs, such as clean energy or responsible consumption, while others may have a more indirect influence.

- High SDG Achievement Level (Right Side of the Axis): SMEs positioned towards the right side of this dimension are actively engaged in activities that directly contribute to the achievement of one SDG. These businesses have incorporated sustainable practices into their core operations and often collaborate with larger enterprises, governmental organisations, or NGOs to amplify their impact. An example could be a renewable energy start-up that directly supports SDG 7 (Affordable and Clean Energy).
- Low SDG Achievement Level (Left Side of the Axis): On the left side of the axis, we find SMEs that have yet to integrate sustainability into their business model fully. While they may indirectly contribute

to SDGs through general business operations, their impact remains modest compared to those on the right side. An example might be a traditional small retailer with limited sustainability practices.

#### Vertical Dimension: Open Innovation Business Model Level of Disruption

The vertical dimension represents the “Open Innovation Business Model Level of Disruption”. This axis assesses how innovative and open an SME’s business model is. Open innovation emphasises collaboration, knowledge-sharing, and leveraging external ideas, making it an essential approach for addressing complex global challenges.

- High Open Innovation Business Model Level of Disruption (Upper Part of the Axis): SMEs situated towards the upper part of this dimension are actively embracing open innovation practices. They are willing to collaborate with other businesses, research institutions, and stakeholders to foster innovation. These SMEs often disrupt traditional industry norms and standards, enabling them to adapt quickly to emerging trends. An example could be a tech start-up collaborating with universities and research centres to develop cutting-edge solutions.
- Low Open Innovation Business Model Level of Disruption (Lower Part of the Axis): Businesses lower on the axis tend to follow more traditional, closed business models. They may be less open to external partnerships and collaborations, which can limit their ability to innovate and adapt. These SMEs are less likely to disrupt their industries. An example might be a family-owned restaurant that relies on traditional recipes and marketing methods.

#### Intersection of Dimensions: Gaining Insights

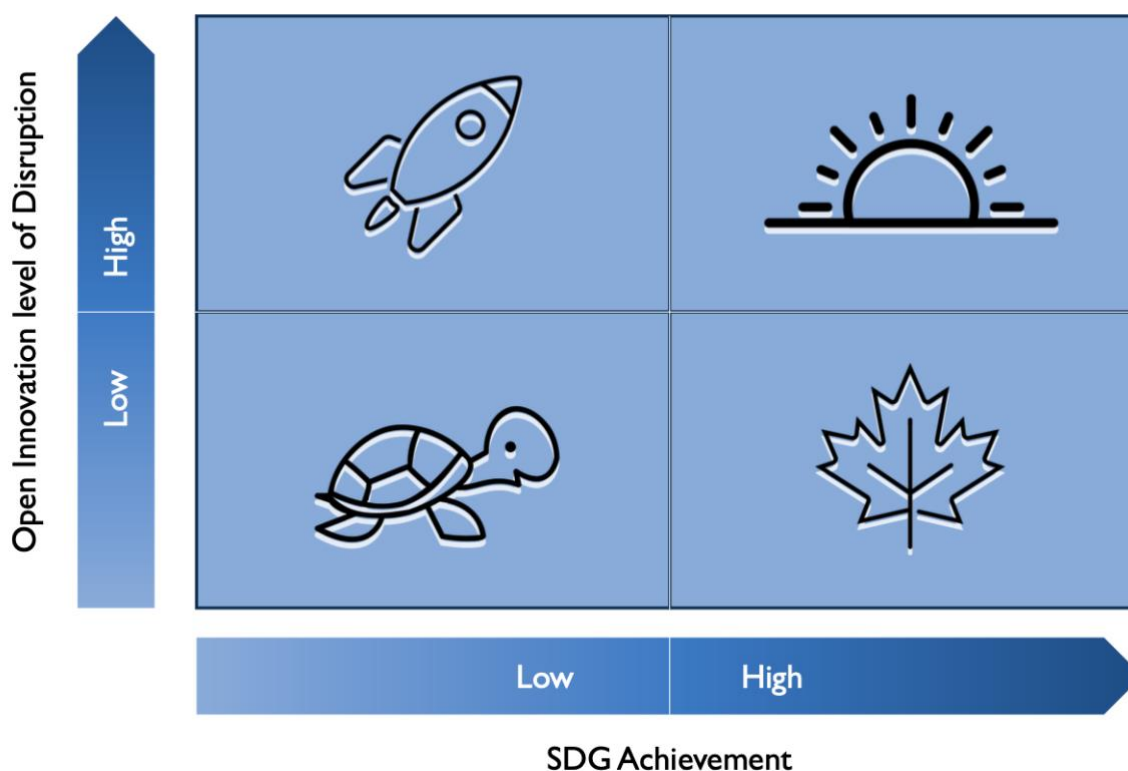
The matrix’s power lies in its ability to pinpoint the intersection of these two dimensions, allowing us to gain valuable insights into the strategies and potential impact of SMEs concerning the SDGs.

- Quadrant I (High SDG Achievement, High Disruption): the Rising Sun.  
SMEs in this quadrant are pioneers of change. They actively pursue SDG alignment and leverage open innovation to disrupt their industries. These businesses hold the potential to be significant drivers of sustainable development and industry transformation. The rising sun symbolises progress and achievement (high on SDGs) but also high disruption with rising innovation and transformative change.
- Quadrant II (Low SDG Achievement, High Disruption): the Rocket.  
SMEs here may not directly contribute to SDG achievement, but their disruptive innovation can create ripple effects, indirectly influencing sustainability. It is crucial to watch for opportunities where their

innovations can align with SDGs. The rocket symbolises the potential for rapid change and high disruption but also the struggle with sustainability, indicating the need for alignment with SDGs.

- Quadrant III (Low SDG Achievement, Low Disruption): the Turtle.  
SMEs in this quadrant face challenges in both sustainability and innovation. They may require comprehensive strategies to innovate and adapt their business models to address the SDGs effectively. The turtle signifies slow progress on sustainability and low disruption, reflecting a cautious and steady approach.
- Quadrant IV (High SDG Achievement, Low Disruption): the Green Leaf.  
These SMEs have already demonstrated a commitment to sustainable development, but their business models are less innovative or disruptive. While they may excel in a specific SDG, they might benefit from exploring more open innovation approaches. The maple green leaf belongs to the Angiosperms – Dicotyledons species, which are the most common plants in the world: it signifies green and sustainability achievement rather than disruptiveness.

Figure 5 – SIM: the Sustainable Innovation Matrix based on SDG and OI



#### 4.3.2 Correlation between OI Business Model and Sustainability Achievement for SMEs

From the previous paragraphs that address the topic of developing business models in Open Innovation for SMEs, we can intuitively deduce that these practices can accelerate the growth, advancement, and operational efficiency of companies. This suggests a possible correlation between a high level of open innovation and a possible high level of SDG achievement.

In this paragraph, we take into consideration several studies to delve deeper into this hypothesis. However, many of them underline the limitations and possible glimmers of improvement in research due to a lack of data in the little-explored territory of small and medium-sized enterprises.

SMEs cannot achieve the SDGs alone with the same level of difficulty as large firms and they require external guidance to attain the 2030 Agenda (Nygaard, 2022).

Open Innovation Business Models offer SMEs several pathways to enhance sustainability. Engaging in collaborative networks associated with OI often provides SMEs with access to sustainable solutions and practices that might otherwise be challenging to develop independently. One key advantage of OI is the mitigation of risks associated with sustainability initiatives, particularly for SMEs constrained by limited resources. By sharing the burden of sustainability efforts with external partners, SMEs can more feasibly pursue and achieve their sustainability objectives. Moreover, OI empowers SMEs to remain agile and responsive to evolving market demands, including those related to sustainability preferences. This adaptability positions SMEs to make more substantial strides in sustainability. Lastly, OI enables resource optimisation, a critical component of sustainability. SMEs can effectively pool resources with their partners, allowing for strategic investments in eco-friendly technologies and processes that might otherwise be beyond their individual capacities. This suggests that there exists a positive correlation between economic innovation performance and sustainability innovation performance (Rauter, 2019).

Another study by the same scholars utilised data from multiple respondents within a cross-sectional sample of firms and employed a thorough metric for gauging sustainability-related innovation performance. The empirical findings indicate that clan cultures have an adverse impact on sustainability-related innovation performance. In contrast, hierarchy and adhocracy cultures exhibit favourable effects. Moreover, there exists a moderately positive association between sustainability-related innovation performance and economic innovation performance (Globocnik et al., 2019).

Moreover, SMEs often encounter obstacles when pursuing SDGs individually but can join open collaborations in order to overcome the issues. A case study by Jiménez, De La Cuesta González, and Boronat-Navarro (2021) on a furniture production *Cluster Management Organization* (CMO) known as *Habic* demonstrates that through a network-based approach to sustainability management, SMEs can address the intrinsic obstacles to

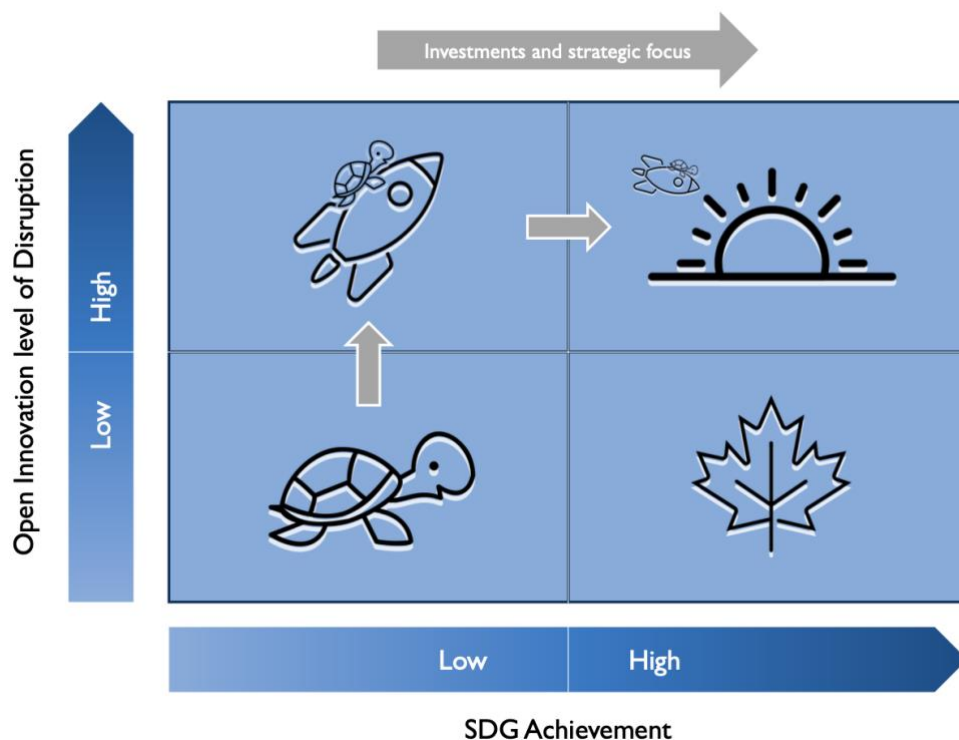
understand and implement the SDGs effectively. The approach involves jointly addressing industry-specific sustainability challenges, resulting in the co-creation of Lehi-ODS, an online sustainability management tool for SME self-assessment. This shared tool allows SMEs to assess their alignment with the UN 2030 Agenda, compare themselves with peers, and prioritise initiatives. The study underscores the role of OI practices, represented by a CMO, in identifying sector-specific sustainability challenges and collaboratively working toward SDG contributions (Jiménez, 2021).

Although the question is not yet clearly addressed, and there are future avenues of research, several studies suggest a positive correlation between OI business models and achievements in sustainability practices. However, it is clear that Open innovation equips SMEs with valuable tools and partnerships to advance sustainability while fostering innovation and market responsiveness.

Dynamic implications: as a consequence of the above, we define the possibility of making the two-dimensional matrix more dynamic in an evolutionary sense, eventually remaining a static snapshot.

In order to achieve maximum alignment with the SDGs, the turtle will have to ride the rocket and ultimately go towards the rising sun. In other words, companies that are in the third quadrant, meaning that they have a low level of SDG achievement and a low level of disruptive approach with an Open Innovation model, can benefit from collaborations, external ideas and other forms of OI to be able to implement their efficiency. All this is aimed at improving a firm towards achieving efficiency in sustainability and, therefore, in the level of achievement of the SDGs.

Figure 6 – Firm Evolution in the Sustainable Innovation Matrix





### 4.3.3 Methodologies

Hereby, we briefly explore the methodologies of the matrix model for assessing the intersection of SMEs, open business models, and SDGs.

- **Data Collection:** Developing the matrix starts with gathering data on SMEs' sustainability practices and their level of engagement with an SDG. This data can include their direct and indirect contributions to specific SDGs, as well as their openness to collaboration and innovation. Also, gathering data on the belonging industry of reference and spotting a discontinuity point can significantly enhance our comprehension of the real impact of innovation. Additionally, collections of data that are proxies for more general assumptions can be useful. For example, for companies that offer a disruptive product that is also a substitute for one currently in use, it could be helpful to collect market share data as a proxy for its diffusion and impact. This specific example will be addressed in more depth in the following paragraph on real-world SME cases.
- **Scoring System:** Assigning scores or values to SMEs based on their sustainability and innovation efforts. This scoring system helps position each SME within the matrix's two dimensions. For example, high sustainability practices might receive a higher score on the SDG Achievement Level, while a strong open innovation strategy might score higher on the Disruption Level. The initial stages of innovation, often referred to as the "fuzzy front end", are deemed crucial for the ultimate success and sustainability impact of a product, especially in the context of SDGs. Additionally, this early phase of innovation poses difficulties for corporate practitioners and innovators due to its abstract, qualitative nature and the scarcity of relevant data. To address these challenges, von Geibler proposes a structured four-stage approach to streamline the innovation process, employing an online tool known as the "SDG-Check". This tool assists in evaluating an innovator's sustainability orientation during the initial stages of product and service development. It operates as a semi-quantitative instrument, aggregating assessments from experts engaged in innovation processes that impact the United Nations' SDGs. The outcomes suggest that this tool effectively supports and stimulates discussions with both internal and external stakeholders regarding sustainability considerations in the early phases of product and service development (von Geibler et al., 2019).

Drawing from the existing body of knowledge on business model innovation, open innovation, and the context of small and medium-sized enterprises (SMEs), to categorise these transformations, we employ a two-dimensional framework for SME business model innovation, which assesses the degree of radical change involved and the extent to which SMEs embrace external collaborations and partnerships.

- **Quadrant Placement:** SMEs are then placed in one of the four quadrants based on their scores. The intersection of the two dimensions determines their quadrant placement.

#### 4.3.4 Limitations

Hereby, we briefly explore the potential limitations of the model for assessing the intersection and positioning of SMEs, open business models, and SDGs.

- **Data Availability on SME:** The accuracy of quadrant placement heavily relies on the availability of reliable data. SMEs might not always disclose their sustainability practices or openness to innovation, making it challenging to assess them accurately, contrary to large firms that have more checkpoints and several mechanisms of analysis to determine the levels. However, cases of greenwashing are not uncommon between big corporations too, and this makes the reliability of gathered data not completely effective. Sustainability reporting policies do not apply to SMEs directly but impact them indirectly by mandating supply chain diligence for large enterprises. The EU has no specific requirements for SMEs to produce sustainability reports yet. However, given the crucial role played by SMEs in the economy and the significance of corporate transparency, sustainability reporting requirements are likely to be extended to cover SMEs in the future. The recent adoption of the *Corporate Sustainability Reporting Directive* (CSRD) proposal by the European Commission supports this. The market where it is possible, the state where it is necessary.
- **Scoring Subjectivity:** One limitation is subjectivity in scoring. Assigning values or scores to SMEs' sustainability and innovation efforts can be somewhat subjective, as different sources of evaluations may have varying opinions on what constitutes the level of achievement and the disclosure of information for SMEs is not yet settled in a structured universal framework.
- **Dynamic Nature:** The matrix does not account for the dynamic nature of SMEs. Their sustainability efforts and open innovation strategies can change over time and in a more rapid way than large firms. A snapshot assessment at a single point in time may not reflect their evolving impact on SDGs and it does not capture the journey of SMEs in evolving their innovation strategies.
- **Generalisation:** While the matrix offers valuable insights, it is a simplification of complex business dynamics. Not all SMEs neatly fit into one of the four quadrants, and nuances in their approaches may be overlooked.

- **Lack of Causation:** The matrix helps identify associations between sustainability, innovation, and SDGs but does not establish causation. It does not explain why certain SMEs excel in both dimensions or whether one dimension directly leads to the other. However, for this last point, further analyses addressed in 4.3.2 underline the correlation between open business models and the level of achievement of the SDG, considering a high level of the first causal for a high level of the second. We have already addressed the possible dynamic of causal evolution of the assumption in the paragraph above.
- **Contextual Differences:** The matrix does not consider contextual factors, such as regional disparities or industry-specific challenges. What constitutes a disruptive business model in one industry might not be the same in another. To overcome this limitation, it is useful to fill in the matrix with SMEs coming from the same region or which have important commonalities for the intended analysis.

To further illustrate the intersection of SMEs, open business models, and SDGs, in the next paragraph, we will examine real-world European SMEs/start-ups, each dedicated to advancing a specific SDG through their innovative business models.

#### 4.4 Fairphone Case: Pioneering Sustainable Electronics

“Buy a phone, start a movement. From the earth to your pocket, a smartphone’s journey is filled with unfair practices. We believe a fairer electronics industry is possible. By making change from the inside, we’re giving a voice to people who care”.

- Fairphone, [www.fairphone.com](http://www.fairphone.com)

##### 4.4.1 Firm General Description and Metrics

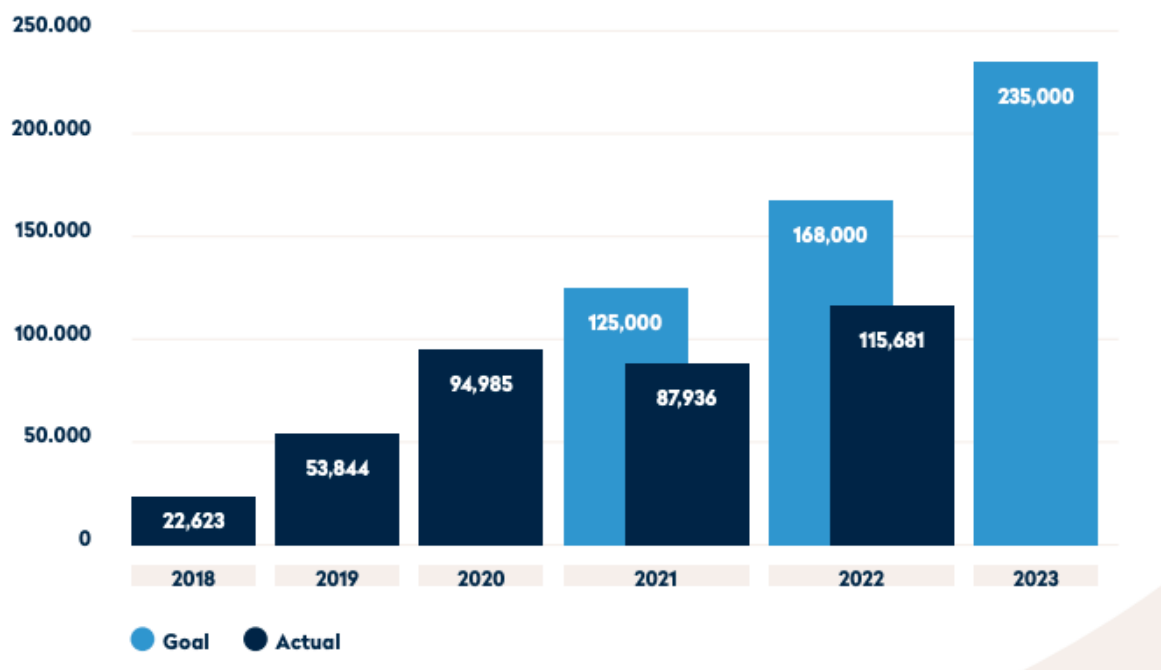
Fairphone is a multi-prize-winning Dutch-based electronics company that stands out as a pioneer in the sustainable electronics industry (*UN Momentum for Change Award 2015*, *European Business Awards for the Environment* (EBAE) 2016 and others). Founded in 2013 by Bas van Abel, Tessa Wernink and Miquel Ballester as a social enterprise and then certified as a B-Corporation, Fairphone’s mission is to create ethically sourced and environmentally responsible smartphones.

Ballester stated that they are not opposed to the phone industry; rather, they work alongside it. Their presence in the industry is intended to inspire change, and this is precisely what they aim to achieve through their Fairphone projects. This is done by reinvesting the profits to finance new projects and strategic partnerships. Other financing sources are EU funds, impact investors, crowdfunding platforms ([fairphone.com](http://fairphone.com)), and government financing (Fairphone, 2018, pp. 28-29).

Unlike traditional smartphone manufacturers, Fairphone prioritises transparency, fair labour practices, and environmental sustainability throughout its product lifecycle. The phone's modular design allows for easy repair and customisation by users. The company claims that extending a phone's lifespan by two years reduces CO<sub>2</sub> emissions by 30%. Fairphone has over 3,500 physical stores in eleven European countries and ships to all of continental Europe from its online store. In 2021, 59% of their sales were through partners and 41% through the website in 2021.

Despite its significant impact, popularity and diffusion, the firm maintains characteristics that align with SMEs with over 70 employees, € 36,961,604 of revenue in 2021 (€35,930,371 in 2020) and around 120,000 devices sold in 2022, placing it among the medium-sized firms. Fairphone aims to serve as an inspiring example to the industry while remaining financially sustainable. Despite facing significant global supply limitations, Fairphone's revenue increased by €1 million, due in large part to the higher sales price of the Fairphone 4 and the expansion of its accessory portfolio, demonstrating that it has a profitable and scalable business model. Fairphone operates with a relatively small team compared to industry giants, emphasising efficiency and sustainability over scale. While expanding globally, Fairphone's operational base remains manageable, with a focus on collaboration with suppliers and partners. As an SME, Fairphone displays agility in adapting to changing market demands and continuously improving its products and supply chain practices, as shown by the rising number of collaborations.

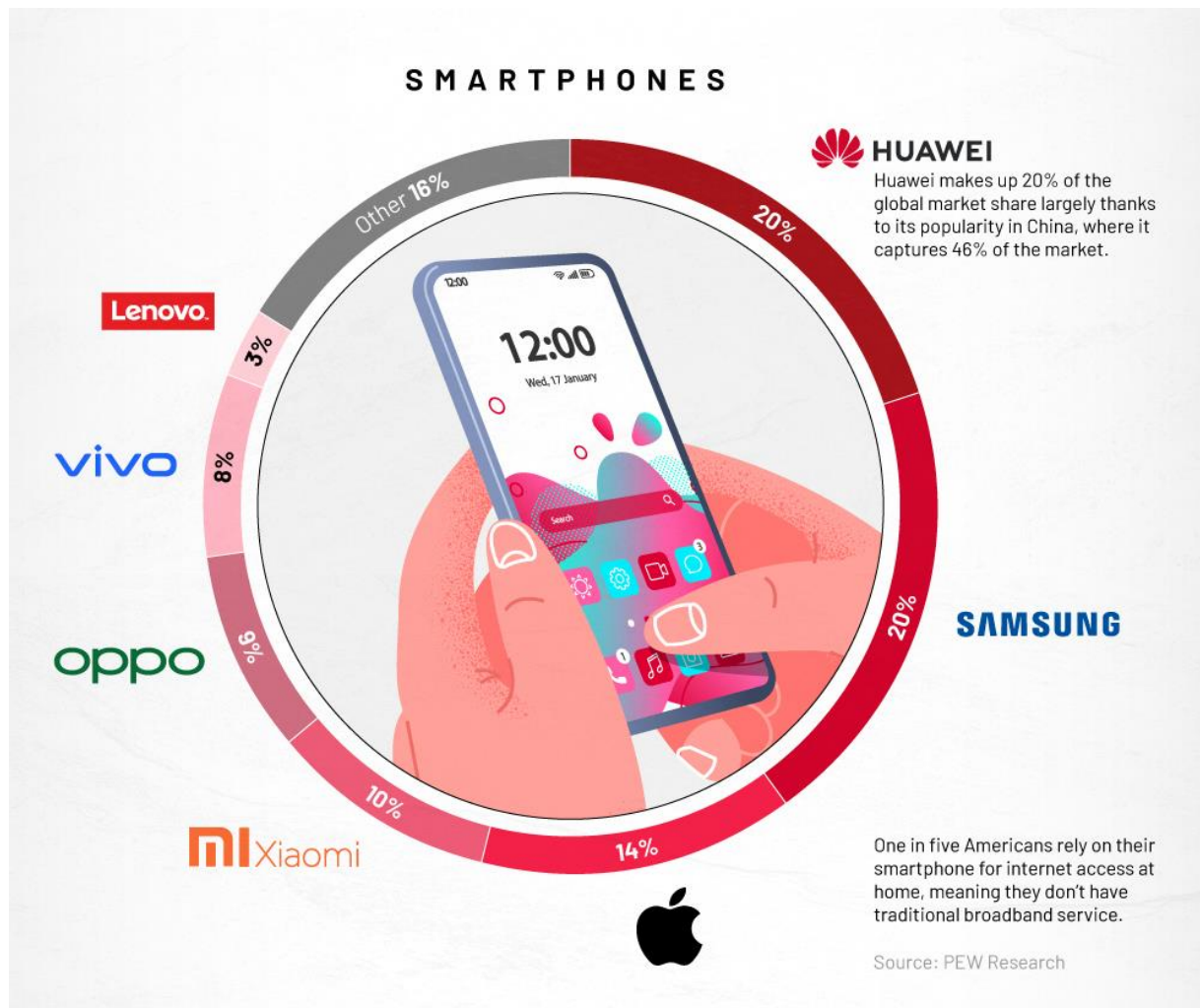
Figure 7 – Number of Fairphone sold between 2018-2022



Source: Fairphone Impact Report 2022 at <https://www.fairphone.com/wp-content/uploads/2023/05/Fairphone-Impact-Report-2022.pdf>

In 2022, global smartphone shipments declined by 12% to 1.2 billion units, the lowest since 2013, but Fairphone increased its sales consistently. However, its market share is around 0.001 %, too small to make assumptions about influencing the market.

Figure 8 – Companies market share in the smartphones manufacturing sector



Source: PEW Research Center

#### 4.4.2 An Open Business Model

In 2011, Fairphone was a social enterprise, part of an open design initiative facilitated by Waag. By 2013, it had become an autonomous entity. Open design, which is also referred to as open engineering, involves creating physical products, machines, and systems using publicly accessible project information. This practice is made feasible by the Internet and is frequently executed without any financial remuneration.

As of today, Fairphone's distinctive approach to sustainable electronics is underpinned by an open innovation business model that emphasises collaboration, transparency, and a commitment to driving positive change within the industry. Central to this model is Fairphone's dedication to challenging the status quo and actively involving various stakeholders in the innovation process. According to the co-founder Tessa Wernink, the company prioritises investment in social innovation over technical innovation. Unlike other phone companies

that focus on researching new technology in order to design a new device, Fairphone researches supply chain improvement.

**Collaboration and Stakeholder Engagement:** Fairphone collaborates with a network of partners, including suppliers, NGOs, academia, and consumers, throughout the product lifecycle. This collaborative approach extends beyond traditional supplier relationships. Fairphone engages with its suppliers to ensure they adhere to fair labour practices and ethical sourcing of materials, thereby promoting responsible supply chain management. Furthermore, the company listens to its user community, actively seeking feedback and incorporating user-driven design improvements. They foster open-source communities through a collaboration with the */e*/Foundation.

**Transparency and Ethical Sourcing:** Fairphone sets the standard for transparency in the electronics industry by openly sharing information about its supply chain, from mine to manufacturing. They disclose the sources of materials used in their products, highlighting their commitment to ethical sourcing. This transparency not only builds trust with consumers but also encourages other companies to follow suit. Fairphone has announced its commitment to setting an example in the electronics industry with the aim of inspiring other industry players and lawmakers. Over the next four years, the *DaCapo Project* will be working on creating digital tools for circular value chains and product manufacturing. The funding for this project has been provided by the EU Commission. This initiative involves collaboration with 15 other organisations and aims to develop digital tools and product passports to increase transparency in the supply chain in anticipation of upcoming EU legislation.

**Modular Design for Repairability:** Fairphone's innovative product design promotes open innovation at its core. Their smartphones are modular, allowing users to replace and upgrade components, from screens to batteries, easily. This design not only extends the lifespan of devices but also encourages a culture of repairability, contributing to the reduction of electronic waste. Fairphone even shares repair manuals and spare parts to empower users to take control of their devices' maintenance and repair and partners with external entities such as *Closing the Loop* or *ReCell in Africa* to collect e-waste. In 2022, they joined the *Responsible Lithium Initiative* to further collaborate with a variety of stakeholders interested in lithium extraction in Chile's Salar de Atacama region. Unfortunately, the extraction of lithium in this area has been associated with harmful effects on ecosystems, waterways, and indigenous communities. At present, a total of 22 groups are working together in roundtable deliberations aimed at safeguarding the ecosystem of the Salar de Atacama basin. Those involved in these discussions comprise Indigenous communities, civil society organisations, academic institutions, private enterprises, government entities, and mining corporations.

Influence on the Industry: Fairphone's open innovation business model has set a precedent for the electronics industry, inspiring larger companies to rethink their supply chain practices and product design. By demonstrating that ethical sourcing, transparency, and user-centric design can be profitable, Fairphone has catalysed conversations and initiatives within the industry to align with sustainability goals.

In 2020, Fairphone collaborated with *The Impact Facility* to establish the *Fair Cobalt Alliance* (FCA). The FCA's primary objective is to improve the ASM cobalt mining and DRC mining sectors by engaging all stakeholders throughout the cobalt mineral supply chain. Currently, the alliance boasts 24 members that represent various segments of the cobalt mineral value chain, including companies and NGOs. Six new members have been accepted by the FCA, including a multinational company specialising in search engine technology, advertising, and consumer electronics, a provider of battery solutions with an international presence, a mining group operating in nine African countries, a fast-growing electric bike company, and a consultancy group.

*Project Access*, an initiative led by Fairphone in collaboration with *The Impact Facility and Solidaridad*, leverages the collective experience gained from years of providing support in environmental, social, and governance (ESG) aspects and formalisation processes to artisanal gold miners in Uganda and Kenya. This project, co-funded by the *Dutch European Partnership for Responsible Minerals* (EPRM), has a twofold objective: to enhance ESG performance among small-scale gold producers and facilitate their entry into international markets. To garner market acceptance, Fairphone also orchestrates engagements with gold purchasers, encouraging them to commit to financial contributions in support of responsible gold sourcing. In 2022, this initiative yielded significant results, with five private gold companies and two consumer electronics firms expressing their commitment through a letter of intent to procure responsibly sourced gold once it becomes available.

These are just a few non-exhaustive examples of the firm's partnership and open ecosystem.

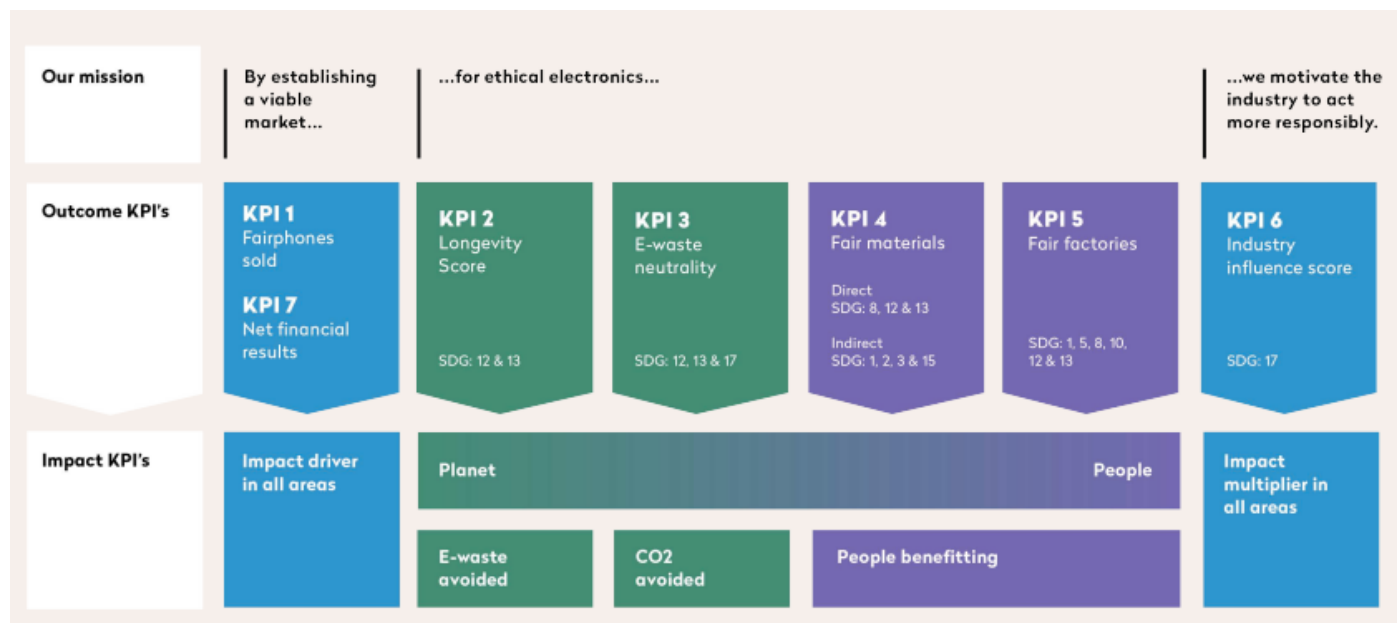
#### 4.4.3 Mission for a Better World

Fairphone strongly aligns with SDG 12 - Responsible Consumption and Production. The company's commitment to sustainability is evident in its efforts to reduce electronic waste, minimise the environmental footprint of electronics production, and promote responsible consumption through an ethical-driven supply chain. By leveraging the open business model with strategic partnerships and focusing its work on the construction principles described below, the company has managed to achieve milestones with a positive impact on the environment. According to company data, in 2022, there were 999 tons of CO<sub>2</sub> less and fifteen tons of electronic waste collected, thanks to the sales of its devices.



The SME has developed a list of six Key Performance Indicators (KPIs), representing the core of the mission and impact, alongside a useful tool to measure and signal their actions.

Figure 9 – Fairphone’s KPIs



Source: Fairphone Impact Report 2022 at

<https://www.fairphone.com/wp-content/uploads/2023/05/Fairphone-Impact-Report-2022.pdf>

The company has listed four main features for its phones’ manufacturing, which are the principles that guide them along the whole supply chain in order to pursue a better result on the KPIs.

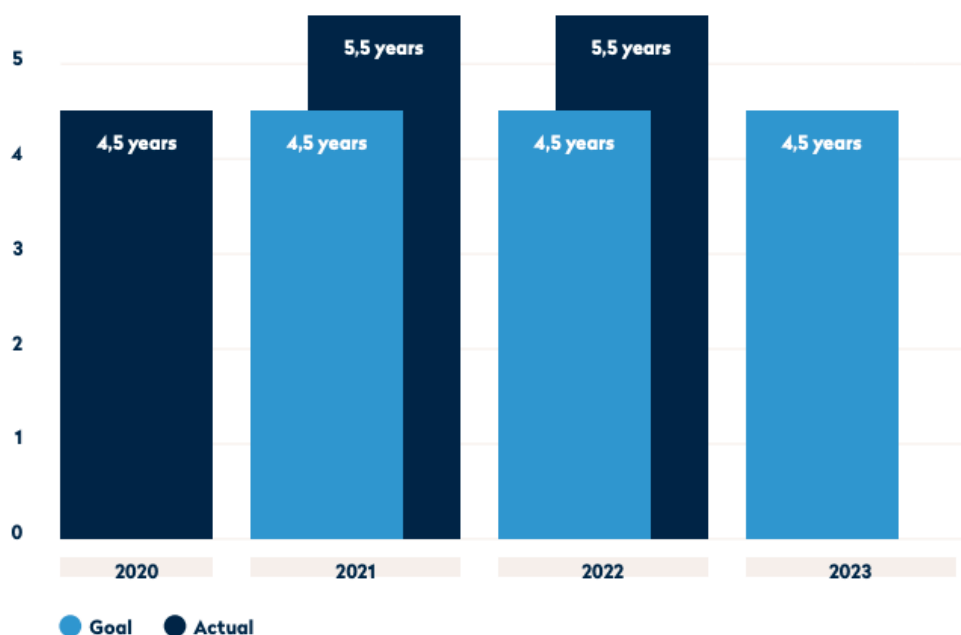
### Built to Last

Fairphone's products are designed with modularity in mind, allowing users to easily repair and upgrade components, thereby extending the lifespan of their smartphones. Since over 75% of a phone’s emissions are caused by its production, the most sustainable smartphone is the one that you can keep, reducing waste and overproduction. Fairphone's Longevity score is used to estimate the average lifespan of Fairphone 4 and 5 devices by combining their measured actual lifetime with their expected lifetime.

In 2021, the goal for the Longevity score was set at 4.5 years, but the actual result exceeded expectations with a score of 5.5 years, more than double the average lifespan of other phones (2.7 years in 2022). The firm offers a 5-year warranty for models 4 and 5. This score reflects the progress made by Fairphone in improving the durability and longevity of their devices with a circular economy approach.



Figure 10 – Actual and Expected lifetime of a Fairphone increased by one year from 2020 to 2021 but remained constant in 2022



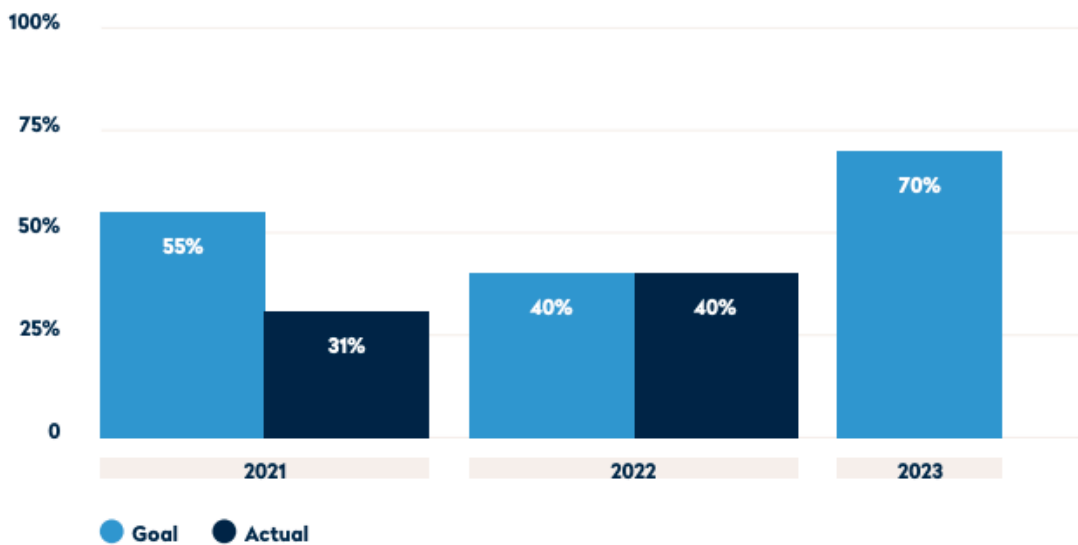
Source: Fairphone Impact Report 2022 at <https://www.fairphone.com/wp-content/uploads/2023/05/Fairphone-Impact-Report-2022.pdf>

### Fair and Recycled

Fairphone has made significant progress in increasing the number of materials sourced fairly in its products. *The Fairphone 5* now includes 14 such materials, compared to just 8 in the previous model, the *Fairphone 3*. The production of the Fairphone smartphone involves the utilisation of more than thirty minerals, including columbite-tantalite, cobalt, and tin. To ensure ethical sourcing, the minerals are carefully selected from mines that are not controlled by individuals with vested interests in the ongoing civil war in eastern Congo. This is a crucial step in preventing the mining revenues from being channelled towards the purchase of weapons for the conflict that first began in April 2012.

The company has set an ambitious target of responsibly sourcing 70% of these 14 materials by the end of 2023. As of 2022, 31% of the *Fairphone 4*'s supply chain is made up of fairly sourced materials. Notably, the phone's back cover is made from 100% recycled plastic, the midframe is composed of 98% aluminium from vendors certified by the *Aluminium Stewardship Initiative (ASI)* Performance Standard, and the speaker and vibration motor contain 86% recycled rare earth. Additionally, Fairphone is working to integrate Fairtrade gold into its board-to-board connectors supply chain, as well as into the PCB, battery PCB, battery connectors and speaker.

Figure 11 – Fairer Materials: average % of 14 focus material sustainability sourced



Source: Fairphone Impact Report 2022 at <https://www.fairphone.com/wp-content/uploads/2023/05/Fairphone-Impact-Report-2022.pdf>

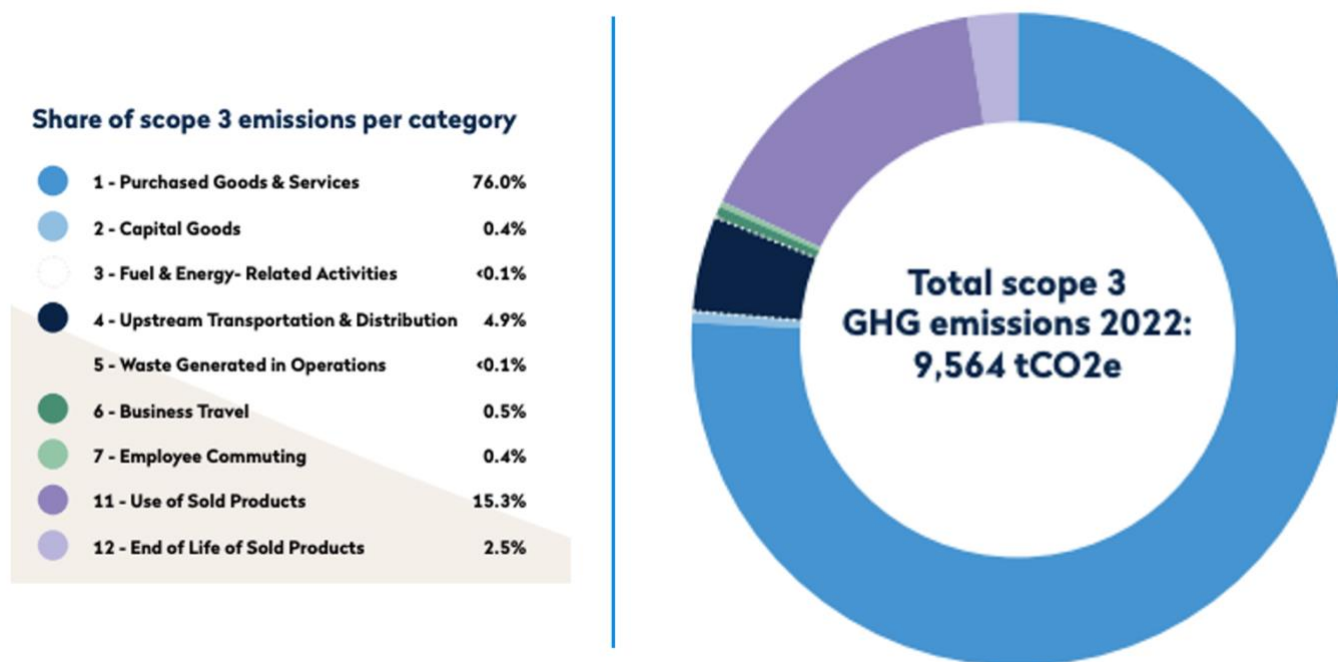
### Climate Conscious

E-waste is a rapidly growing waste stream worldwide, with only 20% of smartphones sold being correctly recycled. Fairphone has launched a new phone that is e-waste neutral to address this issue. This means that for every *Fairphone 5* phone and module sold, an equivalent amount of e-waste is neutralised. In order to realise it, Fairphone is focusing on three main actions: avoiding emissions, reducing them, and contributing to climate projects.

- **Avoiding emissions:** By designing their products for repairability and longevity and providing robust support, they contribute to a reduction in the overall number of products requiring manufacturing, as we have seen in the “built to last” section. This approach helps mitigate the carbon-intensive phase typically associated with the lifecycle of electronic products.
- **Reducing emissions:** The reduction of emissions from products can be achieved by using recycled materials. This is due to the fact that the production of primary raw materials is often more polluting than the production of recycled materials. Nevertheless, the production of high-quality products from recycled materials is a difficult task. The company works closely with its suppliers to explore innovative ways to integrate recycled materials and lower emissions during the production process.
- **Contributing to climate projects:** Their focus is on backing projects that reduce carbon emissions and have received certification from internationally recognised quality standards. Their investments are determined by considering the total amount of carbon emissions generated from the start to the end of

the product’s life cycle, including production, transportation, usage, and waste management, as reported in their life cycle assessments.

Figure 12 – Fairphone 2022 total GHG emissions



Source: Fairphone Impact Report 2022 at <https://www.fairphone.com/wp-content/uploads/2023/05/Fairphone-Impact-Report-2022.pdf>

### Better Working Conditions

The CEO of Fairphone, Eva Gouwens, posits that a pivotal moment is forthcoming wherein the implementation of equitable and sustainable materials and manufacturing practices will evolve from an anomaly into a standard. Despite this, she has also noted a burgeoning awareness of the necessity to reform our treatment of the environment, yet a dearth of expediency in ensuring the just treatment of labourers.

The production of a phone involves a significant amount of teamwork, with thousands of workers participating in the mining, fabrication, assembly, and testing of various phone components. However, many of these workers endure long working hours, low wages, and poverty, with some being children or victims of violence. Unfortunately, these workers are often not involved in the decision-making process regarding their wages or working conditions. In some cases, these conditions can lead to abuse or even fatalities. While most companies conduct audits of their suppliers to ensure ethical conduct and good working conditions, these audits only address basic health and safety concerns on the factory floor. It is crucial to acknowledge that there are ongoing

problems within factories that require attention, such as inadequate salaries, insufficient worker representation, and excessive overtime.

Furthermore, factory assessments often overlook subjective factors that contribute to worker well-being, such as their satisfaction level and exposure to discriminatory practices in the workplace.

Based on a programmatic approach, the company went beyond traditional audits and Codes of Conduct. They conducted research to assess working conditions, surveyed workers to understand their needs, and developed worker-driven action plans to find and implement solutions.

As per the CEO, *Fairphone 4*'s key suppliers have taken significant steps to improve the working conditions of their employees. Of the eight suppliers, including the final assembly factory and the suppliers of the camera, battery, speaker, and vibration motor, five have implemented changes. Fairphone also collaborated with the *Fairphone 3+* final assemblage and *True Wireless Stereo Earbuds* supplier to enhance working conditions.

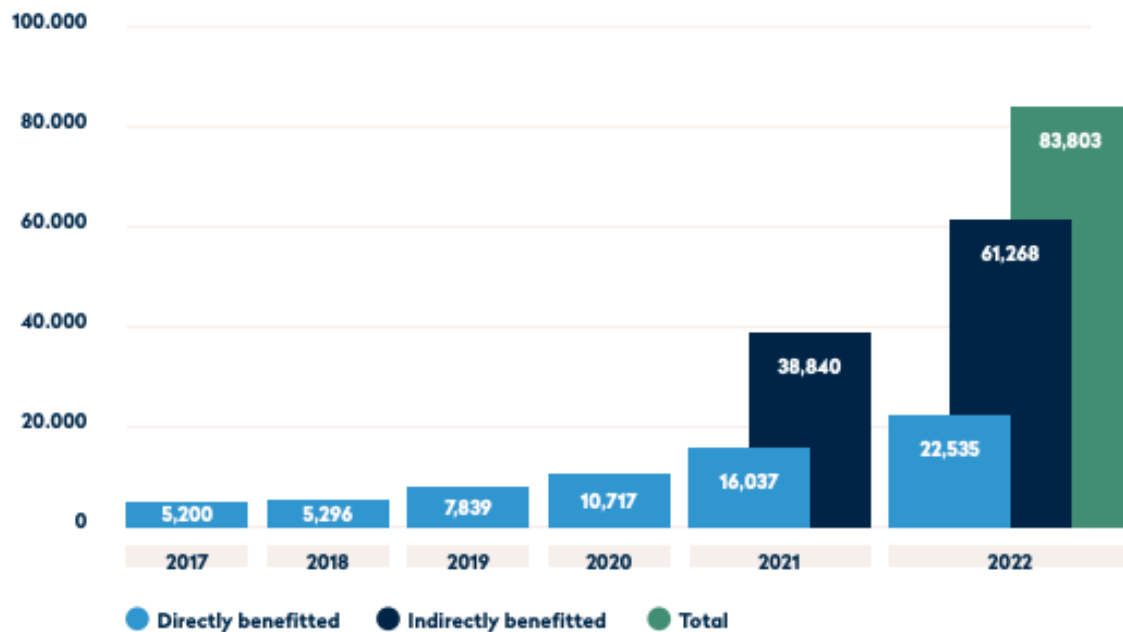
The final assembly factory for *Fairphone 4* gained the prestigious SA8000 certification for providing safe and decent working conditions and has also been awarded an ISO14001 certification for environmental management. To increase the wages of factory workers in 2022, Fairphone paid a total of US\$ 305,000 to 1,926 workers across three factories. This wage increase is equivalent to almost one month's extra salary for workers at the final assembly factory for *Fairphone 4*. Although the increase is substantial, it still falls short of a full living wage since Fairphone cannot compensate workers for their efforts on other brands' products produced in the same factory.

It is crucial for electronics companies to pay prices that allow their workers to earn a living wage. Furthermore, the factory workers have requested that Fairphone distributes bonuses to all low-paid employees, even if they are not working on Fairphone products.

Rather than providing a modest bonus to a large number of individuals, Fairphone's bonus system effectively narrows the gap between minimum wage and living wage by 6.5%.

Fairphone has implemented measures towards promoting ethical and fair practices in the technology industry. To achieve this, they have released a guidebook that provides instructions on how to pay living wages throughout the supply chain. Moreover, the legislation also plays a vital role in propelling the industry forward. Thus, Fairphone launched an advocacy campaign in 2022, urging the EU to recognise living wages and income as a human right in the EU Corporate Sustainability Directive. In collaboration with 64 companies, investors, and NGOs, Fairphone sent a letter to key members of the EU Parliament, the EU Commission, and member states while including specific amendments that would enhance the directive.

Figure 13 – Number of people who gained benefits from Fairphone’s interventions and programmes from 2017 to 2022 and total



Source: *International Labour Organisation, 2020 State of the Artisanal and Small-Scale Mining Sector;*  
and *IndustriALL Mining and DGOJP*

#### 4.4.4 SIM Positioning

Fairphone's journey in the smartphone market has been remarkable. While it may not rival the market share of industry giants like Apple, Samsung, or Huawei, it has made substantial achievements:

- **Market Impact:** Fairphone's products have gained traction in the sustainable consumer electronics market, setting an example for larger players to adopt ethical and sustainable practices.
- **Transparency:** The company has made strides in supply chain transparency, publishing annual reports detailing the social and environmental impact of its products and making efforts towards a fair and just treatment of workers along the supply chain.
- **Modular Design and Sustainable Materials:** Fairphone’s modular smartphone designs have garnered attention for their repairability and eco-friendliness, contributing to a reduction in electronic waste and using recycled and fair materials for production.

- Partnerships: Fairphone collaborates with like-minded organisations and suppliers to promote ethical sourcing of materials and fair labour practices in the electronics industry.

As we have assessed in the previous paragraphs, Fairphone has an open business model with disruptive innovation in its sector. Although it was not the first initiative in the manufacturing of sustainable phones, it has been one of the pioneering ones. It represents a point of discontinuity of great importance in the sustainable and ethical production of telephone devices. Its collaborations and influences in the sector make it a company with a great innovative drive and an open approach.

The countless initiatives in support of SDG 12 (Responsible Consumption and Production) present highly successful KPIs in the main action metrics of the goal: 0% e-waste, fair and recycled materials, climate-conscious approach, better working conditions along the whole supply chain, and many more. This makes them very aligned with UN goal 12 and positions Fairphone in the first quadrant of the SIM matrix (Rising Sun), with a high level of SDG achievement and a high degree of OI disruption.

From the data and outcomes published in the company reports, it is clear that collaboration and commercial partnership initiatives have been key determinants in achieving the sustainability objectives. This strengthens the thesis of a positive and synergistic correlation between the open innovation model and sustainable development.

However, it is worth noting that despite Fairphone is making substantial improvements in organic growth and in influencing the big players in its sector, as can be seen from the market share data (0.001%), it does not have the strength necessary to determine a high degree of achievement of SDG 12 in its sector globally. If we took this last aspect into consideration for an evaluation at a global level, we would have to place the SME in quadrant II (Rocket).

## 4.5 WAMI case

*“Water with a Mission”.*

*“We dream of a planet where everyone has sustainable and equitable access to drinking water”.*

- WAMI

### 4.5.1 Firm General Description and Metrics

WAMI (Water with a Mission) is an Italian SME that specialises in providing sustainable water solutions for communities in need, particularly in developing regions, by selling bottled water, the soft drink *Wanderfuse*, and reusable aluminium bottles at a regional level. The company operates ensuring maximum transparency: each project is tracked online via a QR code on each product and shows the litre count and the families

involved. From its inception at the end of 2016, WAMI has donated more than 8 billion litres for over 50 projects, and thanks to these results, it has been a Certified B Corporation since 2017. As the CEO – or *Chief Water Giver* as they define him – Giacomo Stefanini states, for every bottle of water purchased, 100 litres of water will be donated to those in need. WAMI has a mission to address the global water crisis by offering innovative, affordable, and eco-friendly water treatment technologies. Their solutions are designed to improve access to clean and safe drinking water, ultimately contributing to better public health outcomes and enhanced living conditions in underserved areas.

WAMI exhibits several metrics that align with Small and Medium-sized Enterprises (SMEs), precisely at the bottom of the small-sized category of firms. It operates with a relatively small team of less than 15 dedicated professionals. This lean workforce allows the company to maintain cost-efficiency and adaptability in its operations.

In 2019, its annual revenues were € 300,000, generated at a regional level and composed of 90% sales from the catering sector and the remaining part of retail sales to final consumers. This contextualises the company in a business-to-business model (B2B). With an actual turnover of € 2.5 million (2022) and 10 million products sold (2022), the start-up showed rapid growth and a successful business model.

While WAMI generates steady but small/micro-sized SME revenues, their focus on sustainability and impact over pure scale guarantees their international projects broader traction and echo, thanks also to collaborations with external partners.

#### 4.5.2 OI Integration

WAMI's approach partially aligns with the principles of open innovation. While it is not a conventional technology firm and does not have pressing constraints to innovate its product, WAMI actively collaborates with local communities, non-profit organisations, and research institutions to develop and deploy sustainable water treatment solutions. This open collaboration fosters knowledge exchange, enabling the incorporation of local expertise into the development process. Additionally, WAMI's emphasis on affordability and eco-friendliness encourages the sharing of best practices in sustainable water management.

Flowe collaboration to build aqueducts.

Flowe, a promising Italian fintech start-up committed to enabling people and fostering community-driven programmes, is striving to obtain B Corporation certification to showcase their unwavering commitment to social and environmental accountability. In collaboration with WAMI, Flowe is encouraging website visitors to support their latest efforts by filling out a straightforward contact form. Each submission will aid in building a water infrastructure that will supply clean drinking water to 37 families residing in Norwood, Sri Lanka. By

providing a phone number and email, individual contributions will be matched, magnifying the positive impact a person can make.

#### Water Equal Partner Initiative

The company expresses the desire for every individual to be part of the change and has started a collaboration project with companies that want to become *water-equal*.

The project involves calculating the water footprint of your company, employees and products in order to reduce water consumption and make the company more sustainable, but also by balancing the equivalent of litres saved with projects that can bring water to communities without access. The partners can also develop a digital journey in the WAMI web app for employees, stakeholders and consumers and thus signal the impact generated.

#### WAMIzzonia

*WAMIzzonia* is a project that actively involves users, partners and suppliers and consists of planting trees in the parks of the major Italian cities to create an urban forest. This initiative is generated by the collaboration with Selva Urbana and Cortilia, as well as with the local administrations of Italian municipalities.

Selva Urbana is a non-profit organisation that deals with environmental communication and social responsibility. Born with the aim of creating culture and innovation in the field of sustainability, it is a connector of needs and ideas.

Cortilia is the first agricultural market that allows consumers to shop online for fresh and seasonal fruit and vegetables, organic products, and gluten-free foods.

Those indicated are just some of the collaborations that the company has structured to be able to expand its sustainable actions. Although this has created a solid network of partnerships to increase, expand and spread the mission as well as to amplify the outcomes, this does not always constitute an innovation of the business model intrinsically, but more specifically, innovation and diversification of collateral projects.

In this sense, the company's business model is not properly aligned to be considered an open innovation business model, despite being disruptive, compared to its competitors, for the allocation of profits deriving from the sale of water products.

#### 4.5.3 Mission for a Better World

WAMI's work strongly aligns with SDG 6 - Clean Water and Sanitation. By providing innovative and sustainable water treatment technologies, WAMI contributes to ensuring access to clean and safe drinking water for all, particularly in regions facing water scarcity and contamination challenges, such as Africa, Asia and South America.



Below, we describe some of the projects that the SME realised.

#### Churumanga – Ecuador

In collaboration with the ACRA Foundation, the SME has realised a water point in the Pelileo village for the locals. For the past fifteen years, access to clean drinking water has been a major concern in Ecuador. Prior to 2007, toxic substances had contaminated all major water sources. The scarcity of potable water in close proximity led to the exploitation of resources along the Ecuadorian coast, which caused the melting of 33% of the country's glaciers, including those surrounding Chimborazo.

To address this issue, the government implemented a National Development Plan in 2007. The plan aimed to restructure the management of drinking water and promote sustainability throughout the country. As part of this initiative, several kilometres of integrated sewer systems were constructed to intercept wastewater.

The objective of the plan is to achieve universal access to clean drinking water and proper sanitation facilities throughout Ecuador by 2030, according to SDG number 6. Presently, 93% of the population has access to clean drinking water, and this figure has increased by nearly 40,000 individuals in 2019. This has resulted in advancements in the quality of education and administrative structures, as well as a substantial reduction in poverty, with only 4% of people living below the poverty line, as opposed to 10% in the 1990s.

#### Ankatsake, East District – Madagascar

During 2021, WAMI created an aqueduct in Madagascar for a total of 1,036 inhabitants that will benefit from direct access to drinking water. This project was realised in collaboration with Aid4Mada, a local non-profit organisation.

#### Foussoulang – Senegal

Foussoulang is a village in Senegal, part of the rural community of TENGHORY, and according to the latest census, it has around 16 families, for a total of 175 inhabitants. In collaboration with the ACRA Foundation, WAMI has built a well, connecting it to the taps of the village. The project was completed in April 2017 but is still under management at WAMI for maintenance operations and has so far generated 67,068,750 litres of potable water.

#### Norwood – Sri Lanka

In collaboration with WAMI, Azzurra has brought water to the homes of 20 families in the Norwood area of Sri Lanka by constructing an aqueduct and connecting it to the water network. The company is committed to preserving the well-being of people and protecting the planet.

For over 35 years, Azzurra has been dedicated to exploring the possibilities of ceramic materials, like washbasins and bathroom fixtures. The firm is committed to improving the quality of life for people by

conducting constant research and developing patents and cutting-edge technologies for the world of the bathroom. Azzurra is also deeply aware of the issue of water scarcity and has taken an active role in a cultural revolution. Since 2010, the company has developed a patented drainage system that can save up to 70% of water, equivalent to 31,000 litres per year.

WAMI's mission directly addresses the core objectives of SDG 6 by enhancing water quality, reducing waterborne diseases, and promoting responsible water resource management in underserved communities.

#### 4.5.4 SIM Positioning

The organisation has forged multiple partnerships to enhance its sustainable efforts and deeply involves local communities in its activities at a national and international level. Although these alliances have facilitated the establishment of a robust network to broaden the scope of the mission and enhance its effectiveness, they do not necessarily equate to a revolution of the business model. Rather, they signify supplementary initiatives that diversify the company's portfolio of sustainability pathways. As a result, the company's business model does not conform to an open innovation business model despite deviating from conventional practices when it comes to distributing profits from water product sales, setting it apart from its competitors in a disruptive way.

WAMI declares to strictly align to the *Global Indicator Framework for the Sustainable Development Goals* and targets of 2030, regarding goal number 6. The Agenda for Sustainable Development report goal 6 to have 8 targets and 11 indicators, among which there is safe and affordable drinking water, to increase water use efficiency and ensure freshwater supplies, implement integrated water resource management and others. Despite the lack of extensive data that characterises the micro/small-sized SME's environment, WAMI has built a business model that consistently ensures the alignment and achievement of SDG 6 - Clean Water and Sanitation with its best efforts and, to date, it has provided 60,000 people with access to clean water for life.

In conclusion, the company's initiatives are in line with the worldwide endeavours to attain the United Nations' goal of ensuring universal and equitable access to safe and affordable drinking water for all.

According to the data provided, WAMI can be placed in the fourth quadrant, known as Green Leaf, on the Sustainable Innovation Matrix. While the company's business model has a limited integration of open innovation, it has remarkably succeeded in fulfilling its commitment to SDG 6, which is the SME's primary focus.

#### 4.6 Conclusion

SMEs are essential actors in the business economy by representing more than 90% of businesses and contributing to more than 40% of the national income. Additionally, they are critical in the open innovation landscape and in the achievement of Sustainable Development Goals. Research indicates that small and

medium-sized enterprises (SMEs) are contributing over 63.3% of greenhouse gas emissions from all types of businesses. In fact, while individual SMEs have relatively modest emissions footprints, their sheer quantity results in a substantial collective contribution to overall emissions. This presents a significant challenge, as any meaningful reduction in CO<sub>2</sub> emissions hinges on the active participation of SMEs.

As a result, it is crucial for SMEs to invest more in sustainable technologies and acquire the necessary skills and knowledge to foster sustainability and maintain competitiveness. An increasing number of small and medium-sized businesses are taking steps to improve their sustainability practices. These companies are investing in changes to their processes and seeing sustainability as a chance to grow, but they are encountering various obstacles. Limited financial resources, a lack of expertise, regulatory hurdles, and fixed costs associated with comprehending and navigating complex administrative and legal procedures are all challenges that SMEs face more frequently than larger corporations. Given the extensive presence of SMEs throughout the European Union, achieving CO<sub>2</sub> reduction targets incurs considerable costs. Furthermore, considering the pressing nature of climate change, there is an urgent need for swift implementation of mitigation and adaptation measures across the EU economy, SMEs included. Given the time constraints and the considerable environmental impact of SMEs, it is imperative to provide efficient and effective policy support to expedite their transition toward sustainability.

Through open business models, collaboration, and strategic use of Proof of Concepts, they not only drive innovation but also address pressing global challenges. The European SMEs analysed in this chapter serve as inspiring examples of how small or medium enterprises can make a substantial impact by aligning their innovative endeavours with SDGs. Their experiences provide valuable insights for SMEs seeking to harness open innovation for sustainable development.

SMEs are the unsung heroes of the innovation ecosystem. Their agility, risk-taking propensity, and entrepreneurial spirit make them invaluable drivers of innovation. They introduce disruptive technologies, create vibrant innovation cultures, and act as a bridge between research and commercialisation. SMEs are not just economic entities but critical components of a thriving innovation ecosystem. Recognising and nurturing their role is essential for sustaining innovation and fostering economic growth in any society.

Although a correlation between OI business models and achievements in sustainability practices is not yet clearly addressed, and there are future avenues of research, several studies clearly suggest that Open innovation equips SMEs with valuable tools and partnerships to advance sustainability while fostering innovation and market responsiveness.

We have developed a simple two-dimensional matrix called the Sustainable Innovation Matrix (SIM) to explain better the intersection of SMEs, open business models, and SDGs. This matrix uses the horizontal axis to represent the “SDG Achievement Level” and the vertical axis to represent the “Open Innovation Business Model Level of Disruption”. The matrix’s application provides a holistic view of how SMEs navigate the intersection of sustainability and innovation. It offers a roadmap for SMEs seeking to maximise their impact on SDGs by embracing open innovation practices and disruptive business models. By understanding where

they stand in this matrix, SMEs can tailor their strategies to become drivers of positive change, contributing significantly to the global pursuit of sustainable development. However, while the matrix is a valuable tool for visualising the intersection of SMEs, open innovation, and SDGs, it has intrinsic limitations related to subjectivity, data availability, and its static nature. It is essential to use the matrix as a starting point for assessment, complementing it with in-depth analysis and considering the broader context in which SMEs operate to derive meaningful insights.

The matrix can trace a reference evolutionary path for companies that want to evolve their business model from the third quadrant to reach the second and, finally, the first with the greatest achievement of the SDG level.

The two real-world examples of SMEs aligning to a specific SDG helped us better understand the practical use of the SDG-OI matrix.

Fairphone exemplifies how an SME can drive positive change in the electronics industry by aligning its business model with sustainability objectives. Through its commitment to responsible consumption and production (SDG 12), Fairphone has not only carved a niche in the market but has also inspired broader conversations about the need for ethical and sustainable practices in the electronics sector.

Fairphone's initiatives in support of SDG 12 have yielded positive outcomes in areas such as zero e-waste, the use of recycled materials, climate-conscious practices, and improved working conditions. Collaborative partnerships have been instrumental in achieving sustainability objectives, reinforcing the positive relationship between open innovation and sustainable development. However, due to limited resources, achieving a high degree of SDG 12 on a global scale may be challenging, placing the SME in quadrant II (Rocket).

WAMI exemplifies the impact that SMEs can have in addressing critical global challenges, such as access to clean water. With a focus on sustainability, affordability, and collaboration, WAMI's mission to provide sustainable water solutions not only aligns with SDG 6 but also showcases the potential of SMEs to drive positive social and environmental change through open innovation and purpose-driven initiatives.

Based on the data provided, we can position WAMI in the fourth quadrant (Green Leaf) of the Sustainable Innovation Matrix. The company has a low level of integration of open innovation within its business model, but it has achieved a high level of success in meeting SDG 6, to which the SME is dedicated.

## Chapter 5: Conclusion

Everything flows. Just as Heraclitus' hand never dips twice into the same river, companies find themselves having to face a constantly evolving world. The difference compared to the past is that the ageing timeframe of innovations – not of novelties that expire even more rapidly – seems to have narrowed considerably due to the phenomena of globalisation and technological advances that reduce frictions to a minimum, breaking down the barriers of space and time. The two great human limits seem to have been exceeded. Are companies – and human beings in a more ontological approach – ready to face Prometheus freed without suffering the price of the eagle Aithon? The future needs our change because we will be tomorrow, where we decided to be today. History always presents the count of missed opportunities. Trying to condense the pre-Socratic ontological and cosmological sense with the subsequent philosophers' anthropological and ethical approach can be the key to accessing a responsible and healthy quality of life and collective conscience for all humanity. In this broader sense, the markedly synthetic definition of ESG principles (environmental, social, and corporate governance) and their materialisation in programmatic goals for sustainable development (SDGs) by the United Nations marks the collective desire to consider the harmony of things in the governance of the economy and its leading players. Synthetically, the market where it is possible, the state where it is necessary. Furthermore, the free circulation, fruition and contamination of ideas could accelerate the possibilities of staying up to date with the times, avoiding waste, systematically exploiting every possibility and hastening advancement. Prof. Henry William Chesbrough's *Open Innovation* paradigm describes the increasing embrace of external cooperation in a complex world by companies that want to innovate. The human being woke up in a world that he did not understand, and that is why he tries to interpret it. But, as Jung encourages, in every case, there is a cosmos, in every disorder a hidden order, in every arbitrariness a lasting law, a sense of purpose within every seemingly random occurrence. The journey towards an elusive, ineffable sense of perfection remains a noble pursuit driven by pure intentions.

In the grand tapestry of human progress, the threads of innovation have woven themselves into the very fabric of our existence. It is through the brilliance of the open innovation business model that we glimpse a future brimming with boundless potential and unprecedented growth. As the walls of traditionalism crumble, a symphony of minds from diverse corners of the globe converges, their ideas intertwining like cosmic constellations. This symposium of creativity births not only revolutionary products and services but also a profound shift in the paradigm of possibility. With open innovation, the shackles of exclusivity are shattered, and the floodgates of collaboration swing wide open. The sparks of one mind ignite the passions of another, birthing innovations far greater than the sum of their parts. Through this symphony of open minds, humanity surges forward, carving its path towards a tomorrow where progress knows no bounds and the spirit of innovation dances eternally.

The journey through the multifaceted landscape of open innovation, Environmental, Social, and Governance (ESG) principles, and the United Nations' Sustainable Development Goals (SDGs) has unveiled a nexus of opportunities and challenges. In this concluding chapter, we reflect on the practical and theoretical contributions of this thesis, acknowledge its potential limitations, and chart a course for future research endeavours.

## 5.1 Practical and Theoretical Contributions

This thesis has unravelled the intricate relationships and synergies between open innovation, ESG principles, and the SDGs within the European context of SMEs. The practical contributions are twofold.

First, this research has advanced the theoretical discourse surrounding these domains. It has underscored the role of open innovation as a catalyst for sustainable development, emphasising its potential to transcend traditional business boundaries and foster collaborative ecosystems. Moreover, it has elucidated the practical manifestations of ESG principles in corporate strategies, accentuating their pivotal role in shaping responsible business practices.

Second, through a meticulous exploration of case studies, it has analysed how European firms, specifically Small and Medium-sized Enterprises (SMEs), are aligning their strategies with the SDGs, catalysed by ESG principles and open innovation. These real-world exemplars serve as beacons of hope, showcasing that businesses can be drivers of positive societal and environmental change. Furthermore, with a preliminary intuition of possible synergies between OI and SDG achievement, it has explored a two-dimensional model framework, the Sustainable Innovation Matrix (SIM). It can be used as a practical tool to frame companies in a specific state of evolution of their business model and achievement of sustainability objectives. In addition, the matrix presents a possible evolutionary dynamic with the passage from a low metric quadrant to a higher one.

By weaving these threads together, this thesis has contributed to a deeper understanding of the interconnectedness of open innovation, ESG principles, and the SDGs, offering a framework for future research and policy deliberations.

## 5.2 Potential Limitations

While this research has navigated the rich tapestry of literature and data with meticulous attention, it is imperative to acknowledge its potential limitations. Firstly, the dynamic nature of these domains poses a challenge as they continually evolve in response to societal, economic, and environmental shifts. The case studies and empirical data herein represent a specific moment in time, and the landscape may have evolved

since. Additionally, the contextual specificity of the European setting warrants caution in extrapolating findings to a global scale.

Furthermore, the availability and accessibility of data on firms' practices related to the SDGs and ESG principles can be limited, especially for SMEs. The lack of data is due to high costs and low incentives. SMEs can gain from sustainability reporting by improving their reputation with clients and suppliers. However, it can be costly and challenging, requiring complex reporting frameworks and KPIs. SMEs may also lack the necessary knowledge and resources to track appropriate sustainability indicators, which can differ from large firms. This limitation may have constrained the depth of analysis in some instances.

Lastly, while the case studies provide valuable insights, they represent a select subset of European firms, and their experiences may not fully capture the diversity of strategies and challenges across the continent.

### 5.3 Future Avenues of Research

As this thesis concludes its exploration, it sets sail for future research endeavours. Numerous avenues beckon scholars and practitioners interested in the confluence of open innovation, ESG principles, and the SDGs for SMEs.

Future research can delve into the dynamic interactions between these domains, examining how changes in open innovation practices influence ESG integration towards SDG alignment over time and comparing SMEs and large firms. Eventually, further investigations can establish a possible correlation between OI and SDG achievement.

Additionally, cross-continental comparisons can be an interesting added value. Expanding the analysis beyond Europe to include firms from various continents can provide a global perspective on the convergence of these domains and uncover regional nuances.

Furthermore, given the pivotal role of SMEs in sustainable development, further research can spotlight their unique challenges and opportunities in aligning with the SDGs and embracing ESG principles at a regional level and with global comparisons. Even if, as we have seen, the major attainments and amount of literature on SMEs are from EU scholars with a special focus on European organisations.

Exploring the policy implications of these intersections can shed light on how governments and regulatory bodies can incentivise and facilitate responsible business practices.

Lastly, further investigating the role of innovation ecosystems in supporting open innovation for sustainable development can uncover the dynamics of collaboration and knowledge exchange.

In conclusion, this thesis has ventured into uncharted territories, shedding light on the transformative potential of open innovation, ESG principles, and the SDGs. While it acknowledges its limitations, it extends an invitation to scholars and practitioners to embark on further explorations guided by the shared vision of a more sustainable, equitable, and innovative future.

Finally, let us think from a wider perspective about the deep and intrinsic relevance of the environmental issue in business economics and, consequently, in human life.

In a Fermi paradox acceptance, let's imagine that in our galaxy of 400 billion stars, there is just us that think. While some microbial life forms may exist, there is no other form of life that can experience the universe with the same depth of emotions and meaning as us. Without us to perceive and appreciate it, the beauty present in these galaxies would be meaningless. Therefore, if these implications hold, the decisions we make as a civilisation hold far-reaching implications for the entire galaxy. If we destroy ourselves, for example, deliberately or through inaction, then it is possible that we eradicate meaning from the universe, perhaps forever. In a sense, in a galaxy of 400 billion stars, we have a tremendous responsibility and opportunity.



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