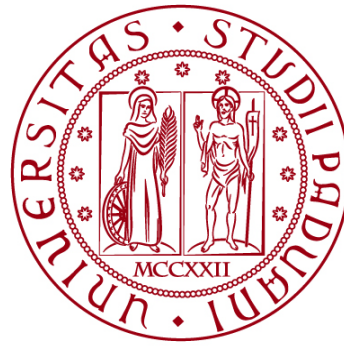


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TESI DI LAUREA

**Integrated Life Cycle Model to support ESG Ratings
of companies: the case of Carel Group**

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Abstract

Sustainability has recently become the driving force of many political actions and initiatives. As a matter of fact, the European Commission issued the Corporate Sustainability Reporting Directive (CSRD), which requires companies to report on their sustainability by next year. A tool used to report on the sustainability of companies is ESG ratings, which are sustainability metrics able to measure the sustainability performance of a company. However, these metrics are affected by many problems. Firstly, there are too many ESG ratings. In fact, the literature review carried out in this study highlights the presence of nearly 500 ESG ratings. Furthermore, the number of indicators assessed by ESG Ratings is huge. As a matter of fact, the analysis of the 7 ESG ratings carried out in this study highlighted the presence of 1085 indicators. Additionally to these issues, each ESG rating presents its own methodology. All these issues are related to the fact that no standards have been released for ESG ratings. To overcome these issues, this study proposes the use of other sustainability metrics, characterized by a standardized procedure and structure. A sustainability metric presenting this feature is the life cycle model, whose structure and procedure are standardized by ISO 14040 and ISO 14044. Therefore, this study applied the standardized structure and procedure of the life cycle model to ESG ratings and investigated the support that ESG ratings and the life cycle model provide one another. Particularly, this investigation has been carried out in Carel Industries, an Italian company specialized in the production of control solutions for heating, ventilation, air conditioning, refrigeration, evaporative cooling and humidification. This company is suitable for the investigation because it is subject to report on its sustainability performance using ESG ratings. Furthermore, Carel has adopted the life cycle model approach to assess the sustainability of one of its products and of the Organization itself. The results of this study shows that the 7 ESG ratings of Carel respond to the standardized structure of the life cycle model. However, the overall support provided by the life cycle model to the 7 ESG ratings of Carel amount to 2,24%. On the other hand, the overall support provided by Carel's ESG rating to the life cycle model amounts to 36,07%.

Chapter I - Introduction

The increasing stress on the environment, the exploitation of natural resources and impoverishment of raw materials have arisen lots of concerns on the future of the planet. The cause is to be found in the economic model adopted until a decade ago.

This model is known as linear economy, which was based on the “take-make-dispose” scheme, similar to a flat straight line. The aim of this economy was to maximize production, starting from the extraction of raw materials. Then, raw materials were transformed into products, which, after being used, were disposed of [1]. Therefore, this model led to many negative impacts on the environment. A schematic representation of the linear economy model is reported below.

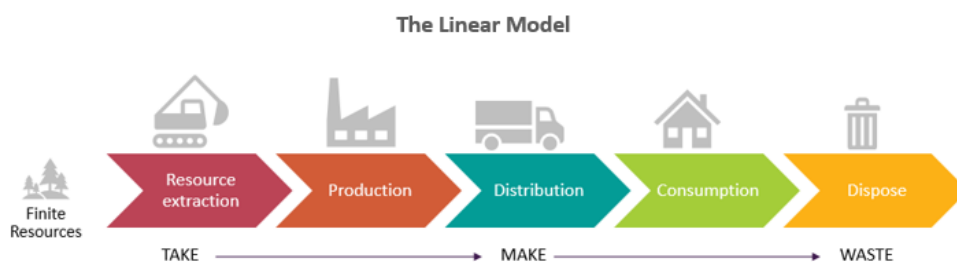


Figure 1: Representation Linear Economy scheme [2].

However, thanks to scientific development and the spread of awareness regarding the impacts caused by linear economy, many actions and measures have been taken to protect, restore and preserve the environment and its resources. Thus, the concept of linear economy has been replaced with circular economy.

Circular economy is a model of production and consumption aimed at extending the life cycle of products, reusing, repairing and recycling them as much as possible. The concept behind this model is to create further value from end-of-life of products. So, the circular economy model looks at waste as a

resource [3]. A schematic diagram of the circular economy model is reported in Figure 2.



Figure 2: Representation of the Circular economy model [4].

Going into details, circular economy has brought to light the concept of sustainability.

Sustainability is based on the concept of sustainable development, which is defined as the development that meets the needs of present generations without compromising future generations to meet their needs. Practically speaking, sustainable development should occur in harmony with the environment and its boundaries [5]. Therefore, to promote sustainability it is necessary to operate within the limits of the Planet. This leads to the concept of Planet boundaries, which identify a “safe operating space” within which is possible to operate respecting the restoring capacity of the environment. Therefore, Planet boundaries define the limits able to guarantee sustainability [6]. Thus, many actions and measures have been taken recently to operate within planet boundaries in order to

promote sustainability in an increasing range of activities. As a matter of fact, today sustainability influences political decisions, plans and activities. In fact, the EU Commission adopted in 2015 the 2030 Agenda, which is a European tool developed to extinguish poverty and promote sustainable development. In fact, Agenda 2030 includes 17 Sustainable Development Goals, committed to promote sustainable development [7]. Moreover, the EU Commission issued in 2020 the European Taxonomy Regulation, aimed at defining all over Europe what is sustainable. Particularly, the main consequence of this Directive (EU Taxonomy Regulation) is the shifting of investments towards sustainable projects and activities [8]. In addition, the European Commission issued the Corporate Sustainability Reporting Directive (CSRD), which requires companies to report on their sustainability by 2024 [9].

Therefore, companies are always more stressed about the reporting of sustainability information. A tool able to help companies in the reporting of sustainability data is ESG Ratings. ESG Ratings are tools able to rate companies according to the management of issues within Environmental, Social and Governance pillars. Particularly, these three pillars make up the sustainability of companies. Practically speaking, ESG Ratings provides a quantitative measure of a company's sustainability performance [10]. This feature makes ESG Ratings a sustainability metric for companies.

However, the increasing stress on sustainability topics has led to an excessive proliferation of agencies that provide ESG Ratings [11]. In fact, a study highlighted the presence of nearly 500 ESG ratings available in the market [12]. Furthermore, each ESG rating presents a considerable number of indicators that assess companies across ESG topics. Moreover, the literature review of ESG ratings carried out in this study shows also that each ESG rating has developed its own methodology to rate companies. Therefore, the huge number of ESG ratings available, the great number of different indicators and the different methodologies characterizing each ESG rating complicate the sustainability reporting for companies. Particularly, companies have to deal with all these issues when reporting on their sustainability because a standard is not available. Moreover, the

literature review made in this study shows that all the issues characterizing ESG ratings lead to divergence among ratings, which generates different results from one rating to another. Summarizing what has been said, ESG ratings are sustainability metrics that measure the sustainability performance of companies. However, there are many shortcomings in these metrics, especially due to the lack of a standard [11, 13].

Another sustainability metric available that measures sustainability performance is the life cycle model. In fact, life cycle models quantify the environmental impact of a product or organization during its life cycle. Unlike ESG Ratings, life cycle models present a standardized structure and procedure reported in ISO 14040 and ISO 14044 [14]. Therefore, this study proposes life cycle models to overcome the shortcomings of ESG Ratings, investigating the support that these two systems provide one another. This investigation is carried out within the boundaries of Carel Industries, an Italian group specialized in the production of heating, ventilation, air conditioning, refrigeration (HVAC/R), humidification and evaporative cooling systems. Therefore, the study investigates the ways in which Carel's Life cycle model and ESG Ratings support one another. Particularly, Carel is suitable for the investigation since it is a company subject to CSR Directive; thus, it has to report on its sustainability, which is a task accomplished with ESG Ratings. Moreover, Carel has adopted the life cycle model approach to assess the environmental impact of one of its products (Inverter) and of the Organization through a life cycle assessment study and a life cycle perspective study, respectively.

The investigation considers the 7 ESG ratings used by Carel. Each one of these ratings was analyzed. This analysis has highlighted the fact that each ESG rating adopts its own methodology, resulting in divergence among the ESG ratings. Moreover, the analysis has highlighted the presence of 1085 indicators across the 7 ESG ratings of Carel, complicating the sustainability reporting for the Organization. Then, the standardized structure of life cycle models was applied to Carel's ESG ratings. This phase was accomplished using the set of 1085 indicators. After, the life cycle model was drawn for Carel Industries. In the end,

the ESG ratings of Carel (standardized according to life cycle models) and the life cycle model of Carel Industries were compared to detect the support that the two systems provide one another. This support was detected by calculating the matching points between the two systems. The results of the study show that Carel's ESG ratings can be supported by the standardized structure and procedure of life cycle models. Moreover, the support provided by the life cycle model drawn for Carel to ESG ratings amounts to 2,24%. On the other hand, the support provided by the 7 ESG Ratings of Carel amounts to 36,07%.

In conclusion, the CSR Directive, issued by the EU Commission, requires companies to report on their sustainability. ESG ratings are tools that fulfill this aim, evaluating the sustainability performance of companies. However, these tools are characterized by many problems. As matter of fact, the number of ESG Ratings available is huge and nearly 500 ESG ratings seem to exist. Moreover, each ESG presents its own set of indicators across the three dimensions. The analysis of the 7 ESG ratings used by Carel carried out in this study highlights the presence of more than 1000 indicators. Furthermore, this analysis along with the literature review made on ESG ratings note that each Rating presents its own methodology. Thus, companies as Carel Industries subject to sustainability reporting have to face all these issues, which are caused by the lack of a standard for ESG ratings. Therefore, this study investigates how these shortcomings can be solved. Particularly, this study proposes the life cycle model to overcome these problems. In fact, the latter is a sustainability metric with a standardized procedure and structure reported in ISO 14040 and ISO 14044.

Chapter II - Overview of ESG Ratings

Nowadays, investments are shifted towards sustainability. In fact, the EU Taxonomy Regulation incentivizes investment in those projects deemed to be sustainable. Moreover, the Corporate Sustainability Reporting Directive (CSRD) requires companies to report on their sustainability by 2024. All these aspects promote the development of ESG ratings, as tools to evaluate the sustainability performance of companies. Particularly, the last few years have been marked by a sharp increase in the companies reporting on their sustainability through ESG ratings. It is reported that from 2011 to 2018 the number of companies undergoing ESG ratings has increased from 20% to 80%. Consequently, also the number of ESG ratings available has increased in these years. The literature review carried out in this section, in fact, highlights the presence of nearly 500 ESG ratings available. Additionally to these issues, the literature review reports the presence of issues in the methodology of ESG ratings, which is different from one rating to another. These issues are due to the lack of a standard for ESG ratings. The consequence of these issues is the divergence among ESG ratings, which lead to different results from one rating to another. These topics are presented in the following section.

2.1. What is an ESG Rating

Nowadays, sustainability is gaining increasing attention. In fact, the old economic model, known as linear economy, was based on the “take-make-dispose” scheme, which caused many environmental issues, concerning the future of the planet. However, linear economy has been replaced by circular economy. Circular economy promotes sustainability in every-day activities. Particularly, it has influenced the way of investing. In fact, not so long ago investments in companies were solely based on the profits made. Nowadays, this trend has changed and a new approach of investment has been set. Now, investments are funneled towards those companies committed to the management of environmental, social and governance (ESG) factors. This type of investing does not consider solely the short-term financial gains, but this strategy takes into

account how firms promote their long-term environmental and social values [12, 15, 16].

ESG investments have grown very quickly in recent years. It seems that from 2011 to 2018 the percentage of companies reporting their ESG performance grew from 20% to 80% [17]. As a matter of fact, in 2020 this type of investments accounted for 51.1 billion USD, more than double then the amount of 2019 and 10 times greater than 2018. The Bank of America determined that in the period between 2019 and 2022 ESG funds accounted for 220 billion USD. This trend keeps on growing and it doesn't seem to stop [18 - 20].

Therefore, investments are now directed to those companies whose management in ESG topics is improving.

To help investors build their portfolio and gain financial success, ESG Ratings have been developed. An ESG Rating is defined as “ the evaluations of a company based on a comparative assessment of their quality, standard or performance on environmental, social or governance (ESG) issues”. This definition is provided by SustainAbility report, called “Rate the Raters 2020: Investor Survey and Interview Results” [21]. Practically speaking, an ESG Rating is a tool able to assess a company for its management in environmental, social and governance issues. At the end of the assessment, an overall score is provided according to the management of ESG topics demonstrated by the company. The overall score is meant to compare the company, undergoing the rating, to its peers or to other companies. Generally, the higher the overall score, the higher the position of a company in the ESG ranking. Thus, a high position in the ESG ranking involves a great performance in ESG topics. Consequently, investments are funneled into those companies showing a high position in the ranking (so, those companies with a great ESG score) [22].

ESG Ratings are very useful tools for investors, as explained. However, investors are not the only ones interested in the ESG rating of companies. Also companies themselves want to report their sustainability performance in ESG issues. Therefore, investors base their activities according to the ESG rating of

companies. Under this light, ESG rating is expected to reflect the impact of a company on the welfare of its investors. Thus, investors influence companies when it comes to decisions and actions to take. From the point of view of a company, the ESG rating is a tool to track and analyze a company's performance in sustainability. Therefore, the ESG Rating is used to measure the impact generated by financially relevant environmental and societal factors [20].

2.2. Legislative framework

The developments in ESG legislation have been mainly carried out by the European Commission. In fact, the legislative framework regarding ESG topics was born within the European Green Deal.

The European Green Deal was presented in November 2019 as a roadmap to introduce the circular economy model in Europe. The Deal set some actions to avoid the waste of resources, climate change, loss of biodiversity and pollution. The main objective of the EU Green Deal is to make Europe the first climate neutral continent by 2050. To achieve this goal, an intermediate objective has been set. In fact, Member States are committed to reducing net greenhouse gas emissions by 55%, by 2030 compared to 1990 levels [23].

The goals set by the EU Green Deal are met only if significant investments are made. Moreover, these investments must be addressed towards sustainable projects in order to accomplish the EU Green Deal Goals. For this reason, the European Regulation n. 852/2020 was issued. This Regulation is also known as European Taxonomy Regulation and it is aimed at defining all over Europe what is sustainable. In fact, this Regulation provides a list of activities, deemed to be economically and environmentally sustainable. As a consequence, this Regulation turns out to be very useful for companies, investors and also policymakers when it comes to establishing the sustainability of an economic activity. Therefore, the EU Taxonomy Regulation allows the development of a secure place, where investments are shifted towards sustainable activities, listed in the Regulation itself [8]. To pursue the aim of this Regulation, “Technical Screening Criteria” (TSC) and “Minimum Safeguards” standards have been defined to ensure the

sustainability of an activity. Thus, “TSC” and “Minimum Safeguards” guarantee that an investment is sustainable and aligned with the EU Taxonomy Regulation. For the application of “TSC” and “Minimum Safeguards”, companies subject to the Non-Financial Accounting have to report information regarding their activities deemed to be economically and environmentally sustainable [24].

The Non-Financial Accounting is a document regulated by EU Directive 2014/95 (which amended the EU Directive 2013/34). The European Directive 2014/95 is also called Non-Financial Reporting Directive (NFRD) and it deals with the disclosure of non-financial and diversity information relative to large companies characterized by more than 500 employees, public companies or companies with public interest. Going into details, this Directive requires large-public interest companies to disclose information related to their operations and management of social and environmental aspects. Consequently, the non-financial information required by NFRD may help investors evaluate the environmental and social performance of large public-interest companies. Therefore, the goal of NFRD and EU Taxonomy Regulation is really close. Thus, it is possible to state that NFRD is the precursor of EU Taxonomy Regulation as well as the European Green Deal. In fact, after the publication of the EU Taxonomy Regulation and the EU Green Deal, the NFRD was revised and amended due to its application, which was restricted to a limited number of companies [9, 24 -26]. As a matter of fact, in 2021 an amendment to NFRD was proposed. This amendment is known as Corporate Sustainability Reporting Directive (CSRD) and it entered into force on 5 January 2023. The CSRD concerns the same subject of NFRD under a new and modern light. In fact, the CSRD enlarges the scope of environmental and social data disclosure to all large companies, not only to the ones with public interest. Therefore, also this directive allows investors to access companies’ transparent non-financial information in order to move their investments towards environmentally sustainable activities. However, compared to the NFRD, CSRD has been developed aligned with EU Taxonomy Regulation and EU Green Deal [9, 24 - 28].

The CSRD incorporates several European Sustainability Reporting Standards (ESRS), which at the moment are still drafts [9]. Considering the purposes of the study, the most interesting drafts are the ones falling in the scope of ESG topics.

These drafts are aimed at setting requirements for the disclosure of each sustainability topic related to ESG issues. This means that each company is expected to report policies, targets, actions, resources, and performance measurement metrics adopted for each ESG topic [9, 29].

In conclusion, the European Commission is promoting investments towards environmentally sustainable activities, issuing specific Directives, Regulations and Standards aligned with the EU Green Deal. Therefore, the reporting and disclosure of ESG data and information are gaining an increasing importance at European legislative level. In particular, there are some efforts in place aimed at standardizing the reporting of ESG information, which may have consequences in ESG Ratings available.

2.3. Benefits of ESG Ratings

The last decades have witnessed an increasing attention towards sustainability and all its surrounding topics. This trend has strongly marked the field of investing, addressing it towards environmentally sustainable projects. Under this light, ESG Ratings have been developed as a useful tool for companies and investors. Particularly, ESG ratings presents some advantages.

First of all, a company disclosing its ESG information can improve its reputation: in particular, if the disclosure is publicly available, the reporting company can enhance its transparency in providing information about its sustainability. Consequently, the company undergoing the ESG Rating can increase its competitiveness among its peers. In fact, the disclosure of ESG data using ESG Ratings allows comparison of performance on sustainability topics among different companies (usually acting in the same industry sector). More precisely, companies disclosing ESG information demonstrate their commitment to ESG topics, beyond their transparency in sustainability reporting. This attracts

investors and other stakeholders, thanks to the increasing attention towards sustainability. Here lies the competitive advantage that companies can gain relative to their peers.

Furthermore, reporting ESG information year after year by means of ESG Ratings creates a history in the development of ESG topic performance. Therefore, companies are able to keep track and benchmark their progress in sustainability over time. As a consequence, they may identify new risks and opportunities in ESG topics, which may lead to a further benefit. In fact, companies that track their performance in sustainability over time are able to improve their ESG plan, optimizing the efficiency. The result is an overall cost reduction. As a matter of fact, the ESG plan analysis may highlight the shortcomings in energy consumption, operations, regulation/legislation, risk management and innovation.

In addition, ESG Ratings are usually developed compliant with available standards. It helps companies to be aligned with standardized procedures for the disclosure of ESG information [30, 31].

2.4. Issues related to ESG Ratings

ESG Ratings have been developed recently due to a change in the trend of investments. For this reason, many issues affect the reliability of these Ratings. The following paragraph provides a literature review of the main issues characterizing ESG ratings.

The first issue that can be listed regards the divergence existing among all the ESG Ratings available. This is due to the great number of ESG Ratings available and to the lack of common unifying standards for ESG reporting. For instance, a study carried out in 2019 highlighted the presence of nearly 500 ESG Ratings [12, 20]. This large availability of ESG Rating providers leads to a great variety and difference from one system to another [32, 33]. Therefore, ESG ratings are divergent, leading to different final results. Thus, divergence among ESG ratings is caused mainly by the lack of standards that standardizes the rating procedure.

Keeping on, *F. Berg et al.* study shows 3 sources of divergence: scope, measurement and weight divergence. The scope divergence is due to different sets of attributes used in the ratings. The measurement divergence comes when the same attribute is measured with different indicators. An example is provided by a company's labor practices which can be evaluated according to the workforce turnover and the number of court cases related to labor against the company. The last one is the weight divergence which represents the different positions taken by different ESG rating providers when assessing the same attributes. The study demonstrated that divergence is mainly caused by measurement issues [34]. However, *V. Capizzi et al.* attributed to the weight component the greatest percentage of divergence among ESG providers. At pillar level, this study demonstrated that the environmental pillar is associated with the smallest divergence, whereas the social and governance pillars resulted to be the greatest responsible for these divergences. Going into details, the study showed that the weights of the categories are attributable for the greatest divergence among ESG providers, especially the ones within the governance pillar [35].

Thus, these two studies showed that the source of divergence is found inside ESG ratings due to the different methodologies adopted by each rating. In fact, another study, that attributed the divergence issue to the different methodologies adopted, highlighted the fact that ESG ratings used different scoring scales: some are based on an industry sector score scale, while others on an absolute scale [20].

Furthermore, another element of divergence among ESG Ratings is to be found in the typology of data required. In fact, each rating system requires its own array of data, which can be very detailed or very general depending on the ESG ranking provider. *L. Feifei et al.* classified the ESG Ratings according to the typology of data required. This classification is represented by a pyramid divided in 3 levels, as illustrated in the image below.

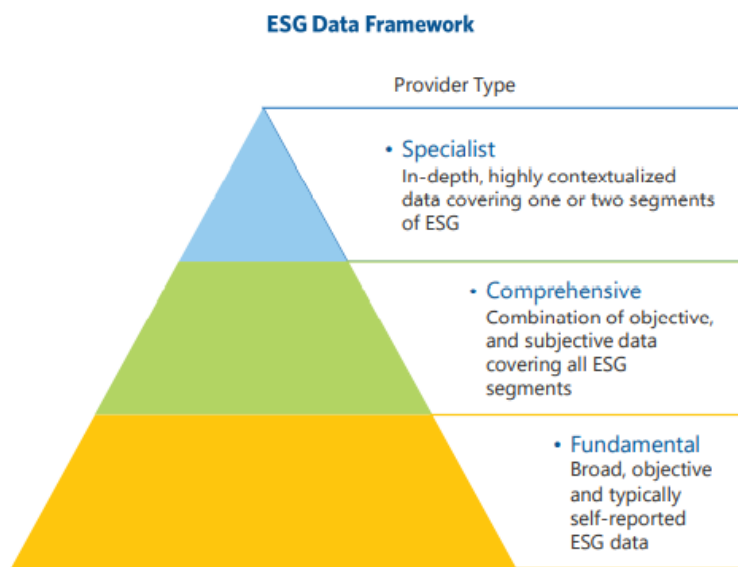


Figure 3: Representation of the classification of ESG Rating providers according to the typology of data required [36].

The base of the pyramid is characterized by those Ratings requiring fundamental data, which are publicly available data. The ESG Ratings in which fundamental data are disclosed, generally do not present a methodology and do not provide an overall score of a company.

The middle of the pyramid represents those Ratings requiring comprehensive data, which cover all ESG market aspects. Comprehensive data are, generally, disclosed by companies through the use of questionnaires, but they can be public data too. Therefore, the ESG Ratings requiring comprehensive data usually develop their own methodology and scoring system to rate companies. Most existing ESG Ratings ask for the disclosure of comprehensive data.

The top of the pyramid is characterized by those Ratings asking for specialist data, which are specific data on a specific ESG issue. Therefore, the ESG Ratings requiring these data are specialized in one specific ESG topic.

Generally, the comprehensive data providers get such an amount of data that they are able to provide specialized data [36].

Thus, the source of divergence among different ratings can be found also in the different data that each ESG Rating requires.

Other issues, different to divergence, affect the reliability of ESG Ratings. In fact, ESG Ratings, sometimes, result to be inaccurate since they focus on old data, looking at the past. Another issue affecting ESG Rating is found in their developers and their lack of expertise in the sustainability field [20, 21].

In conclusion, all these studies show that divergence among rating systems represents the biggest issue in the field of ESG Ratings. Many different sources cause the divergence of ESG ratings. The main causes are found in the huge number of ESG Ratings available and indicators used, the different methodologies adopted and the lack of a standard. All the elements causing this divergence lead to a great variability of final results among Ratings. Thus, divergence among ESG Ratings can raise uncertainty in the interpretation of the final results. This affects both companies, when selecting the ESG rating to be used, and Investors, when deciding the companies to invest.

Chapter III - Carel Group

The following section presents Carel Group, the subject on which the study is applied.

The group is an industry headquartered in Northern Italy (Brugine, PD) and nowadays, operates all around the world. Since it was founded 50 years ago, Carel has been growing and developing in the market of control solutions for heating, ventilation, air conditioning, refrigeration, evaporative cooling and humidification. In particular, during these years sustainability has progressively been integrated into the Group and now plays a key role in every decision and action taken by Carel. Moreover, Carel is subject to the CSR Directive and therefore has to report on its sustainability in ESG ratings. This makes Carel suitable for the investigation pursued in this study. Furthermore, the evidence of Carel's commitment to sustainability are found also in the adoption of life cycle models to assess the environmental impact of one of Organization's products and Organization itself.

3.1. History of Carel Industries Group

Carel Industries S.p.a was founded in 1973 in Brugine (Padova) as a factory specialized in the production of electrical panels. Seven years later, in 1983, the Group introduced the SMD (surface mount devices) and test-in-circuit technologies in the production processes.

In 90's, thanks to the success achieved, Carel began to expand in other countries, opening new branches in France, United Kingdom, South America and Germany.

Then, from the 00's Carel Industries started the production of items, which has made the Group famous worldwide. In fact, Carel, nowadays is known for the specialized production of control solutions for air conditioning, refrigeration and heating as well as humidification and evaporative cooling systems, aimed at commercial, industrial and residential applications.

In addition, in 2000, Carel expanded in the United States with a new production plant. Since this moment, the Group has been growing and expanding on a global scale. As a matter of fact, today Carel counts 31 subsidiaries and 13 production plants worldwide.

During these years, Carel won multiple innovation awards

Moreover, Carel debuted in the stock exchange market in 2018, confirming its leading position in the production of control solutions and humidification systems for HVAC/R (Heating, Ventilation, Air Conditioning / Refrigeration) [37].

Therefore, Carel Industries started its production 50 years ago as a small factory, operating in Northern Italy. However, thanks to its efficient and optimized solutions, the Group has confirmed and enforced its position in the global market, enlarging its presence and production more and more around the world. Nowadays, Carel Group plays a key role in the international scene as a leader in the production of HVAC/R systems.



Figure 4: A photo of the Carel Industries Headquarter, placed in Brugine (PD) [38].

3.2. Carel's commitment to sustainability

Carel Group started its production activity in 1973 as a small factory, but during the years it has been growing and expanding globally, becoming a leader in its industry sector.

As the Group has grown in these years, so has the attention for the environment. Today, Carel is driven by the motto “better control, better environment”, recognizing the importance of environment and sustainability as a corporate priority. In fact, Carel ensures the respect of the environment in each step of the manufacturing process, through the integration of sustainability in all business activities.

Carel's commitment to sustainability is mainly accomplished through the compliance with standards and regulations.

Moreover, Carel has nominated an ESG team, aimed at fulfilling many different tasks relative to environmental, social and governance factors. In fact, this team is committed to the creation of goals, targets and sustainability metrics in order to support the Board of Directors for the development of the long-term sustainability plan. Therefore, a task of ESG team is the monitoring and evaluation of such goals and targets.

In addition, the sustainability promoted by the Group involves the field of Research & Development (R&D) too. As a matter of fact, in 2021 Carel allocated 4.5% of its revenue in R&D activities, aimed at developing energy-efficient products, reducing the environmental impact and using natural refrigerator gasses. Going into details, in 2021 the Group carried out a study regarding the energy savings derived from the use of Carel's electrical components in a refrigeration unit. The results of this study showed that the customers using this technology saved 5,867 GWh, which corresponds to 28% of energy savings compared to 2020.

Carel's efforts in energy savings are not only found in the products developed, but also in the production sites. In fact, in 2021 the Group started the project to

replace the lighting system with a high-efficiency technology (LED). It led to an energy saving of 3% of the total energy consumption. This initiative is part of a broader plan, aimed at reducing Carel's contribution to climate change. For instance, this plan also addressed the issue related to the heating/cooling systems, replacing it with more efficient heat pumps in 2020.

Speaking of natural refrigerator gasses, Carel is committed to the use of carbon dioxide (CO₂) as a refrigerant gas in its refrigeration systems. Despite the potentially less efficiency, carbon dioxide represents the best environmentally-friendly choice available not only compared to any other HFC/HFO refrigerant, but also to other natural refrigerants.

Moreover, sustainability is also found in Carel's commitment to ensure environmental protection. In fact, the company has identified some risks, which potentially may cause environmental impacts associated with emissions and consumption of natural resources. Therefore, Carel constantly controls and manages these risks in order to guarantee the compliance with legislation as well as the protection of the environment.

Also Carel's packaging is environmentally friendly. More precisely, packaging suppliers are part of a project along with Carel aimed at developing certified green packaging. As a matter of fact, plastic packaging has started to be replaced by FSC certified cardboard and wood. In addition to this certification, packaging is designed with water-based color and starch glues instead of vinyl glues. The commitment to the use of these green products has resulted in GREENGUARD Certification.

Sustainability also interests the field of supply chain. As a matter of fact, Carel's policies favor the use of local suppliers (EU suppliers account for 75%). Furthermore, during a supplier selection process, Carel takes into account suppliers' environmental and social responsibilities. In fact, in 2020 Carel carried out a survey regarding the sustainability of its suppliers and in 2021 the Company introduced a self-assessment questionnaire to spread awareness about sustainability topics in the supply chain. Additionally, Carel's policies inherent to

the supply chain take care about controversial sourcing topics too. Therefore, the Group is committed to respect human rights and avoid the procurement of minerals from conflict areas. The goal is to purchase only completely traceable materials. For this reason, Carel signed up the Responsible Minerals Initiative (RMI).

As a proof of its commitment to sustainability, Carel is certified by ISO 9001:2015 for Quality Management System, ISO 14001:2015 for Environmental Management system and ISO 45001:2018 for Occupational Health & Safety Management System [39].

Moreover, Carel is a large company subject to the Corporate Sustainability Reporting Directive (CSRD), which requires Carel Industries to report on its sustainability. Therefore, Carel uses ESG ratings for sustainability reporting and to assess its sustainability performance. Furthermore, Carel's commitment to sustainability is proven by the adoption of life cycle models. In fact, Carel assessed the sustainability of one of its products (the inverter) using a life cycle assessment study. Moreover, a life cycle model approach has been used to determine the environmental aspects that might cause significant environmental impacts through the use of a life cycle perspective study, carried out within Carel boundaries.

In the end, Carel is a company that has been growing, since it was founded, and claimed itself as a leader in the global market, providing high-efficiency control solutions and humidification systems for HVAC/R. The Group owes its success to the increasing attention for sustainability, making it a priority in every corporate activity

Chapter IV - Analysis of ESG Ratings used by Carel Industries

The following section is aimed at introducing the ESG Ratings used by Carel for the disclosure and reporting of its ESG data. Carel adopts 7 ESG Ratings: MSCI, EcoVadis, CDP, S&P Global, Gaïa, Ambienta and Sustainalytics. Each of these ratings have been analyzed, considering general information available on the rating, their historic background, investors opinion and the methodologies developed by the rating provider. Moreover, this analysis also studies how these ESG ratings are applied to Carel Industries. In fact, for each ESG rating the criteria used and the indicators topics are reported. Particularly, according to this analysis, MSCI, CDP, S&P Global and Sustainalytics ESG ratings result to be the most reliable ratings thanks to their high-quality assessment, the usefulness of the results displayed by these ratings and the transparent methodology. Also EcoVadis ESG rating results to be reliable from this analysis thanks to its transparent methodology. Furthermore, according to this analysis, Gaïa ESG Rating results to be limited and the methodology is not transparent. Regarding Ambienta, it provides only an ESG approach but not a rating. This is due to the nature of Ambienta, which is interested only in suitability data of companies to understand if investing in that company is convenient or not. Moreover, this analysis identified 1087 indicators assessed across the 7 ESG ratings. S&P Global is the one presenting the largest number of indicators assessed across the 3 pillars, accounting for 524 indicators. Therefore, Carel Industries uses a considerable number of ESG ratings, which amounts to 7, to report on its sustainability. These 7 ratings assess Carel's sustainability using more than 1000 of different indicators. This makes the reporting of sustainability really challenging.

4.1 MSCI ESG Rating Provider

MSCI, founded in 1986 when Morgan Stanley firm bought the licensing rights to Capital International data, is the acronym Morgan Stanley Capital International. It represents an American investment company, famous all around the world for providing stock indexes and other finance tools, such as ESG Rating [40].

Nowadays, MSCI is one of the most well-known and used ESG Rating by both investors and companies [41]. Up to October 2020, the Firms counted 14 0000 rated companies, worldwide. As a matter of fact, according to the survey “Rate the Raters 2020: Investor Survey and Interview Results”, some investors really rely on this rating thanks to its broad coverage and to the qualitative report that explains the final score. In fact, many investors suggest companies to report their ESG performance using MSCI rating. However, others criticize MSCI rating for its scoring procedure and for not being completely transparent [21]. Moreover, some concerns relative to MSCI may arise from its background. In fact, MSCI was founded to provide finance tools and stock-market indexes, which characterize the primary aim of the Firm. Therefore, the development of an ESG Rating does not represent the primary purpose of MSCI. In fact, MSCI entered the ESG rating business due to the recent increasing stress in sustainability topics. This feature may affect MSCI ESG rating, since firms that purposely developed ESG Ratings to assess companies sustainability exist [20]. Anyway, most of the investors interviewed in the “Rate the Raters 2020: Investor Survey and Interview Results” declared the MSCI ESG Rating is one of their favorite ratings thanks to its reliability. In fact, this rating (along with Sustainalytics’ one) has been mentioned to be the highest-quality and most useful one [21].

In the end, MSCI is considered a reliable ESG Rating provider thanks to 40 years of experience in assessing ESG performance of companies [41]. However, even though some concerns relative to the scoring process and its background exist, MSCI is deemed to be a reliable ESG Rating provider. In fact, over the years this rating achieved great success among companies and investors thanks to a long experience in ESG topics, which allow MSCI ESG Rating to be deemed the highest-quality and most useful one.

4.1.1 MSCI methodology

MSCI is one of investors’ favorite ESG Rating providers thanks to the long experience required to develop it, which has resulted in a great reliability.

This system measures the management of ESG risks and opportunities financially relevant to a company. Therefore, the MSCI provider is aimed at identifying the exposure to ESG risks of a company and how well the company can manage those risks relative to its peers. It means that this rating provides a specific industry-sector adjusted score.

Going into details, each industry presents its own risks and opportunities and MSCI has spent the last 13 years to determine the ESG Key Issues that characterize each industry [41]. Specifically, 35 Key Issues are identified intersecting the core business of companies with the specific industry issues that can lead to relevant risks and opportunities for the company. Then, each key issue is weighted according to impact and time horizon of the risk and opportunity generated [42].

The 35 Key issues measure the risks of a company across 10 themes, which make up the environmental, social and governance pillars.

Then, Key issues are scored based on exposure to and management of risks and opportunities. The scoring scale for Key issues range from 0 to 10, the 0 represents the worst case and 10 the best one.

After scoring Key issues, weights are assigned to each Key issue that contributes to the environmental, social and governance pillar for a specific industry. Specifically, the Environmental and Social present a different weighting procedure from the Governance pillar.

In fact, for the Environmental and Social pillar weights are assigned considering the negative or positive impact on the environment or society generated by the industry under investigation and related to its peers. Another factor affecting the assignment of weights of Environmental and Social Key issues is the time: indeed, a higher weight is associated with environmental and social impacts that are expected to occur within 2 years. Otherwise the weight is lower. So, for the Environmental and Social pillars, the weights are assigned to each Key issue considered relevant for the industry under investigation.

For the Governance pillar, weights are set at pillar level rather than at Key issue level.

Anyway, Key issue scores are combined with the associated weight to provide the pillar scores. So, the Environmental and Social pillar scores are calculated with the weighted average of key issues scores. The Governance pillar is calculated using a deduction-based approach.

The last step of this procedure involves the assignment of a final numerical score, also called Industry-Adjusted Score (IAS), which is calculated as the weighted average of the Environmental, Social and Governance scores.

In the end, the numerical score is converted into the MSCI ESG rating, which ranges from CCC (the lowest score - lower performance) to AAA (highest score - greater performance). MSCI classifies the ESG rating in 3 classes: laggard, average and leader. Figure 5 represents the MSCI scoring scale.

Letter Rating	Leader/Laggard	Final Industry-Adjusted Company Score
AAA	Leader	8.571* - 10.0
AA	Leader	7.143 – 8.571
A	Average	5.714 – 7.143
BBB	Average	4.286 – 5.714
BB	Average	2.857 – 4.286
B	Laggard	1.429 – 2.857
CCC	Laggard	0.0 – 1.429

Figure 5: representation of the MSCI scoring scale [43]

Laggard means that the exposure to the ESG key issues is poorly managed compared to their peers. Average means that the company is managing some ESG key issues effectively, but others poorly. Leader means that the company is proactively managing ESG risk and taking advantage of ESG opportunities better than their peers.

It is noteworthy that the MSCI ESG rating is also made up considering the controversies tackled by the company under investigation. Each controversy is scored according to the severity of its impact on the environment or society. The scoring scale used is: Very Severe, Severe, Moderate, or Minor [22, 43]

Ultimately, the MSCI ESG rating provider considers the ESG risks that a company has to tackle. Particularly, this system rates the companies according to the exposure and management of these risks, considering the sub-industry in which the company operates.

The main advantage of MSCI ESG Rating is its reliability due to the long experience in this field. In fact, many investors rely on the final results of MSCI rating when deciding the company to invest. However, other investors complain about the scoring procedure and the lack of transparency. Additionally to these critiques, MSCI ESG rating can be affected by Firm's background which entered in the ESG rating business when the stress on sustainability topics started to increase.

4.1.2 MSCI ESG Rating applied to Carel Industries

MSCI ESG rating selected for Carel Industries the rating suited for building products industry sector. This involves the activation of determined Key Issue and the deactivation of others. The Key Issues activated in this industry sector are 11: 3 for the Environmental pillar, 2 for the Social pillar and 6 for the Governance pillar. Particularly, the Key Issues of the Governance Pillar are always active for all the industries.

The Key Issues activated for the Environmental Pillar are: "Carbon emission", "Toxic emission and Waste" and "Opportunities in Clean Tech". The number of

indicators assessed by MSCI ESG rating in the Environmental pillar is 113. Table 1 represents the 3 Key Issues activated for the Environmental pillar as well as the topics tackled by indicators within each Key Issue and the number of indicators.

MSCI ESG Rating	
Environmental Pillar	
Key Issue	Indicators topics
Carbon Emission	Risk exposure and reduction targets related to carbon emissions
	Energy management and cleaner energy sources
	GHG emissions and energy consumption reporting
Toxic Emissions & Waste	Risk exposure assessment due to damages caused by Toxic emissions and Waste
	Presence of Environmental Management Systems (EMS) and audits
	Toxic emissions reduction targets
	NOx, SOx, PM and VOC emissions reporting
Opportunities in Clean Tech	Opportunities due to demand change or taking advantage of regulatory incentives
	Development of clean technology and patent families
	Targets to increase investment in clean tech and R&D expenses reporting
Total indicators	113

Table 1: Schematization of Key Issue and Indicators topics and numbers of indicators selected for Carel Industries by MSCI ESG Rating in the Environmental Pillar

The Key issues activated for the Social Pillar are: “Labor Management” and “Health & Safety”. The number of indicators assessed by MSCI ESG Rating is 55 in the Social pillar. Table 2 shows the 2 Key Issues activated for the Social pillar as well as the topics faced by the indicators within each Key Issue and the number of indicators.

MSCI ESG Rating	
Social Pillar	
Key Issue	Indicators topics
Labor Management	Risk exposure due to labor unrest, or reduced productivity
	Reporting of employee data
	Workforce covered by trade unions
Health & Safety	Risk exposure leading to production disruptions, litigation, and liabilities
	Health & Safety committee and policies
	Reporting of Health & Safety data (LTFI, etc...)
Total indicators	55

Table 2: Schematization of Key Issue and Indicators topics and numbers of indicators elected for Carel Industries by MSCI ESG Rating in the Social Pillar

The Key issues activated for the Governance Pillar are: “Board”, “Pay”, “Ownership & Control”, “Accounting”, “Business Ethics” and “Tax Transparency”. The number of indicators assessed in the Governance pillar is 115. Table 3 shows the 6 Key Issues activated for the Governance pillar as well as the topics faced by the indicators within each Key Issue and the number of indicators in this pillar are reported.

MSCI ESG Rating	
Governance Pillar	
Key Issue	Indicators topics
Board	Reporting of CEO, CFO and Chair
	Reporting of Board of Directors and other Boards/Committee
Pay	Reporting of Executives pay
	Reporting of non-Executives pay
Ownership & Control	Corporate, Capital and Ownership structure
	Shareholders rights
	Directors election
Accounting	External auditors
	Reporting of auditors fees
Business Ethics	Business ethics policies and practices
	Risk exposure due to corruption
Total Indicators	115

Table 3: Schematization of Key Issue and Indicators topics and numbers selected for Carel Industries by MSCI ESG Rating in the Governance Pillar

4.2 EcoVadis ESG Rating Provider

EcoVadis is an ESG Rating provider founded in 2007 in Paris, aimed at assessing the environmental impact of companies. Then, from 2008 EcoVadis enlarged the scope of its assessment, including social practices. In fact, in 2018 the rating provider joined the UN Global Compact, aligning with the ten principles of the United Nations [44].

Nowadays, EcoVadis rates more than 100 000 companies all around the world, claiming itself as a trusted ESG rating provider [45]. Particularly, this trust is due to the specific setting in which EcoVadis was founded, irrespectively to other rating providers. In fact, EcoVadis was born to assess companies on sustainability topics, whereas other rating providers were developed with different purposes initially (such as MSCI) [12].

Therefore, EcoVadis is another ESG Rating provider founded with the aim to assess the companies' sustainability. Therefore, it has recently become a very trusted ESG rating thanks to the nature of its foundation.

4.2.1 EcoVadis methodology

The objective of EcoVadis methodology is to rate companies, measuring the quality of its sustainability management system.

EcoVadis developed its own methodology, which is based on the 7 principles. Firstly, the rating procedure is carried out by a group of experts. Then, the methodology has been developed to provide an overall score tailored to industry sector, country and company size. Moreover, the rating is based on input data provided directly by stakeholders, which must be supported by the appropriate documentation to guarantee the transparency and traceability of the information disclosed. Therefore, EcoVadis provides a final score according to an evidence-base procedure. Moreover, the methodology guarantees the protection of confidential information. The last principle that characterizes EcoVadis is the continuous improvement.

An additional value regarding EcoVadis is the integration of international standards (such as GRI, UN Global Compact, etc...) in its methodology.

As already mentioned, the score provided by this ESG rating is industry-based and it considers 200 categories of industries. Furthermore, the methodology relies on 21 criteria within 4 themes: environment, labor and human rights, ethics and green procurement [45].

Regarding the Labor and Human rights theme, it is focused mainly on two areas: human resources (as health and safety, conditions of work, structured social dialogue, career management and training) and human rights (as child and forced labor, human trafficking, diversity, discrimination and harassment and human rights of external stakeholders).

The Environment theme evaluates the measures adopted by a company to mitigate its environmental impact, through the assessment of policies adopted, actions taken and monitoring of the results. The areas covered by this theme are Operations and Products.

Then, in the Sustainable procurement theme, a company is asked to report where materials are purchased, services received, the conditions of workers producing the components and the actions taken to guarantee a sustainable logistics in the supply chain.

The last theme asked in the questionnaire is Ethics, which investigates topics such as corruption, anticompetitive practices and information security.

EcoVadis requires companies to provide information on ESG issues through a questionnaire. The company undergoing the questionnaire should support its answers with the relative documentation and declarations for each specific theme.

Once the questionnaire is completed, the analysts assess the quality of the documentation and input data provided by the company. Then, the rating is decided considering 3 factors: Policies, Actions and Results. More precisely, Policy factor is measured considering Policies (policies, objectives, targets and governance) and Endorsement of external sustainability initiatives and principles. The Actions are evaluated through the analysis of Measures (actions taken), Certifications (including labels and third-party audits) and Coverage - Deployment of actions (level of deployment of certifications). Result factor is analyzed according to the Reporting (the quality of reporting) and 360° Watch findings (the standpoints of stakeholders).

The final ESG rating provided by EcoVadis includes an overall score, a theme-specific score and improvement areas. The scoring procedure starts providing a score from 0 to 100 to each element inside each factor (Policies, Actions and Results) throughout the 4 themes. These 3 factors present an assigned weight (Policies account for 25%, Actions for 40% and Results for 35%). Therefore, combining the weights of each factor with the relative elements for each theme leads to a specific-theme score. Then, each theme is assigned a weight according to the industry. Thus, the overall score is the weighted average of the theme-specific scores. Furthermore, EcoVadis provides a set of strengths and improvement areas for each theme. Therefore, the final ESG rating provided by EcoVadis includes an overall score, a theme-specific score and improvement areas [46].

In conclusion, EcoVadis ESG Rating is a very trusted rating thanks to the specific foundation in sustainability topics. Its reliability is also due to the methodology aligned with many international standards. Furthermore, EcoVadis ESG Rating requires companies to support information provided with the relative documentation. This element is not present in all ESG Ratings and it increases the reliability of this rating. Moreover, this rating does not only provide an industry-scale scoring, but it also provides a score on an absolute scale.

4.2.2 EcoVadis ESG Rating applied to Carel Industries

EcoVadis provides a reliable rating thanks to the consistent development with its primary purpose, but also thanks to the methodology aligned with many standards.

EcoVadis developed an ESG Rating based on an industry scale too. Therefore, once the industry sector in which Carel operates was selected, the criteria assessed by EcoVadis were activated consequently. Each of these criteria contains a series of indicators (which assumes the form of questions due to the nature of EcoVadis ESG Rating). The criteria activated are 15: 6 criteria for the Environmental pillar, 7 criteria for the Social pillar and 2 for the Governance pillar.

The criteria activated for the Environmental pillar are: “Energy consumption and GHGs”, “Water”, “Supplier environmental practices”, “Materials, Chemicals and Waste”, “Product use”, “Product End-of-life”. The number of indicators in the environmental pillar is 105. The criteria activated by EcoVadis in the Environmental pillar along with the topics tackled by the indicators within each criteria and the number of indicators are reported in Table 4.

EcoVadis ESG Rating	
Environmental Pillar	
Criteria	Indicators topics
Energy consumption and GHGs	Energy consumption and GHG emissions management
	GHG emissions and energy consumption reporting
	Reduction targets
Water	Reporting of water consumption
Supplier Environmental Practices	Conflict mineral policies
	Risk assessment due to conflict mineral in the supply chain
	Reporting of Scope 3 emissions in the supply chain and reduction targets
Materials, Chemicals and Waste	Policies regarding the management of hazardous materials and chemicals
	Reporting of production of waste
	WEEE directives and compliance
Product Use	Reduction of impact due to the product use
Product End-of-Life	Reduction of impact due to product end-of life
	Compliance with directives
Total Indicators	105

Table 4: Schematization of Criteria and Indicators topics and the number of indicators selected for Carel Industries by EcoVadis ESG Rating in the Environmental Pillar

The criteria selected for the Social pillar are: “Employee Health & Safety”, “Working conditions”, “Career Management & Training”, “Child Labor, Forced

Labor & Human Trafficking”, “Diversity, Discrimination and Harassment”, “Social Dialogue” and “Supplier social practices”. The number of indicators in the social pillar is 85. The criteria activated by EcoVadis in the Social pillar along with the topics tackled by the indicators within each criteria and the number of indicators are reported in Table 5.

EcoVadis ESG Rating	
Social Pillar	
Criteria	Indicators topics
Employee Health & Safety	Policies for employee health & safety
	Risk assessment for employee health & safety
	Reporting of employee health & safety (LTIFR, etc...)
Working conditions	Policies for working conditions
	Reporting of workforce covered by trade unions
Career Management & Training	Policies for career management and training
	Reporting of training data and professional review
Diversity, Discrimination and Harassment	Policies for diversity, discrimination and harassment
	Reporting of workers belonging to a minority group and workforce composition
Social Dialogue	Policies for social dialogue (collective agreements, trade unions, etc...)
Supplier Social Practices	Policies to check supplier social practices
	Reporting of supplier social practices data
Total Indicators	85

Table 5: Schematization of Criteria and Indicators topics and the number of indicators selected for Carel Industries by EcoVadis ESG Rating in the Social Pillar

The criteria activated by EcoVadis for the Governance pillar are: “Corruption” and “Responsible information management”. The number of indicators in the governance pillar is 29. These criteria along with the topics faced by the indicators within each criteria and the number of indicators are reported in Table 6.

EcoVadis ESG Rating	
Governance Pillar	
Criteria	Indicators topics
Corruption	Policies for bribery and corruption
	Reporting of corruption data
Responsible Information Management	Policies for responsible information management
	Reporting of cyber security incidents certification for information security management system
Total indicators	29

Table 6: Schematization of Criteria and Indicators topics and the number of indicators selected for Carel Industries by EcoVadis ESG Rating in the Governance Pillar

4.3 CDP ESG Rating Provider

CDP is a not-for-profit charity that provides a system for companies, cities, states and regions aimed at measuring and managing the environmental risks and opportunities.

It was founded in 2000 as one of the firsts systems to help companies disclose their environmental impacts. Over the years, this platform has developed and grown, enlarging the disclosure to cities, regions and states. Nowadays, CDP counts more than 18700 companies and 1100 cities, regions and states rated.

The particular feature of CDP is found in its ESG Rating, focused only on environmental topics, namely climate change, water safety and deforestation. For

this reason it is considered the gold standard for environmental reporting available not only for companies, but also for cities, regions and states [47]. Moreover, CDP ESG Rating can help organizations to report their environmental impacts to investors, to reduce these impacts and to become leaders in the management of environmental issues [48]. According to the study “Rate the Raters 2020: Investor Survey and Interview Results”, CDP is deemed to be a useful and high-quality rating. More precisely, investors find more useful the ESG information reported in CDP rating rather than the final score [21]. This is due to the specialized ESG Rating provided by CDP.

Therefore, CDP provides an ESG Rating very strong relative to the Environmental pillar, but it does not assess deeply the Social and Governance pillars. This characteristic allows CDP Rating to be very useful for investors, which are particularly interested in the ESG data reported in it. Moreover, it has been developed with the aim to assess companies, cities and states for their management of environmental issues. This feature entails that CDP is really consistent with the purpose of its foundation, making it a used and reliable ESG provider (especially for the E pillar).

4.3.1 CDP methodology

CDP provides an ESG Rating mainly focused on environmental issues, which are climate change, water safety and deforestation. Going into details, CDP assesses each one of the three environmental issues reported (climate change, water safety and deforestation) with a specific Rating, suited for the aspect under consideration and industry sector. More precisely, CDP has developed three topic-specific questionnaires: the Climate Change one, the Water Safety one and the Forest one.

Each topic-specific questionnaire presents its scoring methodology. The scoring procedure is carried out by accredited scoring partners trained by CDP. Then, all the scores are checked by an internal scoring team in order to guarantee the compliance with the scoring standards [49].

Since the study under investigation is applied to Carrel Industries, only the Climate Change questionnaire is analyzed in the following paragraph since it is the only one used by the Group.

The Climate Change questionnaire is divided into scoring categories. Each scoring category presents a group of questions (indicators) and is assessed across four consecutive levels: Disclosure, Awareness, Management, and Leadership. These four levels of assessment are carried out sequentially. Going into details, all questions in the questionnaire are assessed at Disclosure level. The points assigned at this level for each question are influenced by the amount of data disclosed and the importance of the question. After the Disclosure, the next level assessed is the Awareness, which evaluates the intersections between environmental issues and a company's business. Therefore, this level provides a score considering how business activities of a company affect the environment and how environmental impacts can affect company's business activities. The Management level can be assessed only if a company has scored beyond a specific threshold during the Awareness assessment. In this level points are assigned to those companies that demonstrate good environmental management. Scores are assigned to each score category, according to the weightings associated with a specific score category. The last level assessed is Leadership. Only companies with an advanced environmental stewardship may be assessed across this level. These companies are scored as leaders in the specific industry sector that the questionnaire is investigating. At the end of the assessment, the company, which has undergone the rating, is provided by a final alphabetic score. At Disclosure level, a company can be scored D- (if the score in this phase is in the range 1% - 44%) or D (if the score in this phase is in the range 45% - 79%). In the Awareness level, a company can score C- (if the score in this phase is in the range 1% - 44%) or C (if the score is in the range 45% - 79%). A company that reaches the threshold score to be assessed in the Management level, it can score B- (if the score in this phase is in the range 1% - 44%) or B (if the score in this phase is in the range 45% - 74%). In the end, a company assessed at Leadership level can score A- (if the score in this phase is in the range 1% - 69%) or A (if the score in

this phase is 70% - 100%) [50]. Figure 6 represents the scoring scale adopted by CDP.

Level	Climate Change	Score band
Disclosure	1-44%	D-
	45-79%	D
Awareness	1-44%	C-
	45-79%	C
Management	1-44%	B-
	45-74%	B
Leadership	1-69%	A-
	70-100%	A

Figure 6: Representation of the final score scale in CDP [50]

Furthermore, one main advantage of CDP’s Climate Change questionnaire is that it is aligned with the TCDF, which will soon be mandatory. TCDF is an acronym of Task Force on Climate-related Financial Disclosures (TCFD), which is meant to increase the reporting of climate-related financial information.

Therefore, CDP ESG Rating is not only addressed to companies, but it also includes cities, regions and countries. In addition to this feature, this system is focused only on the assessment of environmental aspects, especially climate change, water safety and deforestation. Particularly, this last feature mentioned has led CDP to be considered the gold standard for environmental reporting, making the resulting ESG Rating very reliable, especially regarding the Environmental pillar. CDP owes its reliability also to its specific background. In fact, CDP was founded in 2000 to provide a platform able to assess the environmental impacts of companies, taking advantage of the increasing attention towards sustainability topics.

4.3.2 CDP ESG Rating applied to Carel Industries

CDP ESG rating provides the final score on an industry-based scale. The industry sector established for Carel Industries is the one of capital goods. The scoring categories selected for the capital good industry sector are 15.

The scoring categories falling under the Environmental pillar are 11: “Risk Management processes”, “Targets”, “Scope 1 & 2 emissions”, “Scope 3 emissions”, “Additional climate related metrics”, “Business Strategy, Financial Planning and Scenario Analysis”, “Carbon Pricing”, “Verification”, “Opportunity Disclosure”, “Energy” and “Emissions reductions Initiatives and low carbon products”. The number of indicators in the environmental pillar is 121. Table 7, reported in the appendix, summarizes the scoring categories selected for the CDP ESG rating of Carel industries falling under the Environmental pillar as well as the topics of the indicators within each scoring category and the number of indicators.

For the Social pillar in CDP ESG Rating applied to Carel Industries the scoring categories selected are 3: “Value Chain Engagement”, “Public Policy Engagement” and “Communications”. The number of indicators in the social pillar is 7. Table 8 summarizes the scoring categories selected for the Social pillar in the CDP ESG rating applied to Carel Industries as well as the topics of the indicators within each category and the number of indicators.

CDP ESG Rating	
Social Pillar	
Scoring category	Indicators topics
Value Chain Engagement	Engagement with value chain actors in climate-related topics and reporting
	Climate-related requirements for suppliers
Public Policy Engagement	Engagement with policy, law, or regulation that may impact on climate change and
	Engagement in activities aligned with the goals of the Paris Agreement
	Engagement with trade associations that may impact on climate change
Communications	Publication of climate related information and GHG emissions in other reports
Total Indicators	7

Table 8: Schematization of scoring categories and Indicators topics and the number of indicators selected for Carel Industries by CDP ESG Rating - Climate Change in the Social Pillar

The scoring category selected in the CDP ESG Rating applied to Carel Industries for the Governance pillar is only one and it is “Governance”. The number of indicators in the governance pillar is 10. Table 9 represents the scoring category and the topics of the indicators within this category and the number of indicators.

CDP ESG Rating	
Governance Pillar	
Scoring category	Indicators topics
Governance	Presence and structure of a climate-related board
	Component with competence in climate-related topics
	Highest position with responsibility for climate-related issues
	Incentives for the management of climate-related issues and achievement of targets
Total Indicators	10

Table 9: Schematization of scoring categories and Indicators topics and the number of indicators selected for Carel Industries by CDP ESG Rating - Climate Change in the Governance Pillar

4.4 S&P Global ESG Rating Provider

S&P Global presents a very long history, which starts in 1860 when Henry Varnum Poor collected data regarding the U.S. railroad industry to make them available to investors. Over the years, the company has grown thanks to the great partnership net that characterizes S&P Global. Nowadays, S&P global is famous for the provision of financial services, such as financial information, financial analytics and research, credit ratings and other financial tools. Particularly, in the area of ratings, S&P Global provides an ESG rating, which is known as Corporate Sustainability Assessment (CSA). In fact, CSA is used to get ESG information from companies, which is then analyzed to achieve an ESG score [51, 52].

The CSA is used by more than 10 000 companies around the world due to its high-quality investigation in companies ESG performance. In fact, according to the study “Rate the Raters 2020: Investor Survey and Interview Results”, S&P Global CSA is lauded for its quality. However, investors do not rely a lot on it,

especially when it comes to investment decisions making. In fact, this ESG Rating is criticized for its limited access to underlying data and analysis [21].

Therefore, S&P Global provides an ESG rating known as CSA, which is a high-quality ESG rating, but it is not very useful for investment decision making. Furthermore, its reliability might be affected by its historical background. In fact, the primary focus of S&P Global is to provide stakeholders with companies' financial information and analytics. The provision of an ESG rating is a secondary purpose of S&P Global business.

4.4.1 S&P Global methodology

S&P Global is a firm famous all around the world for its financial services, including its ESG Rating, deemed by investors to be a high-quality one.

The Corporate Sustainability Assessment (CSA) is the ESG rating provided by S&P Global that assumes the form of an annual questionnaire. Its aim is to evaluate the environmental, social and governance performance of a company.

The CSA provides a rating based on a specific industry-sector scale. Therefore, the Group identifies the industry sectors and developed a specific questionnaire for each industry sector identified. At the moment, S&P Global has identified 61 industry sectors. Each questionnaire is characterized by groups of questions within the Environmental, Social and Governance dimensions. Weights are assigned to each question and each dimension. Furthermore, the CSA questionnaire requires certain questions to be supported by evidence (documents). Public documents as supporting evidence are preferable. Moreover, CSA also asks for the coverage of the data disclosed as well as the trend of key indicators in the last years. In addition, the trend of key indicators are also compared with the S&P Global expected performance (for the company undergoing the CSA). Last but not least, CSA requires to specify if the reported data are third-party verified.

CSA also performs a Media & Stakeholder Analysis (MSA), which is aimed at checking how a company behaves in case of crisis situations. More precisely, MSA assesses if a company is aligned with its policies relative to controversies in

sustainability topics. The assessment carried out by MSA can result from a low impact company (with low reputational risks) to a high impact one (with high reputational risks) [53].

Once a company completes the CSA questionnaire, the ESG Evaluation process starts only if a company gives the permission. The ESG Evaluation is a process able to evaluate the management of a company's future risks and opportunities. This process is the sum of two previous steps: ESG Profile and Preparedness.

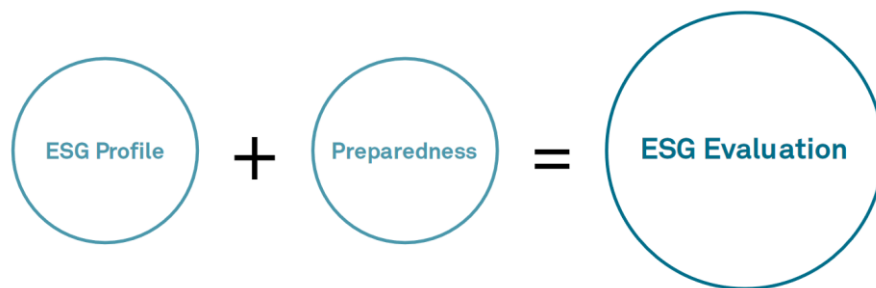


Figure 7: Representation of ESG Evaluation developed by S&P Global [51]

The first step involves the quantitative evaluation of a company's ESG profile, which represents the exposure from current to near-term ESG risks and opportunities. More precisely, in this step the mitigating actions put in place to tackle ESG risks as well as how a company is capitalizing on opportunities are considered. This assessment is carried out taking into account the industry sector and the geographical location. At the end of this step, a score on the 100-point scale is provided.

The second step is a qualitative opinion of a company's long-term Preparedness, which represents the ability to adapt to long-term disruptions. In this phase, S&P Global analysts meet with the company's management and board to discuss the emerging risks.

Once these two steps are completed, the ESG profile score is combined with the Preparedness opinion to provide an ESG Evaluation Score, which can range from 0 to 100 (higher the score, higher the sustainability of the company under investigation). Therefore, the ESG Evaluation comprises the assessment of the exposure to current/near-term ESG risks and opportunities and the qualitative opinion of a company's long-term adaptability to emerging risks. Thus, the ESG evaluation provides the ESG score of a company undergoing the CSA [54].

In conclusion, S&P Global provides an ESG rating which consists of a questionnaire (CSA) where a company reports all the information required to undergo the ESG Evaluation, at the end of which an ESG score is assigned. The information required by the CSA questionnaire is very detailed. This is what makes this Rating a high-quality one. In fact, investors really appreciate the information and data reported in the questionnaire. However, investors do not rely a lot on the ESG Evaluation part due to the limited access to data and analysis. This is what makes this rating not very useful. Furthermore, it must be taken into account the expertise background of S&P Global, which may furtherly affect the reliability of this ESG Rating.

4.4.2 S&P Global ESG Rating applied to Carel Industries

S&P Global ESG Rating, also called Corporate Sustainability Assessment, has been developed to provide an ESG Rating on an industry-based-scale. Thus, once the Carel industry sector was selected, the specific ESG criteria were activated according to the selection of the industry sector. The criteria selected for Carel Industries are 70.

In the Environmental pillar of S&P Global ESG rating of Carel Industries the criteria selected are 21: “Climate-Related Targets”, “Direct Greenhouse Gas Emissions (Scope 1)”, “Indirect Greenhouse Gas Emissions (Scope 2)”, “Scope 3 GHG Emissions”, “Climate Change Strategy”, “Volatile Organic Compounds Emissions”, “Water Consumption”, “Coverage of Environmental Management Policy”, “Environmental Violations”, “EMS: Certification/Audit/Verification”, “Waste Disposal”, “Hazardous Waste”, “Energy Consumption”, “Product Design

Criteria”, “Low-Carbon Products”, “Open Innovation”, “Product Innovations”, “Process Innovations”, “Life Cycle Assessment”, “Environmental Reporting — Coverage”, “Environmental Reporting — Assurance”. The number of indicators in the environmental pillar is 216. Table 10, reported in the appendix, represents the criteria selected for Carel Industries in the specific industry-sector questionnaire as well as the topics of the indicators within each criterion and the number of indicators falling under the Environmental pillar.

The criteria selected by S&P Global CSA ESG Rating for the specific industry sector of Carel Industries in the Social pillar are 22: “Lost-Time Injury Frequency Rate (LTIFR) – Employees”, “Fatalities”, “Training & Development Inputs”, “Employee Development Programs”, “Human Capital Return on Investment”, “Human Rights Commitment”, “Human Rights Due Diligence Process”, “Human Rights Mitigation & Remediation”, “Workforce Breakdown: Gender”, “Gender Pay Indicators”, “Customer Satisfaction Measurement”, “Online Strategies & Customers Online”, “Quality Management & Audits of Distribution Networks”, “Lost-Time Injury Frequency Rate (LTIFR) – Contractors”, “Freedom of Association”, “Supplier Code of Conduct”, “Trend of Employee Engagement”, “Type of Individual Performance Appraisal”, “Social Reporting — Coverage”, “Social Reporting — Assurance”, “Corporate Citizenship Strategy” and “Philanthropic Contributions”. The number of indicators in the social pillar is 224. Table 11, reported in the appendix, summarizes the criteria selected by S&P Global CSA ESG Rating for Carel Industries along with the topics faced by the indicators within each criteria and the number of indicators in the Social pillar.

The criteria selected in the Governance pillar by S&P Global CSA ESG Rating suited for Carel Industries are 27: “Board Structure”, “Non-Executive Chairperson/Lead Director”, “Board Diversity Policy”, “Board Effectiveness”, “Board Average Tenure”, “Board Industry Experience”, “Risk Governance”, “CEO Compensation — Success Metrics”, “Contributions & Other Spending”, “Management Ownership”, “Management Ownership Requirements”, “Government Ownership”, “Family Ownership”, “Dual Class Shares”, “Corruption & Bribery”, “Reporting on Breaches”, “Codes of Conduct”, “Privacy

Policy: Systems/ Procedures”, “Customer Privacy Information”, “Breaches of Customer Privacy: Complaints”, “Critical Supplier Identification”, “Supply Chain Risk Exposure”, “Supplier Risk Management Measures”, “ESG Integration in SCM Strategy”, “Supply Chain Transparency & Reporting”, “Conflict Minerals” and “Effective Tax rate”. The number of indicators in the governance pillar is 84. Table 12, reported in the appendix, represents these criteria selected for Carel Industries by S&P Global CSA ESG Rating in the Governance pillar as well as the topics tackled by the indicators and the number of indicators within each criterion.

4.5 Gaïa ESG Rating Provider

Gaïa Research is an agency founded in 2004 that provides ratings for EthiFinance. Speaking of EthiFinance, it is a group resulting from the merger of two agencies (Spread Research and EthiFinance) aimed at providing ratings at European level, research and advisory in sustainability topics.

Focusing on Gaïa Research, it is specialized in the provision of ESG ratings, but it is also able to monitor ESG controversies, to evaluate the contribution to SDGs and to verify the alignment with the European Green Taxonomy of companies [55, 56]. Therefore, Gaïa Research is an agency specialized in the sustainability assessment and evaluation of European companies.

Considering Gaïa ESG Ratings, the Group has rated more than 2300 companies all around Europe (400 of which are placed in France). Particularly, the ESG ratings are addressed to small cap (with a market value between \$250 million and \$2 billion) and mid cap (with a market value between \$2 billion and \$10 billion) companies listed in the European countries [57 - 59].

Therefore, Gaïa Research is an agency specialized in the assessment of companies’ sustainability. Thus, thanks to its specific background of development, the ESG Ratings provided by the Group might be characterized by a good reliability. However, compared to the other ESG ratings analyzed, this one

assesses only the European companies of small and medium size. Therefore, Gaïa ESG rating can be quite limited compared to the others.

4.5.1 Gaïa methodology

Gaïa Research provides many tools aimed at evaluating the sustainability of European small or mid-sized companies. One of these tools is the Gaïa ESG Rating, which assesses the environmental, social, corporate governance and external stakeholders' aspects of companies using 140 criteria.

The rating process starts with the collection of publicly available ESG information in the last 3 years. Then, this information is checked for its quality. After the collection step, Gaïa Research builds a dialogue with the company undergoing the ESG rating process in order to clarify some information and complete other ones. This step is accomplished by the filling in of a questionnaire, where a company can report further ESG information. Once the questionnaire is completed, the information reported is verified. In the end, the ESG score is calculated and provided according to the information disclosed.

Furthermore, the ESG rating process developed by Gaïa Research adapts to the evolving size of the company undergoing the system. Moreover, the final score is also made up of a controversy score. The controversy score calculates the exposure of a company to a controversy risk, which can negatively affect the reputation of a company, leading to an impact on the company itself and its stakeholders. The controversy score is translated as a "malus" into the overall score. More precisely, this "malus" can remove scoring points (from 0 to 20 points) to the overall score according to the severity of the controversy: the greater the severity of the controversy, the greater the malus. Additionally to adaptation to the company size and to the controversy score, the methodology also considers the emerging risks and regulatory expectations. Furthermore, for those companies that do not report their GHG emissions, the Agency is provided with a model able to evaluate the direct and indirect emissions (organization's carbon footprint). To run this model, the company must provide some information, such as turnover, number of employees, and the main industry sector of the company.

As already mentioned, at the end of the rating process an overall score is provided, which represents how a company manages environmental, social, corporate governance and external stakeholders aspects. This score can range from 0 (representing a company with bad performance in sustainability topics) to 100 (reflecting a company with an excellent performance in sustainability topics) [60].

Ultimately, EthiFinance, a group specialized in EU companies rating, research and advisory for sustainable finance and sustainability topics, acquired Gaĭa Research group. Gaĭa Research was founded in 2004 with the aim to provide tools to measure the sustainability, including ESG Rating. Therefore, over the years the Group has been consistent with its primary goal. However, the application of Gaĭa Research is limited to European small-medium sized companies. It means that the ESG Rating provided by this Group can compare only a limited number of companies, placed in European countries (not around the world). Furthermore, the ESG rating methodology described by Gaĭa Research is not completely clear and transparent. This feature may affect the reliability of this rating, making it not very useful, especially for investors. However, investors might be interested in the information reported by companies in the ESG rating.

4.5.2 Gaĭa ESG Rating applied to Carel Industries

It seems that the ESG rating provided by Gaĭa Research is the same for all the companies. Thus, according to questionnaire used by Carel (which should be the same for all the other companies), Gaĭa ESG Rating assess the sustainability of companies using 18 criteria. Each criterion presents a set of indicators, which assumes the form of questions due to the nature of the Rating.

Gaĭa's Environmental pillar contains 3 criteria: "Energy and Greenhouse Gases", "Water, ground, air and waste" and "Environmental policy and management system". The number of indicators in the environmental pillar is 52. Table 13 represents the criteria selected in Carel's ESG Rating provided by Gaĭa Research in the Environmental pillar along with the topics tackled by the indicators within each criterion and the number of indicators.

Gaia ESG Rating	
Environmental Pillar	
Criteria	Indicators topics
Energy and Greenhouse Gases	Action plan for the reduction of GHG emissions and energy consumption
	Reporting of energy and other fuels consumption
	Sources of cleaner energy
	Reporting of Scope 1, 2 and 3 emissions
Water, ground, air and waste	Initiatives to reduce raw materials and waste
	Water consumption reporting
	Waste production reporting and recycling rate
Environmental policy and management system	Environmental policies adopted and certifications
	Product eco-design
	Impact assessment of company's activities on biodiversity- sensitive areas
Total Indicators	52

Table 13: Schematization of criteria and Indicators topics and the number of indicators selected for Carel Industries by Gaia ESG Rating in the Environmental Pillar

The criteria used by Gaia Research in its ESG Rating for the Social pillar and reported for Carel Industries are 8: “Social characteristics and policies”, “Working conditions”, “Skills development”, “Equal opportunities”, “Health and Safety”, “Relations with suppliers”, “Relations with customers, civil society and responsibility of products” and “CSR policy, extra-financial issues and implementation of the non-financial reporting (EU directive)”. The number of indicators in the social pillar is 69. Table 14 represents the criteria used in Carel’s

Gaia ESG Rating for the Social pillar as well as the topics tackled by indicators within each criterion and the number of indicators.

Gaia ESG Rating	
Social Pillar	
Criteria	Indicators topics
Social characteristics and policies	Reporting of the company's workforce
	Presence of HR manager
Working conditions	Reporting of working conditions
	Policies in favor of social dialogue
Skills development	Reporting of employees training and development
Equal opportunities	Reporting on workforce composition and management positions by gender
	Gender pay gap
Health and Safety	Policies for health & safety
	Reporting of health & safety data (LTIFR, etc...)
Relations with suppliers	Environmental and social requirements and policies for suppliers
Relations with customers, civil society and responsibility of products	Quality certification
	Customer satisfaction survey and IT risk assessment
	Activities linked to Sustainable Development Goal (SDG)
CSR policy, extra-financial issues and implementation of the non-financial reporting (EU directive)	CSR Strategy and a division in charge or responsible for it
	UN Global Contact and its status
Total Indicators	69

Table 14: Schematization of criteria and Indicators topics and the number of indicators selected for Carel Industries by Gaia ESG Rating in the Social Pillar

The criteria reported in Gaia ESG Rating applied to Carel Industries for the Governance pillar are 5: “Compensation of officers and directors”, “Composition of governance bodies”, “Operation of governance bodies”, “Dilution risk of minority shareholders” and “Business ethics”. The number of indicators in the governance pillar is 18. Table 15 shows the criteria reported in Gaia ESG Rating applied to Carel Industries in the Governance pillar along with the topics tackled by the indicators within each criterion and the number of indicators.

Gaia ESG Rating	
Governance Pillar	
Criteria	Indicators topics
Compensation of officers and directors	Reporting of the compensation of CEO and Board members
	Criteria used for the calculation of CEO variable compensation
Composition of governance bodies	Reporting of the board members and board composition by gender
Operation of governance bodies	Reporting of board effectiveness
	Others existing committees
Dilution risk of minority shareholders	Control of capital by a shareholder or a group of shareholders
Business ethics	Codes of conducts and anti-corruption policies and whistleblowing system
	Auditors fees
Total Indicators	18

Table 15: Schematization of criteria and Indicators topics and the number of indicators selected for Carel Industries by Gaia ESG Rating in the Governance Pillar

4.6 Ambienta ESG Approach

Ambienta is an asset management company founded in 2007 specialized in investments focused on environmental sustainability, resource efficiency and pollution control. As an asset management company, Ambienta invests in companies, considering sustainability as the key driver in the investment process. In fact, Ambienta supports the concept that sustainability is a competitive advantage for companies rather than an economic cost. However, the Firm differentiates from the other one thanks to its holistic approach to environmental sustainability. This means that Ambienta does not consider only the GHG emissions, but it takes into account all the other drivers that cause the environmental impact.

This is the idea driving the investment process of the Firm.

Therefore, Ambienta has developed its own ESG Approach in order to understand which companies better reflect the Firm's philosophy. Particularly, the ESG approach developed by the company is part of a wider Ambienta's plan, called ESG in Action, which is aimed at integrating ESG practices within the Firm, by assessing the sustainability practices of invested companies [61].

Therefore, Ambienta is an asset management company really committed to sustainability. In fact, this Firm has been developed with the aim to invest in those companies that are leaders in the management of sustainability topics. Thus, Ambienta requires companies to report few indicators of Firm's interest.

4.6.1. Ambienta methodology

Ambienta is an asset management firm, whose day-to-day activities are driven by sustainability. Therefore, the Firm invests into those companies that put sustainability before each activity and operation. In fact, these companies are deemed by Ambienta to have competitive advantage over the others.

To be consistent and solid with its main primary goal, the Firm has developed a program, aimed at integrating ESG practices in its everyday operations. This program is known as ESG in Action and its aim is accomplished by assessing the

sustainability of companies that make up Ambienta's portfolio. At the end of the assessment, the Firm engages with its stakeholders in order to guarantee the adoption of sustainability driven measures.

Thus, under this context, Ambienta has developed its own ESG Approach, aimed at assessing the companies' ESG indicators. Therefore, the results of this rating does not display how a company manages ESG topics compared to its peers, but it is a tool useful to understand the convenience of an engagement for Ambienta.

Going into details, this ESG approach assumes the form of a questionnaire where only a few questions for each of the three pillars are asked. Particularly, these questions investigate the ESG Key Performance Indicators (ESG KPI) relative to a company. In fact, through the analysis of ESG KPI, Ambienta can understand if sustainability is a priority for the company under study, reflecting Firm's primary goal. Thus, Ambienta can determine if the engagement with this company is convenient or not [62].

Therefore, Ambienta is an asset management company, focused on environmental and sustainable investments. The Firm's investment process is driven by sustainability and the investment targets are private and public companies that look sustainability as a competitive advantage rather than an economic cost. Under this light, Ambienta has developed its own ESG approach, which is aimed at assessing the performance of companies in ESG topics. This assessment is carried out using a questionnaire that collects all the information relative to ESG KPI of the company under investigation. This questionnaire is very short, but the questions inside are very specific. However, it is not specified how the information reported in the questionnaire by the company under investigation is treated and analyzed. In the end, the ESG approach developed by Ambienta is a high-quality one due to the very detailed information required. In particular, the ESG data reported by the disclosing company can be also used by other investors. However, this ESG approach is useful for Ambienta. In fact, it does not provide a rating of companies among their peers, but using the questionnaire Ambienta can understand the direction taken by the company under

investigation and can suggest to this company the measures to apply in order to increase its sustainability.

4.6.2 Ambienta ESG Approach applied to Carel Industries

Ambienta is an asset management company, whose purpose is to invest in those companies with a good sustainability management. Therefore, Ambienta has developed an ESG approach, rather than an ESG rating, aimed at collecting ESG data from companies. From the analysis of the reported ESG data, Ambienta can understand if it is more reasonable to engage with a company rather than another one.

This ESG approach, therefore, investigates how a company manages ESG topics. The criteria reported in this questionnaire for the 3 pillars are 10. Each criterion presents a set of indicators, which assume the form of question due to the nature of the approach developed.

The criteria reported in the Environmental Pillar for Carel Industries are 3: “Climate Risk”, “Climate Strategy” and “Environmental Impact”. The number of indicators in the environmental pillar is 20. Table 16 summarizes the criteria reported by Ambienta in its ESG approach for Carel Industries falling under the Environmental pillar as well as the topics faced by the indicators within each criterion and the number of indicators.

Ambienta ESG Approach	
Environmental Pillar	
Criteria	Indicators topics
Climate Risk	Climate-related risk assessment
	Status of GHGs reduction
Climate Strategy	Decarbonization strategy in line with Paris agreement
	Reduction target for GHG emissions
Environmental Impact	Main environmental impacts
	Reduction targets to reduce the main environmental impacts
Total Indicators	20

Table 16: Schematization of criteria and Indicators topics and the number of indicators selected for Carel Industries by Ambienta ESG approach in the Environmental Pillar

The criteria selected in the Social pillar by Ambienta ESG approach for Carel Industries are 3: “Human Capital”, “Working Conditions” and “Supply Chain”. The number of indicators in the social pillar is 4. These criteria are reported in Table 17 along with the topics faced by the indicators within each criterion and the number of indicators.

Ambienta ESG Approach	
Social Pillar	
Criteria	Indicators topics
Human Capital	Reporting of employees eligible for bonuses or equity-based compensation
	ESG criteria in the performance management system
Working Conditions	Reporting of lowest-paid staff salary and minimum legal wage
Supply Chain	Reporting of supplier with ESG assessment and audits
	ESG integration in the supply chain
Total Indicators	4

Table 17: Schematization of criteria and Indicators topics and the number of indicators selected for Carel Industries by Ambienta ESG approach in the Social Pillar

The criteria selected in the Governance pillar by Ambienta ESG approach for Carel Industries are 4: “Board Effectiveness”, “Executive-level Diversity”, “Auditor Independence” and “Litigation”. The number of indicators in the governance pillars is 5. These criteria are summarized in Table 18 as well as the topics faced by the indicators within each criterion and the number of indicators falling under the Governance pillar.

Ambienta ESG Approach	
Governance Pillar	
Criteria	Indicators topics
Board Effectiveness	Position of CEO and President
Executive-level Diversity	Reporting of women management position
Auditor Independence	Reporting of non-audit fees
Litigation	Fines, penalties, etc...
Total Indicators	5

Table 18: Schematization of criteria and Indicators topics and the number of indicators selected for Carel Industries by Ambienta ESG approach in the Governance Pillar

4.7 Sustainalytics ESG Rating Provider

Sustainalytics is an agency providing ESG ratings, research and other analysis services aimed at helping investors in investment decisions. Nowadays, Sustainalytics can count on more than 14 000 rated companies.

Sustainalytics is characterized by a history made of acquisitions and mergers. In fact, Sustainalytics was founded in 1992 by Michael Jantzi and at that time it was known as Jantzi Research, an agency specialized in ESG investing. However, Sustainalytics was officially founded in 2009, after a merger of Jantzi Research. Then, in 2020 Sustainalytics Group was acquired by Morningstar, which is a leading company in the provision of financial research and services [63 - 65].

According to the study “Rate the Raters 2020: Investor Survey and Interview Results”, Sustainalytics, along with MSCI, is investors’ favorite ESG rating thanks to its broad coverage. In fact, many investors stated that the two ESG Rating providers are very similar. However, it was noted that in some parts of the

rating Sustainalytics is more transparent compared to the MSCI. Another feature really appreciated by investors is that Sustainalytics keeps on evolving in order to satisfy investors and companies needs [21].

Therefore, Sustainalytics, with nearly 30 years of expertise in the field, provides ESG ratings, research, analysis and data to investors and companies. Furthermore, the acquisition by Morningstar has improved the quality of the services provided by Sustainalytics, bridging meaningful ESG insights to investors and companies [64]. All these characteristics make Sustainalytics a reliable ESG Rating, really appreciated by investors. This is due to the broad coverage, to the transparency and to the capacity to adapt to companies and investors' needs. Its reliability might also depend on the consistency of its development. In fact, Sustainalytics was developed as an agency specialized in ESG investing. Over the years, the Group has only widened the object of investigation, becoming a provider of ESG Ratings, research, data and analysis. Thus, Sustainalytics has never changed the object of investigation.

4.7.1 Sustainalytics methodology

Sustainalytics has always been specialized in ESG topics. Therefore, the ESG Rating developed is really reliable. This is due to the features of the rating: indeed, investors highlighted that Sustainalytics ESG Rating has a broad coverage, it is transparent and able to adapt to investors and companies' needs. All these features make Sustainalytics ESG Rating a high-quality and useful one.

Sustainalytics has developed an ESG Rating aimed at evaluating the extent to which a company's economic value is at risk due to ESG factors. This rating is actually called ESG Risk Rating and it depends on three building blocks: Corporate Governance, material ESG issues (MEIs), and idiosyncratic ESG issues. The Corporate Governance block is applied to all companies, no matter the sub-industry they are in. Regarding the Material ESG Issues, it is applied at sub-industry level, differently from the Corporate Governance block. In this block all the ESG issues that can affect the economic value of a company in a quite predictable way are considered. Particularly, an issue is material when it can

affect the economic value of a company. However, some issues may become material, influencing a company's economic value unpredictability. This concept leads to the last and third block. The Idiosyncratic Issues block refers to those issues, which are unpredictable or unrelated to a specific sub-industry. Specifically, these issues may become Material ESG issues when a specific threshold is exceeded.

To each one of these three blocks a quantitative score and a risk category are assigned. The quantitative score represents ESG risks (a low quantitative score means less unmanaged risks). This score is provided on an open-ended scale, ranging from 0 (no risk) to a maximum score lower than 50 for 95% of cases. Then, according to the quantitative score achieved, a company is classified into one of the five risk categories, which are: negligible, low, medium, high, severe. Specifically, the risk categories provide a result in an absolute scale, meaning that a bank can be compared to an oil company. Therefore, Sustainalytics has introduced a single currency for the evaluation of companies' ESG Risk Rating scores thanks to the methodology developed.

The final ESG Risk Rating score depends on two dimensions: the exposure and the management. The exposure considers the risk to which a company is exposed to. The management considers how a company manages these risks. Therefore, the final ESG Risk Rating score depends on unmanaged risks, which include unmanageable risks and management gaps. The first one cannot be managed by a company's initiatives and the second ones could be potentially managed, but they are not. Therefore, the final score is the sum of unmanaged risks' scores (quantitative scores) of each material ESG issue [66].

Therefore, Sustainalytics, thanks to the nearly 30 years of expertise in ESG investing, is able to provide a high-quality and useful rating. In fact, even though it seems a bit complex, the methodology results to be disclosed transparently and very detailed. Furthermore, Sustainalytics is able to provide a broad coverage when establishing the exposure and management of a company's risks. All these features make Sustainalytics ESG Rating one of the most reliable ratings available (along with MSCI) and investors' favorite one.

4.2.7 Sustainalytics ESG Rating applied to Carel Industries

Sustainalytics requires the selection of the industry sector. The industry sector selected for Carel is Industrial Machinery, whose selection activates specific ESG material Issues according to the industry sector. Then, Carel’s exposure to ESG material issues was carried out. Then, Sustainalytics evaluated the management of the risks represented by material ESG issues. For this phase, Carel’s ESG programs, practices and policies were assessed. Particularly, in this phase the ESG criteria considered for Carel Industries were 21. Within each criteria there is a set of indicators (which consist of the information required to Carel).

The criteria in the Environmental pillar selected for Carel Industries by Sustainalytics ESG Rating are 6: “Carbon Intensity”, “Carbon Intensity Trend”, “Environmental Policy”, “Environmental Management System”, “EMS Certification” and “Eco-Design”. The number of indicators in the environmental pillar is 27. Table 19 shows this criteria selected falling in the Environmental pillar as well as the topics of the indicators within each criterion and the number of indicators.

Sustainalytics ESG rating	
Environmental Pillar	
Criteria	Indicators topics
Carbon Intensity	Carbon emission disclosure for the organization’s performance
Carbon Intensity Trend	Trend of carbon emissions
Environmental Policy	Commitment to reduce emissions, releases, wastes and use energy and natural resources efficiently
	Commitment to EMS, environmental performance, reporting on environmental issues, environmental protection and environmental awareness
Environmental Management System	Roles with responsibilities and managerial responsibility level
	Environmental programs Training on environmental issues and awareness

	Internal and external audits
	Environmental performance, impact assessment and targets
EMS Certification	Reporting of ESM certified sites
Eco-Design	Environmental impact assessment at the design-stage of products
Total Indicators	27

Table 19: Schematization of criteria and Indicators topics and the number of indicators selected for Carel Industries by Sustainalytics ESG Rating in the Environmental Pillar

The Social pillar of Sustainalytics ESG Rating applied to Carel Industries presents 8 criteria: “LTIR Trend”, “Human Rights Policy”, “Diversity Programs”, “Product and Service Safety Program”, “QMS Certifications”, “Freedom of Association Policy”, “Scope of Social Supplier Standards” and “Global Compact Signatory”. The number of indicators in the social pillar is 32. Table 20 represents the criteria in the Social pillar selected by Sustainalytics ESG Rating for Carel Industries and the topics of the indicators within each criterion and the number of indicators.

Sustainalytics ESG rating	
Social Pillar	
Criteria	Indicators topics
LTIR Trend	Reporting of health and safety data (LTIFR, etc...) and the trend over the years
Human Rights Policy	Commitment to correct negative impacts, communication of the HR policy to employees and stakeholders, programs to address industry-specific human rights risks, respecting human rights international standards
	Human right risk assessment and impact evaluation

Diversity Programs	Diversity programs audits
	Targeted recruitment, networking groups, diversity councils,
	Diversity initiatives approved by top management, Training programs, initiatives supporting diverse workforce
Product and Service Safety Programs	Policy for product and service safety, training for product and service safety, product and service safety audits, managerial responsibility for product and service safety
	Product/service safety risk assessment, targets, testing to ensure product/service safety, public reporting of product/service safety issues and performance
QMS Certifications	Reporting of quality management systems
Freedom of Association Policy	policy and strength for the freedom of associations
Scope of Social Supplier Standards	Supplier code of conducts
Global Compact Signatory	Signatory of UN Global Compact
Total Indicators	32

Table 20: Schematization of criteria and Indicators topics and the number of indicators selected for Carel Industries by Sustainalytics ESG Rating in the Social Pillar

The Governance pillar of Sustainalytics ESG Rating applied to Carel Industries presents 7 criteria: “ESG Governance”, “Board Diversity”, “Board Independence”, “Bribery & Corruption Policy”, “Whistleblower Programs”, “ESG Reporting Standards” and “Verification of ESG Reporting”. The number of indicators in the governance pillar is 19. Table 21 represents the criteria in the Governance pillar selected by Sustainalytics ESG Rating for Carel Industries and the topics of the indicators within each criterion and the number of indicators.

Sustainalytics ESG rating	
Governance Pillar	
Criteria	Indicators topics
ESG Governance	ESG Committee and executive in it
Board Diversity	Reporting of board composition by gender,
	Diversity policy for the board memberships
Board Independence	Independent members in the board
	Independent directors are affiliated with the company/controlling shareholder/ the CEO or other insiders
	Other monitoring boards
Bribery & Corruption Policy	Guidelines for acceptable behavior, bribery and corruption policy, conflict of interests
Whistleblower Programs	Policies for whistleblowers, confidentiality of the anonymous reporting and reports, services available for whistleblowers
	Reporting of whistleblower cases
ESG Reporting Standards	Strength of the ESG reporting
Verification of ESG Reporting	Adequacy of ESG reporting
Total Indicators	19

Table 21: Schematization of criteria and Indicators topics and the number of indicators selected for Carel Industries by Sustainalytics ESG Rating in the Governance Pillar

4.8 Sum of Carel's ESG Ratings

In this section, the ESG Ratings used by Carel to measure its sustainability were analyzed considering general information, the historic background, investors' opinion and the methodologies developed for each ratings.

From this analysis, MSCI, CDP, S&P Global and Sustainalytics seem to be the most reliable thanks to the high-quality of the ESG Rating provided and to their transparency, especially when disclosing the methodologies. Moreover, MSCI and Sustainalytics are deemed to be very useful by investors thanks to detailed reports produced at the end of the rating process. In fact, many investors rely on the score provided by these two ESG Rating providers. On the other hand, CDP and S&P Global are really appreciated by investors for their quality. As a matter of fact, investors use the ESG data disclosed in these two ratings for their investment decisions. In any case, MSCI, CDP, S&P Global and Sustainalytics are investors' favorites ESG Rating providers. Also EcoVadis seems to be a good ESG Rating, too. In fact, the methodology is disclosed transparently by the Group and it is aligned with many international standards. Furthermore, it requires that each answer provided must be supported by the relative documentation. Regarding Gaïa Research ESG Rating, it can be applied only to small/medium sized companies, located in European countries. Therefore, the rating provided is limited. Furthermore, the methodology is disclosed, but it is not completely transparent. In the end, Ambienta, which is an asset management company, does not properly provide a rating, but it provides an ESG approach aimed at understanding the concrete commitment towards sustainability of a company. Therefore, due to the nature of the company and the ESG approach developed, the methodology is not disclosed by Ambienta.

Regarding the historic background, CDP, Sustainalytics, EcoVadis, Gaïa Research and Ambienta ESG Ratings and approaches are consistent with their primary goal, which is the reason why these systems have been developed. On the other hand, MSCI and S&P Global primary goal is not to provide ESG Ratings, tools to measure sustainability or advisory for sustainable investing. The development of ESG ratings for these two groups is a secondary goal, driven by the increasing attention towards sustainability.

Regarding the application of these to Carel Industries, MSCI, EcoVadis, CDP, S&P Global and Sustainalytics asks for the selection of the industry sector in which Carel operates, allowing the activation of some criteria instead of others

(irrelevant for the selected industry sector). Regarding Ambienta and Gaia Research the industry sector in which Carel operates was not required. However, the criteria assessed by all these 7 Ratings were quite similar.

The analysis highlighted the presence of 1085 indicators across the 7 ESG Ratings used by Carel. It can be noted that S&P Global is the ones with the greatest number of criteria assessed; in particular, 21 criteria were assessed in the Environmental pillar, 22 in the Social pillar and 27 in the Governance pillar. The environmental pillar of S&P presents 216 indicators, the social pillar 224 and the governance pillar 84, with a total number of indicators assessed of 524. However, CDP presents the strongest and most detailed criteria falling in the Environmental pillar, especially regarding climate change. In fact, CDP presents 121 indicators in the environmental pillar against 7 indicators of the social pillar and 10 indicators of the governance pillar. This is due to the nature of CDP ESG Rating provider, which is mainly focused on climate-related topics.

However, even if the criteria assessed by Carel's ESG ratings are quite similar in the topics, the ESG data reported by Carel in these ratings are treated and processed differently, according to the specific methodology developed for each one of the 7 ESG ratings. Therefore, the results coming from these ESG ratings can differ from one to another. This issue was also highlighted by the literature review of ESG Ratings (the issue of divergence among ESG Ratings has been already presented in the sub-chapter 2.4). The cause must be found in the great number of ESG ratings available and the lack of a standard, able to standardize the procedure. Therefore, to solve this problem, a standardized procedure should be applied to ESG Ratings. For this aim, Life Cycle Models can be helpful. In fact, Life Cycle Models are environmental sustainability metrics, aimed at measuring sustainability like ESG Ratings. However, unlike ESG Ratings, Life Cycle Models present a standardized structure and procedure. The main issue affecting ESG Ratings, caused by the lack of standard and by the great number of existing ratings, could be solved by applying the structure of Life Cycle Models to ESG Ratings and looking for the matches between the two sustainability metrics.

Chapter V - Life Cycle Models

The attention towards sustainability promotes the adoption of a life cycle thinking approach. Life cycle thinking provides an analysis that considers the environmental impacts generated during the life-cycle of a product or organization. Particularly, the tool developed to evaluate this environmental impact is the life cycle model. Life Cycle Models are able to measure the sustainability of products, services, processes or activities, scaling up to a whole organization. Therefore, life cycle models identify themselves as environmental sustainability metrics, like ESG ratings. However, these models, unlike ESG Ratings, present a standardized structure and procedure, reported in ISO 14040 and ISO 14044. This standardized structure and procedure consists of 4 steps: Goal and scope definition, Inventory analysis, Impact assessment and Result interpretation.

5.1 The Life Cycle Thinking

The last decades have been marked by an increasing attention towards sustainability topics. This trend has influenced companies, producers, consumers and also governments, which has become more sensible to environmental issues, especially for those topics linked to production processes and models. Therefore, many actions and measures have been recently taken to promote sustainable production and consumption, which are characterized by an improved environmental and socio-economic performance (compared to the previous and ordinary models). At the beginning, to evaluate environmental and socio-economic performance, environmental management tools were developed. These tools were limited to evaluate the environmental impact of a process or product, considering the environmental problems generated by only one stage of this process or product chain (for example, all the environmental impact generated by a product or process was attributed only to suppliers or consumers) [67]. It resulted in an underestimation of the environmental impact generated during a process or product system. More precisely, the use of environmental management tools shifted the environmental impact in different stages of a process or product

system. However, over the years this problem was noted and solved using a life cycle approach. In fact, a life cycle approach considers the environmental impact generated during the overall life cycle of a process or product system. The comprehensive analysis required to evaluate the environmental impact of a process or product system, using a long-time horizon and multidimensional point of view (namely the life-cycle point of view) is offered by Life Cycle Thinking (LCT) [14].

The aim of LCT is to consider the environmental impact generated by the life-cycle of a process or product system in order to allow a reduction in resource use and emissions release. In fact, LCT considers a process or product system from the extraction of raw materials to the end-of-life, encompassing the production, the packaging, the distribution, the use, the maintenance and eventually the reuse phases. The following image represents the typical scheme used for product life cycle.

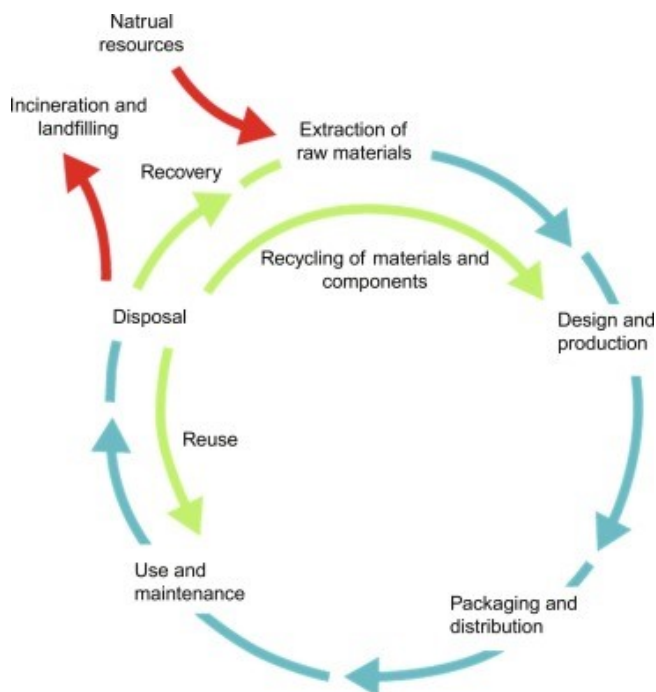


Figure 8: Representation of a typical product life cycle [68]

Therefore, the LCT, considering the environmental impact generated during a process or product life-cycle, allows to decrease this impact, reducing the use of resources and emissions release, so that the process and product system results to be improved in their life-cycle socio-economic performance [68].

The concept of LCT is strictly connected to sustainability. In fact, sustainability refers to the sustainable development, which is based on the concept of fulfilling present generations' needs without compromising the needs of future generations. The fulfillment of these needs must occur within Earth capacities, available technologies and respecting the socio-cultural context [69]. Therefore, sustainability requires an efficient use of resources and reduction of emission releases in the environment. Thus, according to its aim, LCT supports the goal of sustainability. In fact, LCT, if it is applied to all processes and product systems, can really drive towards a global reduction in resource use and emissions release, in line with the goal of sustainability [14].

To promote sustainability, actions must be taken. However, to measure the sustainability of these actions, specific tools must be developed in order to avoid the shifting of the environmental impact of one action at different stages of the process or product system. LCT happens to be proper for the development of these tools. In fact, through the LCT concept, it was possible to develop tools able to measure sustainability of actions, projects, processes and products.

In conclusion, LCT is able to promote sustainability, reducing the use of resources and the release of emissions in the environment. This is possible because LCT is based on the comprehensive view that considers the environmental impact generated by a process or product. Therefore, the concept behind the LCT can help to reach the goal of sustainability, which is to guarantee the development in harmony with the ecosystems. For this reason LCT has been used to develop tools able to measure the sustainability of actions, projects, processes and products.

5.2 Life Cycle Model to measure sustainability

LCT and sustainability are strictly related. Particularly, LCT is able to provide tools to measure sustainability thanks to its holistic approach to the environmental impact of process and product systems. In fact, LCT looks at the impact generated during the life-cycle of a process or product system.

One of the most powerful tools that LCT provides to measure sustainability is Life Cycle Models, which are also known as Life Cycle Assessment Models. Life Cycle Models (LCM) are able to quantify the environmental impact of products and processes, using a cradle-to-grave approach. LCM investigates the cause-effect relationships between environmental aspects and provides a quantitative result of the environmental impact due to anthropogenic actions, namely processes and product systems. Practically speaking, LCMs evaluate in a quantitative way the potential impact on human health and environment as well as resource depletion during a product or process life cycle (from raw materials extraction - cradle - to the end-of-life - grave) [14, 70, 71]. Therefore, LCMs are able to identify the greatest stressors in a process or product system. So, these models are able to suggest the improvements that can be applied in order to reduce the impacts on environment and human health and resource use. It means that LCMs promote the reduction of resource use and emissions releases, measuring quantitatively the impacts on environment and human health and resource depletion. This makes LCMs completely aligned with the goal of sustainability, which is to promote the development in harmony with the ecosystems. Therefore, LCMs are metrics used to measure sustainability of a process or product system. Particularly, four characteristics make LCMs prestigious tools for the evaluation of sustainability. First of all, they are based on a life cycle perspective (that considers a process or product in its overall life cycle). Then, LCMs consider a great range of environmental issues. At the end of the assessment, LCMs provide quantitative results of the environmental impact generated by the product or process under investigation. Last but not least, LCMs present a scientific-based methodology [72]. Speaking about the methodology, it represents the main advantage of LCMs. In fact, LCMs are based on a

comprehensive and standardized structure and method. It means that when a LCM is applied, the requirements and guidelines reported in ISO 14040 and ISO 14044 must be followed. Therefore, these two ISO standards constitute the framework for LCMs [14, 71].

In conclusion, LCT allowed the development of LCMs, aimed at quantifying the impacts on human health and environment as well as the resource depletion due to a process or product system. Particularly, since LCT is completely aligned with the goals of sustainability, LCMs can be used to measure the sustainability of a process or product systems. Therefore, LCMs are identified as environmental sustainability metrics. The main feature of these models is the standardized procedure and structure, which is available in the ISO 14040 and ISO 14044.

5.3 Standards ISO 14040 and ISO 14044

LCMs are environmental sustainability metrics, used to measure sustainability of a process or product system, whose main characteristic is the comprehensive and standardized structure and procedure. The international standards that define the guidelines and requirements for LCMs are ISO 14040 and ISO 14044:2006. Particularly, these two standards specify that the first phase to carry out a LCM consists in the goal and scope definition of the study. Then, it is followed by life cycle inventory analysis, life cycle impact assessment and result interpretation phases. Moreover, the two international standards also define the reporting and the critical review of the application of LCMs, the limitation of the study and the relationships between the four phases characterizing the LCMs. Furthermore, according to the purpose of this paper, it is noteworthy that thanks to the technical specifications provided in the ISO/TS 14072:2014 it is possible to apply LCMs also to Organizations. In fact, ISO/TS 14072:2014 presents the principles and methodology to apply LCMs to organizations and the benefits gained by an organization through the application of LCMs at corporate level. Additionally to these two elements, this standard defines the system boundaries for an organization while applying LCMs and the specific requirements to carry out the goal and scope definition, inventory analysis, impact assessment and result interpretation phases for the application of LCMs at organizational level.

However, all these international standards require LCMs to have a specific structure, divided in four phases, which are interconnected: goal and scope definition, inventory analysis, impact assessment and result interpretation.

During the goal and scope definition phase, the function of the system and the boundaries of the analysis are determined. Going into details, the goal must be unambiguously defined, specifying the intended application, the reasons that have led the study and the intended audience. Regarding the scope, it must be clearly defined. Particularly, the scope could be redefined during the study. In fact, LCMs are characterized by an iterative process, during which each phase provides a feedback relative to the other phases [73]. During the scope definition phase, the organization under investigation as well as the products made by the organization, the unit processes, the facilities and sites included in the reporting unit must be reported. Therefore, the goal and scope definition of LCMs (especially if applied to organizations) must present the organizational boundaries and the reporting unit. Particularly, the organizational boundaries consider the geographic distribution of organization sites as well as the financial control, operational control and the equity share of the organization on a facility. The reporting unit is defined as the quantified performance expression of the organization under study to be used as a reference [74]. The reporting unit includes the products produced by the organization, the unit processes, elementary flows, facilities and organization's sites. Moreover, the scope of LCMs also defines the system boundaries, in which the processes to include in the LCM are specified. Generally, LCMs adopt the cradle-to-grave approach for the definition of system boundary. This approach encompasses all the life-cycle stages of a process or product system. In the end, in the goals and scope definition, the organization has to perform a materiality analysis in order to understand which significant environmental aspects cause a significant environmental impact. The definition of significant environmental aspects is provided in the EU Accounting Directive 2013/34/EC as well as in GRI Standard and ISO 14001. According to the EU Directive, material is an information that its reporting can reasonably influence the decisions taken on the base of the financial statement [75]. The GRI Standard defines the material topics as the ones that have a significant impact on the

economy, environment and people [76]. According to the ISO 14001, a significant environmental aspect can cause one or more significant environmental impacts. To determine a significant environmental aspect the organization has to apply one or more criteria [77]. In any case, to find the significant environmental aspects, an organization can identify the activities and their environmental aspects. Then, the organization can evaluate the related impacts and assess the significance of the impacts.

After the goals and scope definition, the second phase characterizing LCMs is the inventory analysis, which is based on the mass and energy balance data, data taken from literature review and datasets. Therefore, Inventory analysis consists of the acquisition of mass and energy flows data of a process, activity or product. These data include the use of resources (input data) and the emissions releases to air, soil and water (output data). Thus, the inventory analysis corresponds to the data collection phase, during which the data regarding significant environmental aspects determined in the materiality analysis are collected.

The inventory analysis is followed by the impact assessment phase, in which the energy and mass balances defined during the inventory analysis are translated into environmental impacts. Particularly, this phase consists of mandatory and optional steps. The mandatory steps are the selection of impact categories, category indicators and characterization models. Moreover, it is mandatory to assign inventory data to impact categories and to calculate category indicator results.

The fourth and last phase of LCMs is result interpretation. This phase encompasses three checks: completeness check, sensitivity check, consistency check. Completeness check investigates the gaps in the data and knowledge in order to understand how these gaps influence the final results. Sensitivity check consists of the discussion of sensitivity analysis results (if it is carried out). Last but not least, consistency check evaluates the consistency of assumptions and methods adopted. Once these 3 checks are made, conclusions, recommendations and future perspectives are provided [78 - 80]. The following image provides a schematization of the four steps characterizing LCMs.

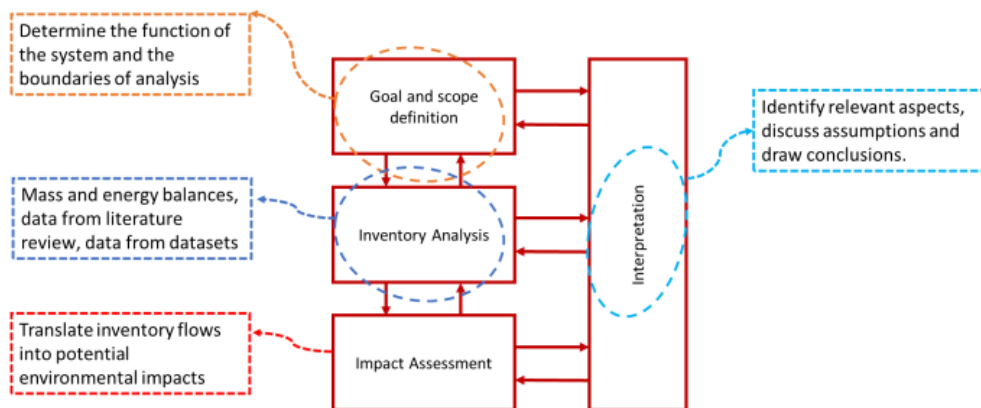


Figure 9: Representation of the 4 phases of LCMs [75, 76]

In conclusion, LCMs present a standardized structure and procedure, which is reported in ISO standards. The standardized procedure to carry out LCMs is divided into 4 phases. It means that each study performed to assess the impacts on environment and human health as well as resource depletion is based on a LCM which is divided in 4 phases. This feature is the main advantage of LCMs as metrics to measure sustainability. This is the reason why this paper aims to apply the standardized procedure of LCMs to ESG Ratings, whose main disadvantage is the lack of standardization process.

Chapter VI - Materials and Methods

In the following section, the materials and methods used to perform the investigation and reach the purpose of the study are reported. The materials used were taken from Carel's ESG Ratings and Carel's LCMs as well as the ESG Ratings websites. Furthermore, this section presents the methods developed to find how LCMs can support ESG Ratings. In particular, this method consists of applying the standardized structure and procedure of life cycle models to ESG ratings and finding the matches between the two systems among the four phases.

6.1 Materials

The materials adopted to pursue the goal of this paper are: Carel's ESG ratings, a product LCA study carried out in Carel Industries, a Life Cycle perspective study carried out within Carel boundaries, the ISO standards 14040 and 14044 for standardized structure and procedure of LCMs and ISO 14072 for the application of LCMs to an organization.

6.1.1 Carel's ESG Ratings

The method developed was based on the 7 ESG ratings adopted by Carel Group. Particularly, the analysis of Carel's ESG ratings identified an overall list of indicators within the three pillars. This list consists of 1085 (443 indicators in the environmental pillar, 403 indicators in the social pillar and 239 indicators in the governance pillar), which were extrapolated from the ESG ratings of Carel Industries. Particularly, for MSCI ESG Rating 113 indicators were extrapolated for the environmental pillar, 55 for the social pillar and 115 for the Governance pillar. For EcoVadis ESG ratings, 105 indicators were extrapolated from the environmental pillar, 85 indicators were extrapolated from the social pillar and 29 indicators were extrapolated from the governance pillar. For CDP ESG rating, 121 indicators were extrapolated from the environmental pillar, 7 indicators were extrapolated from the social pillar and 10 indicators were extrapolated from the governance pillar. For S&P Global ESG ratings, 216 indicators were extrapolated from the environmental pillar, 224 indicators were extrapolated from the social

pillar and 84 indicators were extrapolated from the governance pillar. For Gaia ESG rating, 52 indicators were extrapolated from the environmental pillar, 69 indicators were extrapolated from the social pillar and 18 indicators were extrapolated from the governance pillar. For Ambienta ESG Approach, 20 indicators were extrapolated from the environmental pillar, 4 indicators were extrapolated from the social pillar and 5 indicators were extrapolated from the governance pillar. For Sustainalytics ESG rating, 27 indicators were extrapolated from the environmental pillar, 32 indicators were extrapolated from the social pillar and 19 indicators were extrapolated from the governance pillar. The overall sum of these indicators is 1410, which is different from 1085 indicators. This is due to the fact that some indicators are asked by more than one Carel's ESG Rating (for example the reporting year is asked by all the 7 ESG Ratings).

6.1.2 Product LCA study carried out in Carel Industries for an Inverter

In Carel, a Life Cycle Assessment (LCA) study was carried out on one of the most important products: the Inverter. This study was used for the application of the LCM to Carel Industries. In fact, some information reported in this LCA study was extrapolated and adapted to the whole Group.

It was possible to use the Inverter LCA study to build Carel's LCM because, even if Carel provides many different products, the raw materials used, the production processes and the use phase of all the products are quite similar from one product to another. The differences are only in the quantities. In fact, Carel produces the electronic and mechanical devices for the HVAC/R systems. Thus, the raw materials entering the Group are always electronic components, mechanical components and packaging. To provide the final products from these raw materials, the production processes always include welding, coating, assembly, operational test and packaging. Moreover, once sold, Carel's products need electricity for their functioning and present the same lifetime. In the end, all these products, once reached the end-of-life, are classified as WEEE and treated consequently.

6.1.3 Life Cycle Perspective study carried out in Carel Industries

A Life Cycle Perspective study was carried out in Carel Industries in order to identify all the material environmental aspects that potentially can generate a significant environmental impact. Particularly, this study was useful to confirm the relevance of the environmental aspects identified in the Inverter LCA study and to adapt these aspects to Carel's dimensions (for the application of the LCM to Carel Industries).

6.1.4 ISO 14040, ISO 14044 and ISO/TS 14072

ISO 14040 and 14044 were used to apply the standardized structure and procedure of LCMs to Carel's ESG ratings in order to support ESG ratings adopting the 4 phases pointed out by these standards. Furthermore, these two standards were used to draw the LCM for Carel Industries and perform the 4 phases for this model. Particularly, these two standards along with ISO/TS 14072 report the elements that each phase must contain for the application of a LCM to an organization.

6.2 Methods

The methods developed to investigate how and where a LCM supports ESG ratings of Carel Industries are divided into 3 main steps. The first one is the application of the standardized LCM structure and procedure to Carel's ESG Ratings, in which the four phases characterizing LCMs are applied to the structure of ESG ratings. The second step consists of a LCM drawn for Carel Industries, applying the four phases of LCMs to Carel Industries. The third and last step was aimed at identifying the matches between Carel's ESG ratings and the LCM drawn for Carel. Through the matches it was possible to understand where Carel's ESG ratings can support the LCM and where Carel's LCM can support ESG ratings.

6.2.1 Application of standardized LCMs structure and procedure to Carel's ESG Ratings

To solve the problem of the lack of standardization for ESG Ratings, LCMs structure and procedure were applied to Carel's ESG Rating. Therefore, the four phases characterizing LCMs were considered for the 7 ESG Ratings adopted by Carel. Thus, for the 7 ESG Ratings, it was identified: the goals and scope definition phase, the inventory analysis phase, the impact assessment phase and the interpretation of the results phase.

6.2.1.1 Goal and Scope definition phase for Carel's ESG Ratings

For the goals and scope definition phase, the goal of each ESG Rating used by Carel was considered, but actually all ratings analyzed convey the same goal: the assessment of Carel's sustainability management in order to rate the Group among other companies or among its peers.

Regarding the scope, general information asked at the beginning of Carel's ESG Ratings was collected. This information requires general aspects regarding the disclosure made by Carel in its ESG ratings. This information refers to: the currency used to report monetary data, the years used to report the data, the consolidated turnover, the total number of employees, Adhesion to UN Global Compact and Science based targets, third party verification of disclosed data, alignment of the data disclosed with national or international standards, presence of materiality analysis, progress made towards SDGs, general description and information about Carel and location of Carel's facilities around the world. For each information required in the goal and scope definition, it has been reported the ESG Rating used by Carel that asks for that information. Table 22, reported in the appendix, summarizes all the information considered in the goal and scope definition phase, applied to the ESG ratings of Carel Industries.

6.2.1.2 Inventory Analysis phase for Carel's ESG Ratings

The inventory analysis in the LCMs corresponds to the data collection. Therefore, in this phase the information asked by all the 7 ESG Ratings used by Carel were collected and listed. This information is called indicators, since it

represents the qualitative and quantitative requests asked by Carel's ESG Ratings, during the data collection.

Particularly, the collection of all the indicators asked by ESG Ratings occurred analyzing one by one the ESG Rating reports compiled by Carel. Through the analysis of each ESG Rating used by Carel, it was possible to collect the indicators asked by each rating for the inventory analysis phase. Particularly, for each indicator collected it was reported the ESG rating that asks for that indicator. For example, through the analysis of the EcoVadis ESG Rating report, the indicator asking for direct GHG (scope 1) emissions was collected and listed. Then, analyzing the CDP ESG Rating report, the same indicator was asked. Therefore, for the inventory analysis of Carel's ESG Ratings the indicator asking for the direct GHG (scope 1) emissions was reported only one time, but a mark was inserted for EcoVadis and CDP, meaning that the indicator was asked by both ESG Ratings.

Table 23, reported in the appendix, lists all the indicators collected through the analysis of the ESG Ratings used by Carel.

6.2.1.3 Impact Assessment phase for Carel's ESG Ratings

The impact assessment phase in the LCMs corresponds to the quantitative impact caused by Organization activities. Some ESG Ratings ask Carel for the reporting of environmental impacts related to Group's activities. Therefore, the 7 ESG ratings used by Carel were analyzed one by one to collect and list all the indicators asking for the assessment of environmental impacts associated with Carel activities. In particular, to identify the indicators asking for the environmental impacts, the impact categories identified by the Inverter LCA study were used to understand what types of indicators are able to assess the environmental impact.

Furthermore, for each indicator in the list of impact assessment of Carel's ESG ratings, the specific ESG rating asking for that indicator was marked. For example, S&P Global ESG rating asks to report the overall water consumption at organizational level. Water consumption represents an impact category assessed

by LCMs. Therefore, the water consumption indicator was introduced in the list making up the impact assessment phase for the ESG Ratings of Carel Industries. Water consumption is also asked by Gaïa ESG Rating. Therefore, the list of indicators for the impact assessment phase applied to Carel's ESG ratings reports the water consumption indicator only one time, but it is marked for S&P Global ESG rating as well as for Gaïa ESG Rating. Table 24, reported in the appendix, represents the list of impacts asked by the 7 ESG Ratings used by Carel for the application of the impact assessment phase to the ESG ratings.

6.2.1.4 Interpretation of results phase for Carel's ESG Ratings

The interpretation of results in a LCM corresponds to the last step in which relevant aspects are identified, assumptions are discussed and conclusions are drawn. Therefore, translating this phase for Carel's ESG ratings means that the rating procedure is carried out and final results for each of the 7 ESG ratings are achieved. Particularly, the final results correspond to Carel's score referring to its sustainability performance. Therefore, from the interpretation of these scores, it is possible to identify the weakness and strengths of Carel's sustainability management plan. Thus, ESG ratings are able to provide recommendations and suggestions to improve Carel sustainability for the future. Ultimately, for the interpretation of the results phase, Carel's ESG ratings were analyzed one by one to identify those providing Carel's strengths and weaknesses in sustainability management as well as recommendations for the future. Table 25, reported in the appendix, represents the application of the interpretation of the results phase to the 7 ESG ratings used by Carel.

6.2.2 Life Cycle Model drawn for Carel Industries

A Life Cycle Model was drawn for Carel Industries, following the standardized structure and procedure defined by the ISO standards. Therefore, the four phases characterizing LCMs were considered: Goal and Scope definition, Inventory Analysis, Impact assessment and Interpretation of the results.

6.2.2.1 Goal and scope definition phase for LCM drawn for Carel Industries

The Goal and Scope definition phase was carried out considering the indications provided in the ISO standards. Therefore, for the Goal, the following elements were listed:

- the goal behind the application of the LCM (to evaluate from cradle-to-grave the environmental impacts associated with Carel Industries activities);
- the intended application of study;
- the reasons to carry out the study;
- the intended audience of the LCM study;
- a statement that the organization will not use the study in a comparative assertion;

Then, it was considered the elements that must be included in the scope of LCM applied to organization, namely Carel Industries. Particularly, the scope includes:

- organizational boundaries (operational and financial control or the equity share of the organization over the other facilities)
- the reporting unit (so the total activity of Carel during a solar year to produce its products)
- the products produced by Carel
- the unit processes (which is divided in Upstream Module, Core Module and Downstream module)
- Organization facilities sites (geographical location of the organization)
- the systems boundaries (from cradle-to-grave)
- materiality analysis

Table 26, reported in the appendix, represents all the elements included in the goal and scope definition phase for Carel Industries.

Particularly, it was necessary to define the unit processes for Carel Industries and the system boundaries. Thus, it was possible to determine the significant environmental aspects through the materiality analysis. Figure 10 summarizes the unit processes of Carel Industries, divided into the three modules (Upstream, Core and Downstream modules) as well as the material environmental aspects deemed to be significant, within the system boundary (from cradle-to-grave).

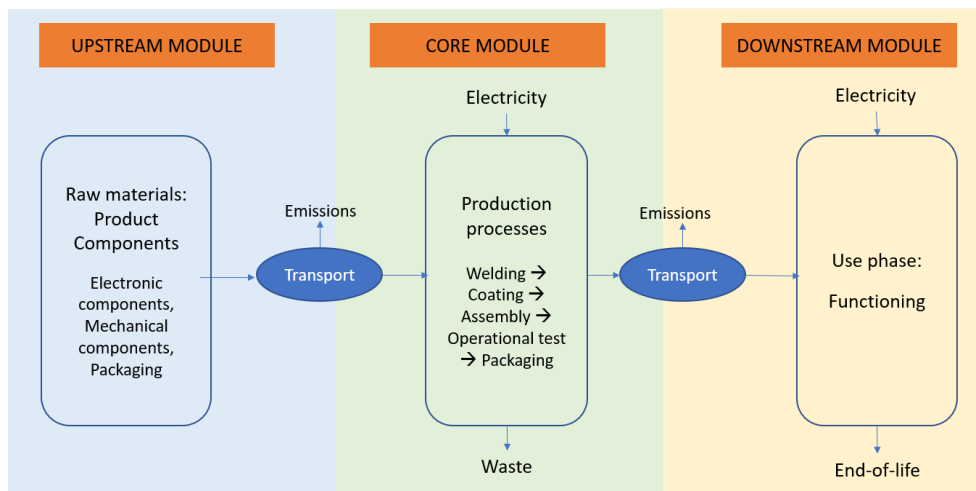


Figure 10: Representation of the unit processes, system boundaries and material environmental aspects drawn for the goal and scope definition for Carel Industries

The unit processes, system boundaries and material aspects defined for the Carel’s LCM were the same identified in the Inverter LCA study. In fact, the system drawn for the Inverter in the LCA study was not different from the one of the LCM applied to the whole Organization. Then, through the use of LCP study carried out within Carel Industries organization boundaries, the environmental

materials aspects identified by the Inverter LCA study were confirmed also at Group level. Furthermore, these material aspects were adapted to Carel's dimensions through the use of the LCP study.

Particularly, the unit processes, system boundaries and environmental material aspects must be identified to proceed to the next LCM phase, which is the Inventory Analysis. Without the definition of unit processes, system boundaries and environmental material aspects it would not be possible to determine which data has to collect the Inventory Analysis phase.

6.2.2.2 Inventory Analysis phase for the LCM drawn for Carel Industries

For the Inventory Analysis the mass and energy balances data must be collected. However, it is important to understand which data need be collected. Therefore, in the goal and scope definition phase, the unit processes, the system boundaries and the environmental material aspects were defined for Carel Industries. Thus, according to Figure 10, the Inventory Analysis collects data for the 3 Modules in which the unit processes are divided. Therefore, the indicators in the Inventory Analysis of the LCM drawn for Carel Industries ask for data regarding raw materials, the transport of raw materials, the energy use for the production processes, the production wastes, the logistics used to transport Carel's products to the main selling sites, the electricity used for the functioning of Carel's products and the end-of-life of Carel's products. It is noteworthy that the Inventory Analysis of the LCM was built from the Inventory Analysis of the Inverter LCA study. However, the indicators of the Inventory analysis of the Inverter LCA study were adapted to Carel's dimensions and boundaries using the LCP study. Table 27, reported in the appendix, lists all the indicators asked by the Inventory Analysis of the LCM drawn for Carel Industries.

6.2.2.3 Impact Assessment phase for the LCM drawn for Carel Industries

The Impact Assessment phase consists of the translation of the mass and energy balance data collected in the Inventory Analysis into the related environmental impact. As already mentioned, this phase requires the mandatory selection of impact categories, category indicators and characterization models. In

the Impact Assessment phase, the impact categories selected for Carel's LCM are the same as those reported in the Inverter LCA study, but they are adapted to assess the environmental impact of the whole Organization using the LCP study. Particularly, the selection of the impact category involves the selection of the categories indicator and the characterization factors. The impact categories selected for the application of the LCM drawn for Carel Industries are represented in Table 28, reported in the appendix.

6.2.2.4 Interpretation of the result phase for the LCM drawn for Carel Industries

The interpretation of the results consists of analyzing the results of a LCM study. In this phase 3 checks are made: completeness check, sensitivity check, consistency check. At the end of these check recommendations and future perspectives are provided. Table 29, reported in the appendix, represents the elements that the LCM drawn for Carel industries contains at the level of the interpretation of the results.

6.2.3 Matching points between Carel's ESG ratings and the LCM drawn for Carel Industries

The application of the standardized structure of LCMs to Carel's ESG ratings was not only aimed at solving the problem of ESG Ratings (caused by the lack of a standard), but also at identifying the matching points between the two systems, both applied to Carel Industries. In fact, once the structure of Carel's ESG ratings was standardized according to the structure of LCMs, it was possible to compare Carel's ESG Ratings with the LCM drawn for Carel Industries. Therefore, Goal and scope definition phase, Inventory Analysis phase, Impact Assessment phase and Result Interpretation phase of Carel's ESG ratings were compared to the respective phases in the LCM drawn for Carel Industries. By comparing the respective phases between the two systems, it was possible to find the matching points. Particularly, the matches highlight where ESG ratings can support LCM and where LCM can support ESG ratings.

Firstly, the matching points with Carel's LCM were searched and found in Carel's ESG Ratings along the four phases. It means that for all the indicators of

each phase in Carel's ESG rating it was searched for the matching indicators in the LCM. For example, considering an indicator asking for the reporting year in the Goal and Scope definition phase of Carel's ESG Ratings, it was searched for the indicators asking for the same information in the Goal and Scope definition phase of the LCM. Then, for each phase of Carel's ESG rating it was calculated the number of matching points and the percentage of matches in that phase. Furthermore, in each phase it was calculated the number of matches with Carel's LCM for each one of the 7 ESG ratings used by Carel. For Carel's ESG ratings it was also calculated the total number of matches with Carel's LCM.

Then, the matching points with Carel's ESG ratings were searched and found in Carel's LCM. As before, for all the indicators of each phase in Carel's LCM it was searched for the matching indicators in Carel's ESG Ratings. For example, considering an indicator asking for the waste reporting in the Inventory Analysis phase of Carl's LCM, it was searched for the indicators asking for the same information in the Inventory Analysis phase of Carel's ESG Ratings. Then, for each phase it was calculated the number of matches and the percentage of matches with Carel's ESG ratings. Moreover, in each phase it was calculated the number of matches with each one of Carel's ESG ratings for Carel's LCM. In the end, for the LCM drawn for Carel it was calculated the total number of matches with Carel's ESG ratings.

Chapter VII - Results and Discussion

This study investigates ESG Ratings as tools to measure the sustainability of companies, thus as sustainability metrics. In fact, these tools are able to rate companies according to the management of topics within Environmental, Social and Governance pillars, which collectively make up the sustainability of a company. However, there are many ESG Ratings available and no standards to uniform the procedure. Consequently, ESG Ratings reliability is affected by divergence, leading to different results between ratings. To overcome this problem, this paper studies the ways in which the standardized structure and procedure of Life Cycle Models can support ESG Ratings. The investigation has been applied to Carel Industries, an Italian company famous for production of control solutions and humidification systems for HVAC/R. Therefore, according to the goal of this study, the LCMs standardized structure and procedure was applied to the 7 Carel's ESG ratings. Then, a LCM was drawn for Carel Industries. In the end, the matches between the Carel's ESG Ratings (with LCM standardized structure and procedure) and the LCM (drawn for Carel) were found. Therefore, in the following chapter the results of the study are presented and discussed.

Firstly, the four phases (Goal and Scope definition, Inventory Analysis, Impact Assessment and Interpretation of the Results) characterizing the structure and procedure of LCMs were effectively applied to Carel's ESG ratings. It means that Carel's ESG Ratings respond to each of the four phases in the LCMs. In fact, it was possible to identify Goal and Scope definition, Inventory Analysis, Impact Assessment and Interpretation of the results phases in Carel's ESG Ratings. Thus, LCMs are able to support Carel's ESG Ratings, providing a standardized structure and procedure.

Then, the matching points between Carel's ESG Ratings and Carel's LCM were detected. The detection of the matching points was, firstly, carried out in Carel's ESG ratings and then in Carel's LCM along the four phases.

In the first case, the matching points between the two systems are found in Carel’s ESG ratings along all the four phases. Starting from the first phase, the Goal and Scope definition phase of Carel’s ESG Ratings presents 5 matching points with Carel’s LCM, corresponding to a percentage of matches of 29,41%. Particularly, EcoVadis and CDP are the ESG Ratings presenting the largest number of matching points with the LCM in the Goal and Scope definition phase. In fact, each one of the two ratings presents 3 matching points. Table 30 reports the matching points with the life cycle model found in Carel’s ESG ratings at the level of Goal and scope definition.

Goal and scope	Carel's ESG Ratings							Matches
Indicators	MSCI	EcoV,	CDP	S&P	Gaia	Ambienta	SustainA.	Indicators
Reporting year	x	x	x	x	x	x	x	The reporting year
Materiality analysis		x						Materiality analysis
General information on the organization			x					Organizational boundaries & the products produced by Carel
Facilities sites, around the world			x					Organization facilities sites (geographical location of the organization)
Indicators data coverage	x	x		x				the systems boundaries (from cradle-to-grave)
Total Matches	2	3	3	2	1	1	1	5

Table 30: Representation of the matching points with the LCM in the Goal and scope definition phase found in Carel’s ESG ratings

The Inventory Analysis phase of Carel’s ESG ratings presents 9 matching points with Carel’s LCM, corresponding to a percentage of matches of 1%. In this phase, Gaia ESG Rating is the one presenting the largest number of matching points with the Inventory Analysis of the LCM. In fact, Gaia ESG Rating presents 5 of the 9 matching points found in the Inventory analysis phase. Table 31 reports

the matching points with the life cycle model found in Carel’s ESG ratings at the level of Inventory Analysis.

Inventory Analysis	Carel’s ESG ratings							Matches with LCM
Indicators	MSCI	EcoV.	CDP	S&P	Gaia	Ambienta	SustainA.	Indicators
Energy consumption in the reporting year	x	x			x			Energy consumed in the reporting year
Renewable energy purchased or generated in the reporting year				x	x			Renewable energy used for the production processes
Weight of non-hazardous waste in the reporting year		x			x			Weight of non-hazardous waste from production
Waste generated in the reporting year				x				Waste produced by production processes
Percentage of waste used/ recycled/sold in the reporting year				x				The recycling rate of wastes generated by production processes
Waste used/ recycled/sold in the reporting year					x			The recycling rate of wastes generated by production processes
Weight of hazardous waste generated in the reporting year		x		x	x			Weight of hazardous waste produced by production processes
Description of 'Waste and hazardous materials management and action taken						x		Types of end of life treatment used for wastes from production
Technical information available to facilitate the treatment and recycling of electrical/electronic waste WEEE		x						Types of wastes generated by the end of life of organization's products & type of end of life treatments for organization’s products
Total Matches	1	4	0	4	5	1	0	9

Table 31: Representation of the matching points with the LCM in the Inventory Analysis phase found in Carel’s ESG ratings

The Impact Assessment phase of Carel's ESG ratings presents 7 matches with Carel's LCM, corresponding to a percentage of matches of 11,67%. In this phase, MSCI and CDP ESG Ratings are the ones presenting the largest number of matching points with the impact assessment phase of the LCM. In fact, both ESG ratings present 6 matching points found in the impact assessment phase. Table 32 reports the matching points with the life cycle model found in Carel's ESG ratings at the level of Impact Assessment.

Impact Assessment		Carel's ESG ratings							Matches with LCM	
Indicators	Unit of measure	MSCI	EcoV.	CDP	S&P	Gaia	Ambienta	SustainA.	Indicators	Unit of measure
Scope 1 emissions in the reporting year	tons of CO2eq	x	x	x	x				Global Warming	kg CO2eq to air
Scope 2 emissions in the reporting year	tons of CO2eq	x	x	x	x				Global Warming	kg CO2eq to air
Scope 3 emissions in the reporting year	tons of CO2eq	x		x		x			Global Warming	kg CO2eq to air
NOx Emissions tons in the reporting year	tons of NOx to air	x		x					Ozone formation, Human Health & Terrestrial ecosystems	kg NOx to air
SOx Emissions in the reporting year	tons of SOx to air	x		x					Terrestrial acidification	kg SO2 to air
PM quantity in the reporting year	tons of PM to air	x		x					Fine particulate matter formation	kg PM2.5 to air
Total water consumption in the reporting year	Mm ³				x	x			Water consumption	m ³ water consumed
Total Matches		6	2	6	3	2	0	0	7	

Table 32: Representation of the matching points with the LCM in the Impact Assessment phase found in Carel's ESG rating

The Interpretation of the results phase of Carel’s ESG Ratings presents 1 matching point with Carel’s LCM, corresponding to a percentage of matches of 33,33%. EcoVadis ESG rating is the one presenting the only matching point with the LCM. Table 33 reports the matching points with the life cycle model found in Carel’s ESG ratings at the level of Interpretation of the results.

Interpretation of the results	Carel’s ESG Ratings							Matches with LCM
Indicators	MSCI	EcoVadis	CDP	S&P	Gaia	Ambienta	Sustainalytics	Indicators
Provision of recommendations, suggestions		x						Future recommendations and suggestions
Total Matches	0	1	0	0	0	0	0	1

Table 33: Representation of the matching points with the LCM in the interpretation of the results phase found in Carel’s ESG ratings

Figure 10 displays the percentage of matches with Carel’s LCM found in Carel’s ESG ratings along the four phases.

Matching points with LCM in Carel's ESG Rating

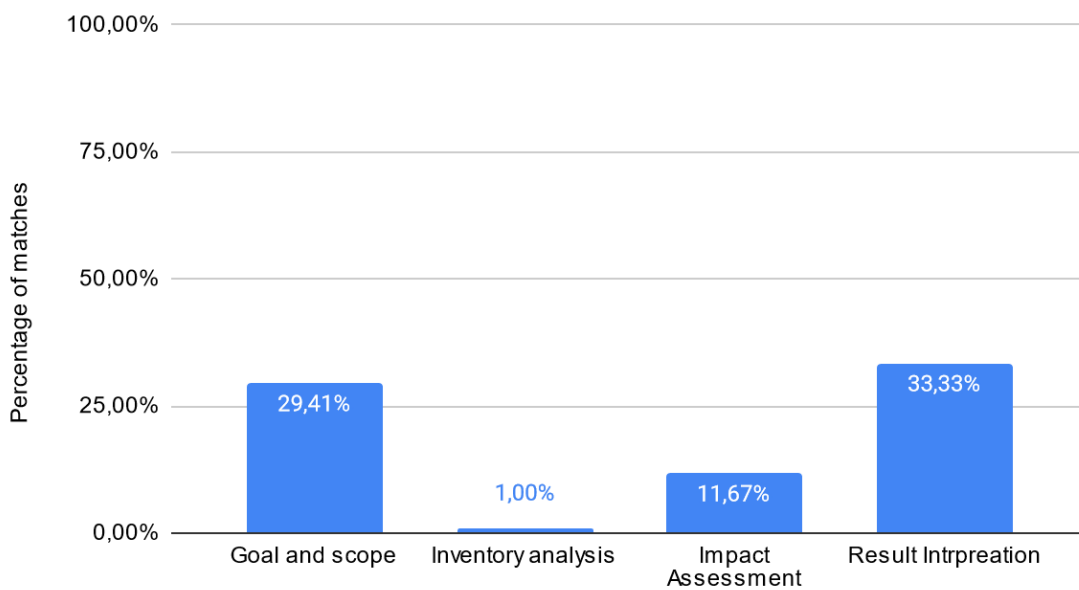


Figure 10: Percentage of Matches found in Carel’s ESG ratings along the four phases

The Interpretation of the results phase of Carel’s ESG Ratings results to be the phase that mostly matches with Carel’s LCM, corresponding to 33,33% of matches. Then according to the percentage of matches, the Goal and Scope definition phase of Carel’s ESG ratings follows the Result Interpretation phase, corresponding to 29,41% of matches. Then, the Impact Assessment phase follows the Goal and Scope definition in terms of percentage of matches, corresponding to 11,67% of matches. In the end, the Inventory Analysis phase is the one presenting the smallest percentage of matches, corresponding to 1%. Thus, Carel’s LCM supports Carel’s ESG Ratings mostly in the phase of Result Interpretation. Therefore, the Result Interpretation phase of Carel’s ESG Rating is the most supported phase by the LCM.

Ultimately, Carel’s ESG ratings presents an overall number of matches equal to 22 out of 983 indicators asked along the four phases, corresponding to an overall percentage of matches of 2,24%. Therefore, the overall support provided by Carel’s LCM to Carel’s ESG ratings is small in terms of number of matches. Table 34 summarizes the number and percentage of matching points and the percentage of matches at the phase level and at overall level.

Phase	Matches	Total indicators	Percentage of matches
Goal and Scope	5	17	29,41%
Inventory Analysis	9	903	1,00%
Impact Assessment	7	60	11,67%
Result Interpretation	1	3	33,33%
Totals	22	983	2,24%

Table 34: Representation of Carel’s ESG ratings matching points with Carel’s LCM and percentage of matches at phase and overall level

Moreover, MSCI ESG rating presents 2 matching points with Carel's LCM in the Goal and Scope phase, 1 matching point in the Inventory Analysis phase, 6 matching points in the Impact Assessment phase and 0 matches in the Result Interpretation phase. Therefore, MSCI ESG Rating provides a total number of matching points equal to 9. Particularly, MSCI ESG Rating is the one presenting the largest number of matches in the Impact Assessment phase. EcoVadis ESG Rating presents 3 matching points with Carel's LCM in the Goal and Scope phase, 4 matching points in the Inventory Analysis phase, 2 matching points in Impact Assessment phase and 1 matching point in Result Interpretation phase. Therefore, EcoVadis ESG Rating presents a total number of matches with the LCM equal to 10. Particularly, EcoVadis provides the ESG Rating with the largest number of matches in the Goal and Scope phase as well as in the Result Interpretation phase. CDP ESG Rating presents 3 matching points with Carel's LCM in the Goal and Scope phase, 0 matches in the Inventory Analysis phase, 4 matches in the Impact Assessment phase, 0 matches in the Result Interpretation phase. Therefore, CDP provides a total number of matches with Carel's LCM equal to 7. CDP is the ESG Rating presenting the largest number of matches (along with EcoVadis) with Carel's LCM in goal and scope definition. S&P Global ESG Rating presents 2 matching points with Carel's LCM in the Goal and Scope definition phase, 4 matches in the Inventory Analysis phase, 3 matches in the Impact Assessment phase and 0 matches in the Result Interpretation phase. Therefore, S&P Global ESG Rating presents a total number of matches with Carel's LCM equal to 9. Gaïa ESG Rating presents 1 matching point with Carel's LCM in Goal and Scope phase, 5 matching points in the Inventory Analysis phase, 2 matching points in the Impact Assessment phase and 0 matches in the Result Interpretation phase. Therefore, Gaïa ESG Rating presents a total number of matches with Carel's LCM equal to 8. Gaïa ESG Rating provides the largest number of matches in the Inventory Analysis phase. Ambienta ESG Approach presents 1 matching point with Carel's LCM in Goal and Scope phase as well as in the Inventory Analysis phase and 0 matches in the Impact Assessment phase and Result Interpretation phase. Therefore, Ambienta ESG Approach provides a

total number of matches with Carel’s LCM equal to 2. In the end, Sustainalytics ESG Rating presents only one match with Carel’s LCM in the Goal and Scope phase. Table 35 represents the matching points with Carel’s LCM for each ESG rating used by Carel.

Phases	MSCI	EcoVadis	CDP	S&P Global	Gaia	Ambienta	Sustainalytics
	Matches number	Matches number	Matches number	Matches number	Matches number	Matches number	Matches number
Goal and Scope	2	3	3	2	1	1	1
Inventory Analysis	1	4	0	4	5	1	0
Impact Assessment	6	2	6	3	2	0	0
Result interpretation	0	1	0	0	0	0	0
Totals	9	10	9	9	8	2	1

Table 35: Representation of number of matches with Carel’s LCM for each one of the ESG Ratings used by Carel

Therefore, EcoVadis ESG Rating provides the largest number of matches with Carel’s LCM at overall level. Furthermore, EcoVadis also presents the largest number of matching points in 2 different phases: Goal and Scope definition and Result Interpretation. Thus, according to the number of matches, EcoVadis ESG Rating is the one that can be mostly supported by Carel’s LCM.

Therefore, according to the number and percentage of matches, Carel’s ESG ratings are mostly supported by Carel’s LCM in the Interpretation of the results phase with 33,33% of matches, followed by the Goal and Scope definition phase with 29,41% of matches. The support provided by Carel’s LCM to the Impact Assessment phase of Carel’s ESG Ratings results to be weak with 11,67% of

matches. In the end, Carel's LCM provides the smallest support to the Inventory Analysis phase of Carel's ESG Ratings with only 1% of matches. Moreover, the overall support provided by Carel's LCM to Carel's ESG Ratings is quite small, corresponding to 2,24% of overall matches. Besides, the Carel's EcoVadis ESG Rating is the one that can be mostly supported by the LCM.

Matching Carel's LCM with ESG Ratings lead to different results from the ones reported above. In fact, the Goal and Scope definition phase of Carel's LCM presents 6 matching points with Carel's ESG Rating, corresponding to a percentage of matches of 46,15%. Carel's LCM presents the largest number of matches with CDP ESG Rating in the goal and scope definition phase. In fact, CDP ESG Rating matches with Carel's LCM in 4 of the 6 matching points found in this phase. Table 36 reports the matching points with Carel's ESG ratings found in the life cycle model at the level of Goal and scope definition.

Goal and Scope Definition	Matches with ESG ratings	Carel' ESG ratings						
Indicators	Indicators	MSCI	EcoV.	CDP	S&P	Gaia	Ambienta	SustainA.
Organizational boundaries	General information on the organization			x				
Reporting year	Reporting year	x	x	x	x	x	x	x
Products produced by Carel	Reporting of general information on the organization			x				
Organization facilities sites	It requires the reporting of all facilities sites around the world			x				
Systems boundaries (from cradle-to-grave)	Indicators data coverage of the indicators	x	x					
Materiality analysis	Materiality analysis		x					
Total Matches	6	2	3	4	2	1	1	1

Table 36: Representation of the matching points with the LCM in the Goal and Scope definition phase found in Carel's ESG ratings

The Inventory Analysis phase of Carel's LCM provides 9 matching points with Carel's ESG Ratings, corresponding to a percentage of matches of 34,62%. Carel's LCM presents the largest number of matches with EcoVadis ESG Rating in the Inventory Analysis phase. In fact, EcoVadis ESG Rating matches with Carel's LCM in 5 of the 9 matching points found in this phase. Table 37 reports the matching points with Carel's ESG ratings found in the life cycle model at the level of inventory Analysis.

Inventory analysis	Matches with ESG ratings	Carel's ESG ratings						
Indicators	Indicators	MSCI	EcoV.	CDP	S&P	Gaia	Ambienta	SustainA.
Energy consumed for	Energy consumption in	x	x			x		

the production processes	the reporting year							
Renewable energy used for the production processes	Renewable energy purchased or generated in the reporting year				x	x		
Weight of waste produced by production	Weight of waste generated in the reporting year				x			
Weight of hazardous waste produced by production	Weight of hazardous waste generated in the reporting year		x		x	x		
Weight of non-hazardous waste produced by production	Weight of non-hazardous waste in the reporting year		x			x		
End of life treatment for wastes generated by production	Description of waste and hazardous materials management and action taken						x	
The recycling rate of wastes generated by production	Percentage Total waste used/ recycled/sold in the reporting year				x			
The types of wastes generated by the end of life of organization's products	Technical information available to facilitate the treatment and recycling of electrical/electronic waste WEEE		x					
The type of end of life treatments for the organization's products	Technical information available to facilitate the treatment and recycling of electrical/electronic waste WEEE		x					
Total Matches	9	1	5	0	4	4	1	0

Table 37: Representation of the matching points with the LCM in the Inventory Analysis phase found in Carel's ESG ratings

The Impact Assessment phase of Carel's LCM presents 6 matching points with Carel's ESG Ratings, corresponding to a percentage of matches of 33,33%. Carel's LCM presents the largest number of matches with MSCI and CDP ESG Ratings in the Impact assessment phase. In fact, each one of the two ESG Ratings match Carel's LCM in 5 matching points. Table 38 reports the matching points with Carel's ESG ratings found in the life cycle model at the level of Impact Assessment.

Impact Assessment		Matches with ESG ratings		Carel's ESG Ratings						
Indicators	Unit of measure	Indicators	Unit of measure	MSCI	EcoV.	CDP	S&P	Gaia	Ambienta	SustainA.
Global Warming	kg CO2eq to air	Scope 1, 2 and 3 emissions in the reporting year	tons of CO2eq	x	x	x	x	x		
Ozone formation, Human Health	kg NOx to air	NOx Emissions tons in the reporting year	tons of NOx to air	x		x				
Fine particulate matter formation	kg PM2.5 to air	PM quantity in tons in the reporting year	tons of PM to air	x		x				
Ozone formation, Terrestrial ecosystems	kg NOx to air	NOx Emissions tons in the reporting year	tons of NOx to air	x		x				
Terrestrial acidification	kg SO ₂ to air	SOx Emissions in the reporting year	tons of SOx to air	x		x				
Water consumption	m ³ water consumed	Water consumption in the reporting year	Mm ³				x	x		
Total Matches		6		5	1	5	2	2	0	0

Table 38: Representation of the matching points with the LCM in the Impact Assessment phase found in Carel's ESG ratings

The Interpretation of the Results phase of Carel’s LCM provides 1 matching point with Carel’s ESG Rating, corresponding to 25%. Carel’s LCM presents only one matching point with EcoVadis ESG Rating in the Result Interpretation phase.

Interpretation of the Results	Matches with ESG ratings	Carel’s ESG Ratings							
		Indicators	Indicators	MSCI	EcoVadis	CDP	S&P	Gaia	Ambienta
Future recommendations, suggestions	Provision of recommendations, suggestions		x						
Total Matches	1	0	1	0	0	0	0	0	0

Table 39: Representation of the matching points with the LCM in the Interpretation of the results phase found in Carel’s ESG ratings

Figure 11 shows the percentage of matches with Carel’s ESG Rating for Carel’s LCM along the four phases.

Matching points with Carel's ESG Ratings in LCM

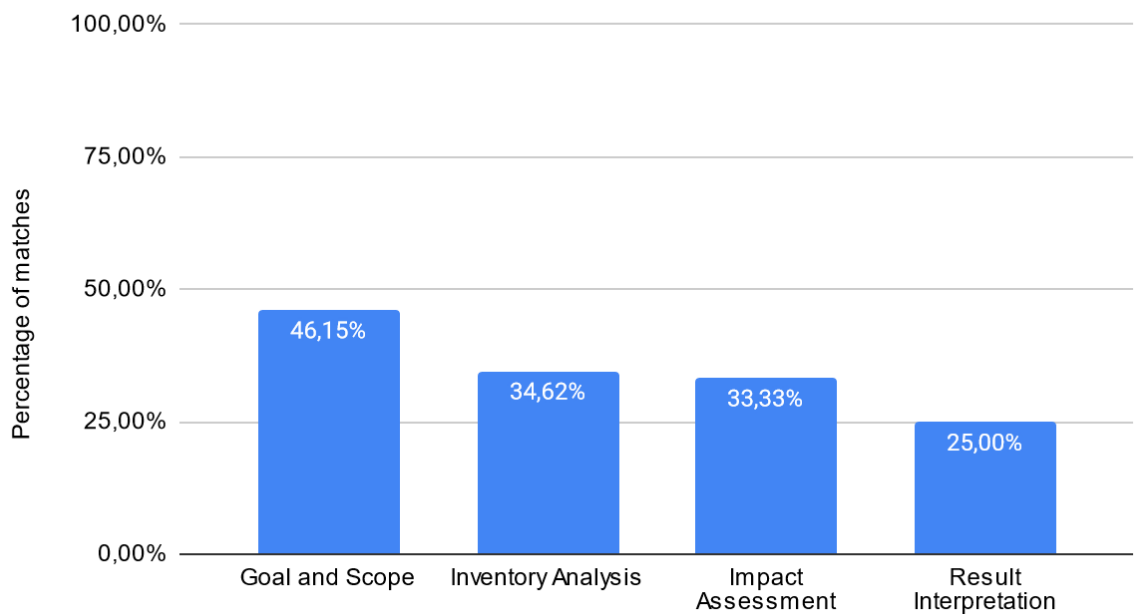


Figure 11: Representation of the percentage of matches with Carel's ESG Ratings for Carel's LCM along the four phases.

Thus, the Goal and Scope definition of Carel's LCM results to be the phase that mostly matches with Carel's ESG Rating, corresponding to a percentage of matches of 46,15%. According to the percentage of the matches, with 34,62% the Inventory Analysis of Carel's LCM follows the Goal and Scope phase. With 33,33% the Impact Assessment phase of Carel's LCM is 1,29% lower than the percentage of matches of the Inventory Analysis phase. In the end, the Result Interpretation phase of Carel's LCM is the one with the smallest percentage of matches with Carel's ESG Ratings, corresponding to 25%. Thus, Carel's ESG Ratings support Carel's LCM mostly in the Goal and Scope definition phase.

Ultimately, Carel's LCM presents an overall number of matches equal to 22 out of 61 indicators asked along the four phases, corresponding to an overall percentage of matches of 36,07%. Thus, Carel's ESG Ratings are able to provide support to Carel's LCM in terms of number and percentage of matches. Table 40 represents the matching points and the percentage of matches with Carel's ESG Rating at the phase level and at overall level.

Phases	Matches	Total indicators	Percentage of matches
Goal and Scope	6	13	46,15%
Inventory Analysis	9	26	34,62%
Impact Assessment	6	18	33,33%
Result Interpretation	1	4	25,00%
Totals	22	61	36,07%

Table 40: Representation of Carel's LCM matching points with Carel's ESG Ratings and percentage of matches at phase and overall level

Moreover, Carel's LCM presents 2 matching points with MSCI ESG Rating in the Goal and Scope phase, 1 matching point in the Inventory Analysis phase, 5 matches in the Impact assessment phase and 0 matches in the Result Interpretation. Therefore, Carel's LCM presents an overall number of matching points with MSCI ESG Rating equal to 8. Carel's LCM presents the largest number of matches in the Impact Assessment phase. Carel's LCM provides 3 matches with EcoVadis ESG Rating in the Goal and Scope definition phase, 5 matches in the Inventory Analysis phase, 1 match in the Impact Assessment phase and 1 match in the Result Interpretation phase. Therefore, Carel's LCM provides an overall number of matches with EcoVadis ESG rating equal to 10. Carel's LCM presents the largest number of matching points with EcoVadis in the Inventory Analysis phase as well as in the Result Interpretation phase. Carel's LCM presents 4 matches with CDP ESG Rating in the Goal and Scope definition phase, 0 matches in the Inventory Analysis phase, 5 matches in the Impact Assessment phase and 0 matches in the result Interpretation phase. Therefore, Carel's LCM presents an overall number of matches with CDP ESG Rating equal to 9. Carel's LCM provides the largest number of matching points with CDP ESG Rating in the Goal and Scope phase as well as in the Impact Assessment. Carel's LCM provides 2 matches with S&P Global ESG Rating in the Goal and Scope phase, 4 matches in the Inventory Analysis phase, 2 matches in the Impact Assessment phase and 0 matches in the Result Interpretation phase. Therefore, Carel's LCM presents an overall number of matches with S&P Global ESG Rating equal to 8. Carel's LCM presents 1 matching point with Gaïa ESG rating in the Goal and Scope phase, 4 matches in the Inventory Analysis, 2 matches in the Impact Assessment phase and 0 matches in the Result Interpretation phase. Therefore, Carel's LCM provides an overall number of matches with Gaïa ESG rating equal to 7. Carel's LCM presents 1 match with Ambienta ESG Approach in the Goal and Scope phase, 1 match in the Inventory Analysis phase and 0 matches both in the Impact Assessment phase and Result Interpretation phase. Therefore, Carel's LCM provides an overall number of matches with Ambienta ESG Approach equal to 2. In the end, Carel's LCM provides 1 match with Sustainalytics in the Goal and Scope definition phase and 0 matches in Inventory

Analysis, Impact Assessment and Result Interpretation phases. Therefore, Carel’s LCM provides an overall number of matches with Sustainalytics equal to 1. Table 41 represents the matching points with each ESG Rating used by Carel for Carl’s LCM.

Phase	MSCI	EcoVadis	CDP	S&P Global	Gaia	Ambienta	Sustainalytics
	Matches number	Matches number	Matches number	Matches number	Matches number	Matches number	Matches number
Goal and Scope	2	3	4	2	1	1	1
Inventory Analysis	1	5	0	4	4	1	0
Impact Assessment	5	1	5	2	2	0	0
Result Interpretation	0	1	0	0	0	0	0
Totals	8	10	9	8	7	2	1

Table 41: Representation of number of matches with each Carel’s ESG rating for Carel’s LCM

Therefore, Carel’s LCM presents the largest number of matches with EcoVadis ESG Rating at overall level, but the LCM also provides the largest number of matches with EcoVadis ESG rating in the Inventory Analysis and in the Result Interpretation phases. Thus, EcoVadis is Carel's ESG Rating that can mostly support Carel’s LCM, according to the number of matches.

Therefore, according to the number of matches Carel’s LCM is mostly supported by Carel’s ESG Ratings in the Goal and Scope definition phase with 46,15% of matches, followed by the Inventory Analysis phase with 34,62% of matches and the Impact Assessment phase with 33,33% of matches. In the end, Carel’s ESG Ratings provides the smallest support to the Interpretation of the

Results phase of Carel's LCM with 25% of matches. Moreover, the overall support provided by Carel's ESG Ratings to Carel's LCM corresponds to 36,07% of overall matches. Besides, Carel's EcoVadis ESG Rating is the one that can mostly support Carel's LCM, according to the overall number of matches.

The results of this study shows that Carel's LCM, thanks to its standardized structure and procedure, is a sustainability metric able to support Carel's ESG Ratings. Therefore, this has been proved within Carel boundaries and not at general level. Thus, further investigations should be carried out in other companies in order to verify the results of this study. However, these further investigations should be carried out with the same methods reported in this study. Presumably, further investigation should lead to the same results of this study.

Moreover, this study proves that Carel's LCM can support Carel's ESG ratings not only in the structure and procedure, but also in the request of information such as indicators, elements and aspects faced by the two systems. However, in this latter case Carel's ESG Ratings result to be more supporting for the LCM rather than the support provided by Carel's LCM to the ESG Ratings. In fact, when Carel's ESG Ratings are used to support Carel's LCM, the goal and scope definition phase presents a percentage of matches of 46,15%, which is nearly 1,6 times higher than the percentage of matches when the LCM is used to support Carel's ESG ratings (29,41%). The same comparison can be done in the other phases. The Inventory Analysis, when Carel's ESG ratings are used to support Carel's LCM , presents a percentage of matches of 34,62%, which is 34,62 times higher than percentage of matches when the LCM is used to support Carel's ESG Ratings (1%). Again, the impact assessment phase in the case in which Carel's ESG ratings are used to support the LCM, presents a percentage of matches of 33,33%, which is nearly 3 times higher than the percentage of matches when Carel's LCM is used to support the ESG Ratings (11,67%). In the end, the Result Interpretation phase, when Carel's ESG ratings are used to support the LCM, presents a percentage of matches of 25%, which is nearly 1.3 times lower than the percentage of matches when Carel's LCM is used to support the ESG ratings

(33,33%). Thus, when Carel's ESG ratings are used to support the LCM, the percentage of matches is higher in 3 of the 4 phases compared to the case in which Carel's LCM is used to support the ESG Ratings. Thus, Carel's ESG Ratings provide a broader support to the LCM compared to the support provided by Carel's LCM to the ESG Ratings. This is proven also by the percentage of matches when Carel's ESG ratings are used as supporting tools. In fact, when Carel's ESG ratings are used as supporting tools, the percentage of matches is 36,07%, whereas when Carel's LCM is used as the supporting tool, the percentage of matches is 2,24%. This difference is due to the fact that the set of indicators, elements and aspects used across the three pillars of Carel's ESG Ratings is huge compared to the one of Carel's LCM. Therefore, along the four phases Carel's ESG Ratings cover more aspects, elements and indicators of the LCM compared to the ability of Carel's LCM to cover elements, aspects and indicators of the ESG Ratings. This situation is clearly visible in the Inventory Analysis phase. In fact, the Inventory Analysis phase of Carel's ESG Ratings is composed of 903 (Table 23 in the appendix) indicators, whereas the Inventory Analysis of Carel's LCM consists of 26 indicators (Table 27 in the appendix). Therefore, when it comes to use Carel's LCM to support ESG ratings, the matches are found in the set of 903 indicators of ESG Ratings using the 26 indicators of LCM. On the other hand, when it comes to use Carel's ESG ratings to support LCM, the matches are found in the set of 26 indicators using the 903 indicators of Carel's ESG ratings.

It is noteworthy that EcoVadis ESG Rating is the rating with the largest number of matches both in the case that Carel's LCM is used to support the ESG Ratings and in the case that Carel's ESG Ratings are used to support the LCM. This is probably due to the broad coverage of EcoVadis ESG Rating across the three pillars. In fact, this ESG Rating is not very detailed in the request of information, but it covers many themes of sustainability.

In conclusion, this study investigates the ways in which LCMs and ESG Ratings can support one another within the boundaries of Carel Group. This investigation demonstrates that Carel's LCM can be a supporting tool for Carel's

ESG Ratings, providing them with a standardized structure and procedure. In fact, the ESG Ratings used by the Group responds to the 4-phase structure, typical of LCMs. Furthermore, this paper shows that the LCM drawn for Carel can support Company's ESG Ratings in the request of information. In fact, there are matching points between the two systems, meaning that some indicators are present both in the LCM and ESG Ratings of Carel. However, regarding the matching points between the two systems, the study shows that the support provided by Carel's ESG Rating to the LCM is greater than the support provided by Carel's LCM to the ESG Ratings. This is due to the great coverage of ESG Ratings. In the end, EcoVadis ESG Rating results to be the one with the largest number of matching points both in the case that Carle's LCM is used to support ESG Ratings and in the case that Carel's ESG Ratings are used to support LCM.

Chapter VIII - Conclusions

The last decades have been marked by an increasing attention towards sustainability and environmental topics. In fact, the linear economic model has been recently replaced by the circular economic model. Circular economy is a model aimed at promoting sustainable development, in which the development is conceived in harmony with the environment. Therefore, a key factor in sustainable development is to operate within the planet's boundaries. Therefore, many actions and measures, also at the political level, have been taken to promote sustainability. At European level, the EU Commission is very committed to the issuing of plans, programs, directives and regulations, all driven by sustainability. Particularly, the EU Commission promotes the shifting of investments towards activities deemed to be sustainable. Therefore, sustainability has also changed the way of investing. As a matter of fact, nowadays investors funnel investments in companies that manage their sustainability. Moreover, the European Commission issued the CSR Directive, which requires companies to report on their sustainability. Therefore, companies have to report their sustainability performance. Particularly, the sustainability of a company is made up of three pillars: Environmental, Social and Governance (ESG) pillars. Tools able to measure the sustainability performance of companies are needed. These tools are ESG Ratings, which rate companies according to the management of ESG issues.

The fact that ESG Ratings measure sustainability performance of companies makes them environmental sustainability metrics, meaning that ESG rating provides a quantitative measure of companies' sustainability. However, there are too many ESG Ratings and no one standard is available. This feature causes divergence among ESG Ratings, which leads to different final results from one rating to another.

Therefore, the study proposes Life Cycle models to overcome the inaccuracies of ESG Ratings. Thus, the study investigates how LCMs support ESG Ratings as well as how ESG Ratings support Life Cycle Model.

The investigation is carried out within the boundaries of Carel Industries. Thus, the study investigates how Carel's LCM and ESG ratings support one another.

After analyzing Carel's ESG ratings, which confirmed the issue of divergence, the standardized structure of LCM was applied to ESG Ratings of Carel Industries. Therefore, the four phases of LCMs were built in Carel's ESG ratings. The results show that the ESG ratings used by the Group positively respond to the four-phase-standardized structure adopted by LCMs. Therefore, LCM standardized structure and procedure supports Carel's ESG ratings.

Then, a Life Cycle model was drawn for Carel Industries, encompassing all the four phases. This model was used to find the matches with Carel's ESG ratings. In particular, according to the percentage of matches, it was possible to determine the support provided by Carel's LCM to the ESG ratings across the four phases. However, in this case the results demonstrate that LCM does not provide a strong support to Carel's ESG ratings across the four phases. On the other hand, Carel's ESG Ratings across the four provide stronger support to the LCM. In fact, when Carel's ESG ratings were used to find the matches with the LCM, the percentage of matches were greater than the previous case, in which Carel's LCM was used to find the matches in the ESG ratings. Ultimately, Carel's ESG Ratings across the four phases provide stronger support to LCM compared to the support provided by Carel's LCM to ESG ratings.

In conclusion, the increasing attention towards sustainability has stressed the development of sustainability metrics, able to measure sustainability. ESG ratings are tools specialized in the evaluation of companies' sustainability performance through the adoption of a holistic approach. However, the excessive number available of these systems and the lack of standards make them not very reliable, especially for the final results. Thus, in this study, the standardized structure and procedure of LCM models have been used to overcome this problem, investigating how LCM and ESG ratings can support one another. The investigation was carried out within Carel industries boundaries. The results of

this study show that the life cycle model drawn for Carel Industries can support the ESG ratings of the Group, providing them with a standardized structure and procedure. Furthermore, this paper demonstrates that the ESG Ratings used by Carel can support the LCM drawn for the Company across the four phases in a stronger way compared to the support provided by the LCM to the ESG ratings.

Appendix

Table 7: Schematization of scoring categories and Indicators topics and number of indicators selected for Carel Industries by CDP ESG Rating - Climate Change in the Environmental Pillar

CDP ESG Rating	
Environmental Pillar	
Scoring category	Indicators topics
Risk Management processes	Climate-related risk assessment and opportunities
	Climate-related risks with substantive financial impact
Targets	Emissions reduction targets
	Description of the climate-related emission reduction target
Scope 1 & 2 emissions	Scope 1 and 2 emissions reporting
	Standard used for the reporting
	Changes affecting the reporting
	Breakdown of scope 1 and 2 emissions
Scope 3 emissions	Reporting of scope 3 emissions
Additional climate related metrics	Reporting of other climate-related metrics measured
Business Strategy, Financial Planning and Scenario Analysis	Transition plan aligning with 1.5 C° world goal
	Description of climate-related scenario analysis
	Influence of the climate risks on business strategy and financial plan
Carbon pricing	Carbon pricing system for the organization's operations
	Use of internal carbon pricing
Verification	Verification Scope 1, 2 and 3
	Verification of other climate-related information
	Verification of data points disclosed in CDP and standards used

Opportunity Disclosure	Climate-related opportunities with substantive financial impact
Energy	Energy consumption activities
	Energy consumption reporting
	Fuel consumption for energy consuming activities and reporting
	Near-zero emissions energy
Emissions reductions Initiatives and low carbon products	Emission reduction initiatives and reporting of initiatives emission savings
	Low carbon products and investments in R&D
Total Indicators	121

Table 10 - Schematization of criteria and Indicators topics selected and the number of indicators for Carel Industries by S&P Global CSA ESG Rating in the Environmental Pillar

S&P Global CSA ESG Rating	
Environmental Pillar	
Criteria	Indicators topics
Climate-Related Targets	Emission reduction targets and reporting
Direct Greenhouse Gas Emissions (Scope 1)	Reporting of Scope 1 emissions, reliable and auditable
Indirect Greenhouse Gas Emissions (Scope 2)	Reporting of Scope 2 emissions, reliable and auditable
Scope 3 GHG Emissions	Most relevant scope 3 sources and explanation
Climate Change Strategy	Climate-related risk assessment
Volatile Organic Compounds Emissions	Reporting of VOC emissions, reliable and auditable
Water Consumption	Reporting of water data
Coverage of Environmental Management Policy	Public availability of environmental policies

Environmental Violations	Fines in the last fiscal years
EMS: Certification/Audit/Verification	Certification/Audit/verification of Environmental Management System and its coverage
Waste Disposal	Reporting of total waste produced, disposed and recycled
Hazardous Waste	Hazardous waste reporting
Energy Consumption	Reporting of energy consumption and energy sources
Product Design Criteria	Environmental criteria for the development of products
Low-Carbon Products	Low carbon products and avoided third party emissions products
Open Innovation	Approaches to contribute to external knowledge with R&D
Product Innovations	Reporting of revenues generated by product innovation
Process Innovations	Company's process innovation with supporting evidences
Life Cycle Assessment	Impacts covered by LCA
	Products assessed with LCA
Environmental Reporting — Coverage	Coverage of environmental indicators reported
Environmental Reporting — Assurance	Assurance received for the environmental reported data
Total Indicators	216

Table 11 - Schematization of criteria and Indicators topics and the number of indicators selected for Carel Industries by S&P Global CSA ESG Rating in the Social Pillar

S&P Global CSA ESG Rating	
Social Pillar	
Criteria	Indicators topics
Lost-Time Injury Frequency Rate (LTIFR) – Employees	Reporting of LTFIR for companies employees
Fatalities	Reporting of fatalities happened in the organization
Training & Development Inputs	Reporting of training and development data for employees
Employee Development Programs	Development programs addressed to employees
Human Rights Commitment	Policies to respect human rights public available
Human Rights Due Diligence Process	Due diligence for the identification of human rights risks
Human Rights Mitigation & Remediation	Public availability of human rights mitigation and remediation
Workforce Breakdown: Gender	Reporting of workforce broken down by gender
Gender Pay Indicators	Reporting of gender pay gap or equal pay
Customer Satisfaction Measurement	Targets to improve customer satisfaction
	Targets result communicated externally
Online Strategies & Customers Online	Reporting of online solution/sales and online revenues
Quality Management & Audits of Distribution Networks	Quality Management System for the compliance with customer standards
Lost-Time Injury Frequency Rate (LTIFR) – Contractors	Reporting of LTIFR for contractors

Freedom of Association	Reporting of employees covered by trade unions
Supplier Code of Conduct	Public availability of supplier code of conduct
Trend of Employee Engagement	Reporting of engaged employees
Type of Individual Performance Appraisal	Coverage for the individual performance appraisal
Social Reporting — Coverage	Coverage of the social indicators reported
Social Reporting — Assurance	Assurance received for the social indicators reported
Corporate Citizenship Strategy	Strategies for guide corporate citizenship/ philanthropic activities
Philanthropic Contributions	Total monetary contributions dedicated for corporate citizenship/ philanthropic activities
Total Indicators	224

Table 12 - Schematization of criteria and Indicators topics and the number of indicators selected for Carel Industries by S&P Global CSA ESG Rating in the Governance Pillar

S&P Global CSA ESG Rating	
Governance Pillar	
Criteria	Indicators topics
Board Structure	Board structure and reporting of executive and non-executives
Non-Executive Chairperson/Lead Director	Presence of non-executive and independent chairperson
Board Diversity Policy	Policies publicly available for the board diversity
Board Effectiveness	Reporting of board effectiveness (meetings, mandates, etc...)
Board Average Tenure	Average tenure of board members
Board Industry Experience	Boards members with experience in the industry of interest
Risk Governance	Risk appetite & tolerance and risk monitoring & reporting

CEO Compensation — Success Metrics	Metrics for CEO variable compensation
Contributions & Other Spending	Contribution to political campaigns, lobbying activities, etc...
Management Ownership	Company shares hold by CEO and other executive
Management Ownership Requirements	Requirements for company's specific stock ownership
Government Ownership	Voting rights for government institutions and Golden shares
Family Ownership	Family members owns more than 5% of voting rights
Dual Class Shares	Shares available for voting category
Corruption & Bribery	Anti-corruption and bribery policies
Reporting on Breaches	Reporting of breaches against company's code of conduct
Codes of Conduct	Aspects covered by the company's codes of conduct
Privacy Policy: Systems/ Procedures	Effectiveness of company's privacy policy
Customer Privacy Information	Customer privacy protection issues communicated
Breaches of Customer Privacy: Complaints	Reporting of breaches of customer privacy
Critical Supplier Identification	Identification and reporting of critical supplier
Supply Chain Risk Exposure	Risk assessment in the supply chain
Supplier Risk Management Measures	Measures to overcome risks in the supply chain
ESG Integration in SCM Strategy	ESG priorities in the supply chain and their integration
Supply Chain Transparency & Reporting	Public available aspects in the supply chain
Conflict Minerals	Policies for conflict minerals
Effective Tax rate	Reporting of the tax rate and explanation of the trend
Total Indicators	84

Table 22 - Schematization of the information asked by Carel's ESG ratings for the application of Goal and Scope definition phase

Goal and Scope definition phase for ESG Ratings								
Carel's ESG Ratings								
	Indicators	MSCI	EcoVadis	CDP	S&P Global	Gaia	Ambienta	Sustainalytics
1	Assessment of Carel's sustainability management in order to rate the Group among other companies or among its peers.	x	x	x	x	x	x	x
2	Currency in which monetary data are disclosed			x	x			
3	Reporting year	x	x	x	x	x	x	x
4	1 year before the reporting year	x		x	x			
5	2 years before the reporting year	x		x	x			
6	3 years before the reporting year	x		x	x			
7	Consolidated turnover				x			
8	Total number of employees				x			
9	Adhesion to UN Global Compact		x			x		
10	Adhesion to Science Based Targets		x	x				
11	Presence of third party verification for sustainability indicators	x	x		x			
12	The indicators are aligned with a national or international reporting standard		x					
13	Presence of a materiality analysis		x					

14	Provision of progress made towards SDGs		X			X		
15	Reporting of general information on organization			X				
16	Reporting of all facilities sites, around the world			X				
17	Data coverage of the indicators	X	X		X			

Table 23 - List of indicators asked by each ESG Rating adopted by Carel for the application of Inventory analysis phase

Inventory Analysis for Carel's ESG ratings								
Carel's ESG Ratings								
Theme	Indicator topics	MSCI	EcoV.	CDP	S&P	Gaia	Ambienta	SustainA.
Atmosphere	Scope 1,2,3 emission reporting and verification	X	X	X	X	X		X
	GHG management, risk and opportunities and targets	X	X	X	X	X	X	X
	Carbon pricing			X				
	Toxic emissions reporting			X	X		X	
Water	General info on water data				X		X	X
	Water Targets and goals						X	
Biodiversity	Biodiversity					X		
Energy	Energy reporting data	X	X	X	X	X		
	Energy consumption management	X	X		X	X		
Product	Environmental criteria used for product development	X	X		X	X		X

	Studies on environmental impact of products		x		x			
	Open Innovation, Process Innovation, Product Innovation and low-carbon products	x		x	x			
	Conflict minerals policies and reporting		x		x			
Waste	Hazardous and non-hazardous Waste reporting		x		x	x		
	Waste management and targets		x				x	x
Environmental Practices/Policies /Certifications	Environmental Management System, policies and certifications	x			x	x		x
	Environmental penalties data				x			x
Health and Safety	Health and Safety reporting	x	x		x	x		x
	Health and Safety risk, management, policies and Certification	x	x		x	x		
	Health and Safety Contractors policy	x	x					
	Product/Service Health and Safety							x
Labor Management	Labor Management reporting	x			x	x		
	Labor Certification		x					
Working Conditions	Working hours, vacation, rest		x					
	Services for employees, compensation	x	x		x	x	x	

	Training and employee development program		x		x			
Human Rights	General Human rights management		x		x			x
	Child Labor, Forced Labor, Human Trafficking, Discrimination and harassment		x		x			x
	Freedom of association, Collective Bargaining and Trade Unions	x	x		x	x		x
	Workforce composition		x		x	x		x
Customer, Supplier and Distributor	Customer satisfaction				x	x		
	Supplier social practices and reporting, Supplier code of conduct and critical supplier		x		x	x	x	x
	Distribution network				x	x		x
Engagement	Value chain engagement		x	x				
	Policy, Law, Regulation engagement			x	x			
	Employee Engagement				x			
Social Reporting	Social reporting and Corporate strategy and Philanthropic Contributions				x	x		x
	Corporate Code of Conduct	x			x	x		
Board	Board of Directors, election system, executive and non-executive/independent directors	x		x	x	x	x	x

	Risk Governance	x			x	x		
	Audit and pay Committee	x				x		x
Pay	Pay for the Executives and non-executives	x		x	x	x		
	Pay for the Board and Audit Board	x				x		
Ownership/Control	Ownership and Control	x			x	x		
Ethics	Business ethics policies and reporting	x	x					
	Bribery and Corruption and other business ethics topics	x	x		x	x		x
Responsible Information	Responsible information reporting and management and customer responsible information management		x		x	x		
Taxes	Taxes reporting	x			x			
	Auditors Fee	x				x		
Total Indicators	903							

Table 24 - Representation of the impacts asked by ESG Ratings adopted by Carel for the application of the impact assessment phase

Impact Assessment phase of Carel's ESG Ratings								
Carel's ESG Ratings								
Category	Indicator topics	MSCI	EcoV.	CDP	S&P	Gaia	Ambienta	SustainA.
Scope 1 emission reporting	Total scope 1 emissions in the reporting year, 1 year before, 2 years before and 3 years before	x	x	x	x			

Scope 2 emission reporting	Total scope 2 emissions in the reporting year, market based emission and location based	x	x	x	x			
	Total scope 2 emissions 1 year before the reporting year, market based and location based	x	x	x	x			
	Total scope 2 emissions 2 years before the reporting year, market based and location based	x	x	x	x			
	Total scope 2 emissions 3 years before the reporting year, market based and location based	x	x	x	x			
Scope 3 emission reporting	Total Scope 3 emissions in the reporting year, for each category of GHG protocol, 1 year before, 2 years before and 3 years before	x	x	x	x	x		
Toxic emissions reporting	NOx Emissions tons in the reporting year an intensity, 1 year before, 2 years before	x		x				
	SOx Emissions in the reporting year, intensity, 1 year before and 2 years before	x		x				
	PM quantity in tons in the reporting year, 1 year before, 2 years before	x		x				
	VOC Emissions in the reporting year, intensity, 1 year before, 2 years before and 3 years before	x		x	x			
Water reporting data	Total water withdrawals, discharges and consumption in the reporting year, 1 year before, 2 years before and 3 years before		x		x	x		
Total Indicators	60							

Table 25 - Representation of the Carel’s ESG ratings providing a result interpretation for the application of interpretation of the results phase

Interpretation of the results phase applied to Carel's ESG Ratings								
	Indicators	MSCI	EcoV.	CDP	S&P	Gaia	Ambienta	SustainA.
1	Weakness of Organization's sustainability performance	x	x			x		
2	Strengths of Organization's sustainability performance	x	x			x		
3	Provision of recommendations, suggestions		x					

Table 26 - Representation of the goal and scope definition phase for the LCM drawn for Carel Industries

Goal and Scope definition phase for LCM		
1	Goal	The goal is to evaluate Carel's environmental impact
2		The intended application of the study
3		reasons to carry out the study
4		Intended audience
5		Presence of a statement that the organization will not use the study in a comparative assertion
6	Scope	Organizational boundaries (financial and operational control vs. equity share of Organization over the other facilities)
7		Reporting unit (so the total activity of Carel during a solar year to produce its products)
8		Reporting year
9		Products produced by Carel
10		Unit processes (which is divided in Upstream Module, Core Module and Downstream module)
11		Organization facilities sites (geographical location of the organization)

12		Systems boundaries (from cradle-to-grave)
13		Materiality analysis

Table 27 - Representation of the indicators asked by the Inventory Analysis phase for the LCM drawn for Carel Industries

Inventory analysis for LCM		
UPSTREAM MODULE		
	Indicators	Unit of measurement
	Raw materials	
1	Type of Raw materials entering the organization	-
2	Material used for each component	-
3	Quantities of components purchased	numeric field
4	Weight of each component	g
	Transport	
5	The sites from which the components are sent (suppliers sites)	-
6	The average distance from supplier sites	km
7	The type of transport used	Truck, Railway, Ship, Airplane
8	The number of travels made in the reporting year	numeric field
CORE MODULE		
	Indicators	Unit of measurement
	Energy	
9	Total amount of energy consumed for the production processes	MWh
10	Amount of renewable energy used for the production processes	MWh
11	Different sources of renewable energy mix	%
	Waste	
12	Total amount of waste produced by production processes	metric tons
13	Total amount of hazardous waste produced by production processes	metric tons
14	Total amount of non-hazardous waste produced by production processes	metric tons
15	Types of different end of life treatment used for wastes generated by production	-

	processes	
16	Amount of wastes sent to each different End of life treatment	metric tons
17	The recycling rate of wastes generated by production processes	%
DOWNSTREAM MODULE		
Indicators		Unit of measurement
Logistics		
18	The main countries in which organization's products is sent and sold	-
19	The weight of organization's products sent to the main selling countries	kg
20	The average distance between the production site and the selling point	km
21	The type of transport used	Truck, Railway, Ship, Airplane
Use phase		
22	The total amount of energy consumed by organization's products while functioning	kWh
23	The mix of energy used when organization's products is functioning	%
End of life		
24	The lifetime of organization's products	y
25	The types of wastes generated by the end of life of organization's products	-
26	The type of end of life treatments used for the wastes generated by the end of life of organization's products	-

Table 28 - Representation of the impact categories, category indicators and characterization factors for the Impact assessment phase in the LCM drawn for Carel Industries

LCM				
Impact Assessment phase				
	Impact category Name	Indicator name	Characterization factor name	Unit of measure
1	Global Warming	infrared radiative forcing increase	global warming potential	kg CO ₂ eq to air
2	Stratospheric ozone depletion	stratospheric ozone decrease	ozone depletion potential	kg CFC 11 to air
3	Ionizing radiation	absorbed dose increase	ionizing radiation potential	kBq CO 60 to air
4	Ozone formation,	tropospheric ozone population	Photochemical oxidant	kg NO _x to air

	Human Health	intake increase (M6M)	formation potential: humans	
5	Fine particulate matter formation	PM 2.5 population intake increase	particulate matter formation potential	kg PM2.5 to air
6	Ozone formation, Terrestrial ecosystems	tropospheric ozone increase (AOT40)	Photochemical oxidant formation potential: ecosystems	kg NOx to air
7	Terrestrial acidification	Proton increase in natural soils	terrestrial acidification potential	kg SO2 to air
8	Freshwater eutrophication	Phosphorus increase in freshwater	freshwater eutrophication potential	Kg P to fresh water
9	Marine eutrophication	dissolved inorganic nitrogen increase in marine water	marine eutrophication potential	kg N to marine water
10	Terrestrial ecotoxicity	hazard weighted increase in natural soils	terrestrial ecotoxicity potential	kg 1,4-DCB to industrial soil
11	Freshwater ecotoxicity	hazard weighted increase in freshwater	freshwater ecotoxicity potential	kg 1,4-DCB to fresh water
12	Marine ecotoxicity	hazard weighted increase in marine water	marine ecotoxicity potential	kg 1,4-DCB to marine water
13	Human carcinogenic toxicity	risk increase of cancer disease incidence	human toxicity potential	kg 1,4-DCB to urban air
14	Human non carcinogenic toxicity	risk increase of non-cancer disease incidence	human toxicity potential	kg 1,4-DCB to urban air
15	Land use	occupation and time integrated transformation agricultural	land occupation potential	m2yr annual crop land
16	Mineral resource scarcity	ore grade decrease	surplus ore potential	Kg Cu
17	Fossil resource scarcity	upper heating value	fossil fuel potential	kg oil
18	Water consumption	increase of water consumed	water consumption potential	m3 water consumed

Table 39 - Representation of result interpretation phase for the LCM drawn for Carel Industries

Carel's LCM	
	Result Interpretation
1	Completeness check
2	Sensitivity check
3	Consistency check
4	Future recommendations, suggestions

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