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# Social Life Cycle Assessment: a literature overview and an application in the textile sector

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# Table of contents

## Abstract

Companies are more and more interested in the sustainability character of products, services and processes and, for this reason, appropriate and suitable assessment tools supporting the transition to a green economy are highly necessary. Currently, there are a number of methods and approaches for assessing products' economic, environmental and social impact and for improving their sustainability performances; among these, the Life Cycle Thinking (LCT) approach emerged as the most useful and effective to reach sustainability goals. Indeed, LCT aims to reduce a product's resource use and emissions to the environment as well as to improve its socio-economic performance through its whole life cycle. LCT is made operational through Life Cycle Management (LCM) that is a management approach that puts the tools and methods of the LCT basket into practice. Many different tools are basic elements of LCM, but Life Cycle Assessment (LCA), Life Cycle Costing (LCC) and Social Life Cycle Assessment (S-LCA) are undoubtedly the most appreciated to assist product-related decision-making activities, from the extraction and processing of raw materials, manufacturing, distribution, use, reuse, maintenance, recycling and final disposal. LCA is already an internationally standardized tool (ISO 14040:2006 and ISO 14044:2006), on the contrary LCC and S-LCA still lack of international standardization (even if guidelines and general frameworks are available) and, especially S-LCA is still in the experimental stages for many aspects of its methodological structure.

Considering that the S-LCA is still in its infancy, an analysis of this assessment tool is a useful starting point for a detailed description of the current situation and of the degree of advancement of the general theory on the subject and, in particular, on the various approaches and tools applied.

Indeed, in recent years several different methods towards S-LCA have been developed.

In this thesis a literature overview of S-LCA is presented. The overview has been carried out using two level of analysis: a bibliometric analysis in order to highlight the role and impact of S-LCA studies within the scholarly communities and, a critical analysis in order to show methodological differences and needs for future development of S-LCA.

Finally, the findings of the literature review will be the key elements from which starting an applicative analysis. In particular, considering that S-LCA makes use of generic and site-specific quantitative, semi-quantitative and qualitative data, and that it complements the environmental LCA and LCC, the S-LCA method (extended with LCA analysis) will be applied to selected a product of a textile factory, "San Lorenzo Group", located in San Marco D'Alunzio (Messina), in order to point verify its applicability and the potentiality to integrate its results into the company decision-making process.

# Introduction

## 1.1 Highlighting the context of analysis

In the last years, one of the most influential argument at the academic and political levels is on how limiting human negative effects on the planet[1]; but today, the global society has suffered a paradigm change from a main focus on environmental preservation to a general concept of sustainability.

Sustainability does not only concentrate on the environmental impact, in fact, it is formed by three dimensions, the "*environmental*", the "*economic*", and the "*social*" ones, for which society needs to find an equilibrium.[2]

In the past the economic development and the environment were considered as independent problems, but nowadays the international community agreed to manage the two elements in a mutually beneficial way and this is the fundamental issue connected to the concept of sustainable development.[3]

Recently, in 2015, the United Nations approved the Global Sustainable Development Agenda, called Agenda 30, and its 17 Sustainable Development Goals (SDGs), articulated in 169 targets to be achieved by 2030. It is an event historical, from different points of view. Indeed, the SDGs underline the importance (already stressed, but with less emphasis, with the previous the8 Millennium Development Goals adopted in 2000) of achieving sustainable development in all three dimensions (economic, social and environmental) in a balanced and integrated way.[4]

In this context, characterized by a growing awareness of the importance of the sustainability aspects, concerns have led academic researchers to create methodological tools capable of assessing the impacts of products and services,

[1]Grillo, M. C. (2014). *Life Cycle Thinking: Strategies for Sustainable Renovation of Existing Buildings* (Doctoral dissertation, University of Trento).
[2]Adams, W. M. (2003). *Green Development: environment and sustainability in the Third World*. Routledge.
[3]www.gatescambridge.org
[4]www.un.org/sustainabledevelopment/development-agenda/

so that these can be made more ecologically friendly, economically profitable, and socially suitable.[5] The results generated by these methodological tools should also be clear and comprehensible to a broad public audience. There are several tools that allow us to assess the level of sustainability, but in recent years, the life cycle philosophy (generally named Life Cycle Thinking) is the approach that has been the main basis of the sustainability policies applied by the European Union.[6]

Life Cycle Thinking (LCT) is a general notion that eases an integrated evaluation of the benefits and the burdens in situation of environmental, social and economic problems for particular products and services.[7] Its assignment is "*to develop and disseminate practical tools for evaluating the opportunities, risks, and trade-offs associated with products and services over their entire life cycle to achieve sustainable development*."[8] The concept is important for administrators, company and citizens. It is a theoretical method that attempts to identify betterments and to reduce the effects at all phases of connected life cycles, from raw material extraction and conversion, product manufacture, through distribution, use and eventual destiny at end-of-life.[9]

LCT methods and instruments have been strengthened and improved, and they are today much used in the private and public area, and are incentivizing and sustaining the passage to a green economy.[10] Different methods, plans and actions exist in the LCT basket that are fundamental in order to comprehend and

[5]Castellini, C., Boggia, A., Cortina, C., Dal Bosco, A., Paolotti, L., Novelli, E., & Mugnai, C. (2012). A multicriteria approach for measuring the sustainability of different poultry production systems. *Journal of Cleaner Production*, *37*, 192-201.

[6] Kopnina, H. (2017). European Renewable Energy. Applying Circular Economy Thinking to Policy-Making. *Visions for Sustainability*, (8).

[7]Grizans, J., & Vanags, J. (2010). Possibilities of the integration of the method of the ecologically oriented independent scientific research in the study process. *Scientific Journal of Riga Technical University. Environmental and Climate Technologies*, *5*(1), 42-48.

[8]Benoît, C. (Ed.). (2010). *Guidelines for social life cycle assessment of products*. UNEP/Earthprint.

[9]UNEP/ SETAC Life Cycle Initiative, *Life Cycle Approaches The road from analysis to practice*

[10]www.lifecycleinitiative.org/starting-life-cycle-thinking/life-cycle-approaches/

assess an economy more sustainable. They have been created to support decision-making activities at every degree concerning product manufacturing, production, procurement, and final disposal.[11] They can be utilised in all areas, and provide the probability to respect a series of fundamental impact categories and indicators, examining the economic, environmental, and social effects.[12]

LCT is made operational through "*Life Cycle Management (LCM) which is a management approach that puts the tools and methodologies in the LCT basket into practice"*.[13] It is a product management scheme that aids companies to reduce the environmental and social obligations connected with their product or product portfolio during its whole life cycle[14] (Figure 1).[15]

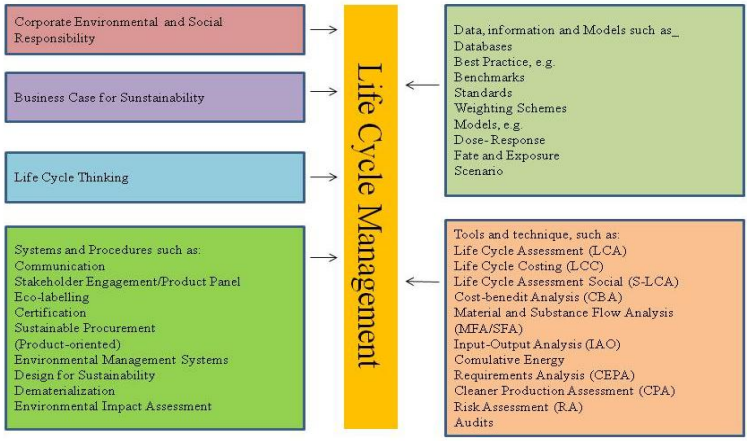


**Figure 1:** Elements of Life Cycle Management[16]

Many different tools are basic elements of LCM, but Life Cycle Assessment (LCA), Life Cycle Costing (LCC) and Social Life Cycle Assessment (S-LCA) - sometimes also called Societal Life Cycle Assessment - are undoubtedly the

[11]www.lifecycleinitiative.org/starting-life-cycle-thinking/life-cycle-approaches/
[12]www.lifecycleinitiative.org/starting-life-cycle-thinking/life-cycle-approaches/
[13]Habisch, A., & Schmidpeter, R. (Eds.). (2016). *Cultural Roots of Sustainable Management: Practical Wisdom and Corporate Social Responsibility*. Springer.
[14]www.lifecycleinitiative.org/starting-life-cycle-thinking/life-cycle-approaches
[15] UNEP/SETAC
[16]Remmen, A. (2007). *Life cycle management: a business guide to sustainability*. UNEP/Earthprint.

most appreciated to assist a decision-making process at all phases, as product manufacturing, production, procurement, and final disposal.[17]

LCA[18]is a methodology, approved and standardized by ISO 14040 -14044/2006 whichis utilized for evaluating environmental effects connected with all the steps of a product's life from cradle-to-grave (raw material extraction, manufacturing, distribution, use, and end-of-life).

LCC includes every cost connected with the life cycle of a product that are straight covered by one or more of the actors in that life cycle.

S-LCA can be illustrated as an instrument that allows a strategic management of the social sustainability of a product and assumes the function of analysis that permits the company to measure the social effect of the product via its sustainability assessment, throughout the life cycle.[19] Therefore, S-LCA provides information on the social aspects useful for decision making, with a view to improving the performance of organizations as well as the well-being of stakeholders.

For the environmental part, LCA is already an internationally standardized tool[20], on the contrary LCC[21] and S-LCA still lack of an international standard and, especially S-LCA, is still in the experimental stages for many aspects of its methodological structure. There are still research and consensus needs of the involved stakeholders that should be improved; in fact, currently no uniform usage of a standardized set of indicators is available, but operationally applicable indicators are generally used.

[17]Mathe, S. (2014). Integrating participatory approaches into social life cycle assessment: the SLCA participatory approach. *The International Journal of Life Cycle Assessment*, *19*(8), 1506-1514.
[18]Sometimes also indicated with the term Environmental Life Cycle Assessment – ELCA
[19]www.lifecycleinitiative.org/starting-life-cycle-thinking/life-cycle-approaches/
[20]ISO 14040 and following
[21] With the exception of ISO 15686-5: 2008 Buildings and constructed assets - Service-life planning - Part 5: Life-cycle costing, which refers only to the LCC of buildings.

In this reason, the topic of the present research project will mainly be focused on the S-LCA method and its application.

## 1.2 Purpose of the thesis

The attention on the social character of sustainability and its connection with the economic and environmental character has become more and more strong in the last years. On the contrary, in the recent past, the idea of sustainable development was almost exclusively observed in term of economic and environmental connection.

Therefore, the interest on Social Life Cycle Assessment (S-LCA) is quite recent but a growing concern on this tool can be registered on an international level. This impetus demonstrates the great significance of the S-LCA in the political and socio-economic framework.

For this motivation, I have decided to undertake the PhD in "*Scienze Economiche*" and to improve my knowledge on the three pillars of sustainability.

My interest in the social aspect of the economy, in particular at the company level, has always been deep, so a research paper on the application of the S-LCA method (that was them associated with a LCA analysis) in a company of my territory formed the ideal argument of my PhD thesis.

Declining the concept of sustainable development at company level, a firm can't only worry about profit, but should evaluate and meet, in a balanced equilibrium, also the environmental and social needs of the relevant stakeholders (and this is perfectly coherent also with the concept of sustained success in the ISO

9004:2009).[22] While life cycle economic aspects are usually integrated into corporate decision-making processes, and the integration of life cycle environmental aspects (at least in certain contexts and production sectors) is becoming relatively common, integration of the social variable is still at its beginnings, largely due to a limited awareness of the value associated with social engagement and for the limits and uncertainties still afflicting the SLCA method.

In this context, the main objective of this thesis is to understand the potential for integrating the S-LCA results into the company product-based decision-making process and the possibility to balance social results with environmental results.

The specific objectives of this thesis are:

1. To conduct a literature overview of the S-LCA method in order to highlight the main limits and uncertainties still afflicting it and to draw a synthetic picture of the strengths and weaknesses of the method (Paper I);
2. To perform a S-LCA of a textile product in order to verify its applicability and the potentiality to integrate its results into the company decision-making process (Paper II);
3. To perform a LCA of the same textile product in order to verify if a combined environmental and social assessment is achievable and to highlight potential obstacles (Paper III).

## 1.3Structure of thesis

This thesis is articulated in three papers, aimed at answering to the three, above mentioned, specific objectives.

[22] ISO 9004:2009 provides guidance to organizations to support the achievement of sustained success by a quality management approach. It is applicable to any organization, regardless of size, type and activity. Available online:https://www.iso.org/standard/41014.html

***PAPER I***

A literature overview in the S-LCA field is carried out with the purpose of highlighting the main limits and uncertainties still afflicting it.

Considering that the S-LCA is still in its infancy, an analysis of the state-of-the-art of this assessment tool is a useful starting point for a detailed description of the current situation and of the degree of advancement of the general theory on the subject and, in particular, on the various approaches and tools applied.

The review has been carried out using two level of analysis:

1. first a bibliometric analysis has been carried out in order to highlight the role and impact of S-LCA studies within the scholarly communities;
2. then a critical analysis of the state-of-the-art, focused on the most cited S-LCA studies, has been performed to highlight methodological differences, limits, and needed developments.

A sector specific highlight has also been carried out within the literature overview, in order to verify the implementation of S-LCA in the textile sector (that is the chosen case study industry in paper II and paper III); results pointed out that, although the social problem is relevant in the fashion sector, few are the authors who studied the social aspects of the textile industry following the Social Life Cycle Assessment method.

***PAPER II***

In order to answer the research questions and considering the findings of the literature overview, a specific industry sector to focus on the applicative analysis has been selected. For the selection of this industry it was important to identify a type of production which really would have allowed me to test the S-LCA about

its most uncertain aspects. Therefore, the selected sector had to have the following characteristics:

1. at least one of the production phases had to be carried out by a firm with a high social value in a specific territorial context, in order to understand if the tool is able to assess this value,
2. the whole production chain had to have a global scale with different life cycle phases carried out in different countries, in order to understand the problems associated to the tool implementation in this complex context (e.g. data access and data availability),
3. it had to be an industry that is known for its social (but also environmental) problems.

Taking these in mind, I had the opportunity to collaborate with an Italian company that operates in a sector that generally presents various environmental, economic and social problems: the textile sector.

In comparison with the fierce competition from emerging countries, Italy has been able to maintain its edge in the global market, especially in the segments related to fashion and luxury goods. The textile industry is strategic for the "*made in Italy",* representing a productive sector of huge importance for the economy of the country.

In an increasingly globalized world, the clothes are the result of a long production process where origin of raw materials, places of manufacturing and consumption become more distant from each other. Mainly for this reason, the world of fashion has always been subject to constant monitoring by the media for the respect of the human rights.

However, the pursuit of sustainability goals for an industry largely based on traditional mature processes is not easy, involving compliance with ecological

and ethical standards characterized by low resource consumption, reduced pollution, recycling of materials, working conditions and fair wages, traceability, transparency and all the other challenges that fall within the definition of sustainability. Yet, this is an effort necessary, given the social impacts in the production chain of clothing and textiles in general and the growing social awareness of customers.

The paper presents the description of the chosen sector, of the firm with a high social value in a specific territorial context (the "San Lorenzo Group", located in San Marco d'Alunzio - Messina), and of the S-LCA results connected to a selected textile product of this firm. The applicative study allowed me to highlight benefits and limits associated to the implementation of S-LCA in this sector and to verify the potentiality to integrate the findings into the company decision-making process.

***PAPER III***

After a brief description of the state-of-the-art of LCA implementation in the textile sector, the paper presents a LCA application on the same textile product in order to verify if a combined environmental and social assessment is achievable and to highlight potential obstacles.

In particular, the research allowed me to highlight that there are still many limits in performing a LCA complementing the S-LCA study, because for some aspects it was impossible to set the same assumptions, mainly due to lack of data.

Finally, in the conclusion part, through a comparison and analysis of the findings obtained, the deficiencies and future research needs has been highlighted, in

particularly for the textile industry, an important and complex sector in the Italian economy.

Extracts from the three papers were presented at the following conferences or presented for publication in the following scientific journals:

1. Paola Lenzo, Marzia Traverso, Roberta Salomone, Giuseppe Ioppolo *Social Life Cycle Assessment of a textile product*, Proceedings of "Convegno dell'Associazione Rete Italiana LCA 2017: Resource Efficiency e Sustainable Development Goals: il ruolo del Life Cycle Thinking", 22-23 June 2017, Siena (Italy) ISBN 978-88-8286-352-4)
2. Paola Lenzo, Marzia Traverso, Giovanni Mondello, Roberta Salomone, Giuseppe Ioppolo, *Sustainability performance of an Italian textile product*, presented at Fifth Annual of the International Conference on Sustainable Development, 18 & 19 September, 2017 New York.
3. Article N.2 has been selected from ICSD 2017 for the publication on Economies (ISSN 2227-7099) -Special Issue "Selected Papers from the International Conference on Sustainable Development 2017, September 18-20, 2017 New York, USA" (actually the paper is under review);
4. Paola Lenzo, Marzia Traverso, Roberta Salomone, Giuseppe Ioppolo, *Social Life Cycle Assessment in the Textile Sector: an Italian Case Study*, presented for publication to Sustainability (ISSN 2071-1050)(actually the paper is under review).

# Paper I

# Social Life Cycle Assessment: an overview

## 2.1 Introduction: the birth of S-LCA

For several years, the relevance of the management of social sustainability has been growing, both in academia and in business practice.

The discussion on how to deal with the social and socio-economic criteria in LCA began around the mid-1990s, following the publication of the SETAC workshop Report, "*a conceptual frame work for life cycle impacts assessment*".[23] It stated that the "*social welfare impact category*" was suggested by stating, inter alia, *"...the primary emphasis should be on environmental impacts that arise directly or indirectly from other social impacts...*". This suggested social impact category called for a more complete debate between LCA methodology developers[24] (Figure 1).

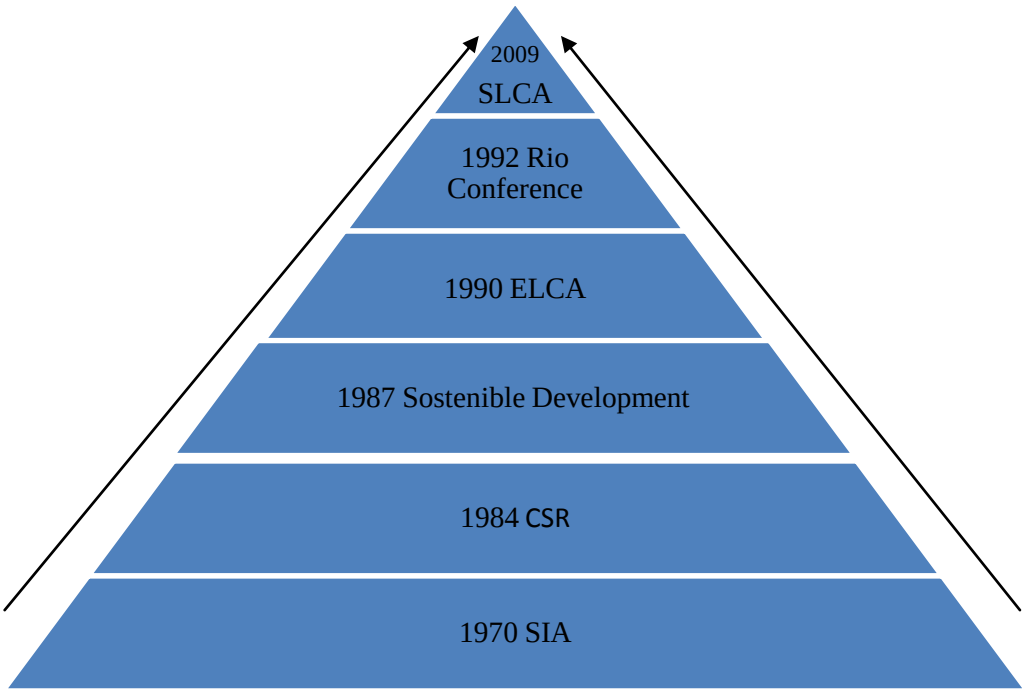


**Figure 1**Evolutionary stages of S-LCA

[23]Fava, J. A., & Society of Environmental Toxicology and Chemistry. (1993). *A conceptual framework for life-cycle impact asesssment: February 1-7, 1992, Sandestin, Florida USA*. SETAC.
[24]UNEP/SETAC 2009

S-LCA has a predecessor[25], called Social Impact Assessment (SIA), which is a concept incorporated into the S-LCA method. SIA emerged during the 1970s and aimed at examining the social impacts of industrial activities.[26]

However, SIA does not include the social impacts of a product during its whole life cycle, but measures the social impact through a project approach. S-LCA aggregates the SIA of every phase in a product's life cycle.

Later, in the 1990, Environmental LCA (E-LCA) spread. S-LCA is based also on E-LCA, with adjustment, and was designed in compliance with the ISO 14040 and 14044 standards for E-LCA.[27]

E-LCA and S-LCA apply the life cycle perspective, analysing the full life cycle of products.

In principle, the full life cycle encompasses extraction and processing of raw material, manufacturing, distribution, use, reuse, maintenance, recycling, and final disposal.[28]

On the contrary, in S-LCA the impact is related to the Business Conduct and it measures negative and positive impacts with quantitative, qualitative and semi-quantitative data.[29]

The main differences between S-LCA and E-LCA are summarized in Figure 2.

[25] Figure 1 evolutionary stages of S-LCA

[26]Freudenburg, W. R. (1986). Social impact assessment. *Annual review of sociology*, *12*(1), 451-478.

[27]ISO, 2004

[28]Menzies, G. F., Khasreen, M. M., & Banfill, P. F. (2009). Life-Cycle Assessment and the Environmental Impact of Buildings&58; A Review. *Sustainability*, *1*(3), 674-701.

[29]Bayart, J. B., Bulle, C., Deschênes, L., Margni, M., Pfister, S., Vince, F., & Koehler, A. (2010). A framework for assessing off-stream freshwater use in LCA. *The International Journal of Life Cycle Assessment*, *15*(5), 439-453.

| E-LCA | S-LCA |
|---|---|
| • Evaluation of environmental impacts<br>• Life Cycle Approach<br>• Framework ISO 14000<br>• Impacts directly related to production, consumption and disposal of the product<br>• Negative impacts<br>• Quantitative data | • Evaluation of social impacts<br>• Life Cycle Approach<br>• Framework ISO 14000<br>• Impacts related to the business conduct<br>• Positive and negative impacts<br>• Quantitative, qualitative and semi-quantitative data |

**Figure 2** Comparison between E-LCA and S-LCA.

Certainly, E-LCA has a Life Cycle Approach, the impact is instantly related to production, consumption and disposal of the product, and it measures only negative impacts with quantitative data.

S-LCA examines organizations' management practices, its goal is always the product and it will seek data about the structure where the unit process is located. S-LCA is not a simple data collection tool at company level. It is a technique where methods are developed to associate business-level information with processes in a lifecycle system and to report, and possibly summarize, this information through product life cycles.[30]

Thanks to these peculiarities, Social Life Cycle Assessment is emerging as an influential and essential tool in sustainability science.

## 2.2 The S-LCA methodology according to the UNEP/SETAC Guidelines

The general methodology for the S-LCA are the UNEP/SETAC "*guidelines for social life-cycle assessment of products*", which follow a structure analogous to that suggested by ISO 14040 for environmental life cycle analysis (E-LCA)[31].

[30] UNEP/SETAC

[31] Grießhammer, R., Benoît, C., Dreyer, L. C., Flysjö, A., Manhart, A., Mazijn, B., ... & Weidema, B. (2006). Feasibility study: integration of social aspects into LCA.

S-LCA methodology comprehends four principal phases: goal and scope definition, life cycle inventory analysis, life cycle impact assessment, and life cycle interpretation.[32]

Accordingly, to the UNEP/SETAC Guidelines the social and socio-economic aspects evaluated in S-LCA may influence affirmatively or adversely company's stakeholders in the life cycle of a product. For this reason, the S-LCA methodology dictated by UNEP and SETAC (2009) states five main stakeholder involvement:

- Workers;
- Local Community;
- Society;
- Consumers;
- Other actors in the value chain.

Stakeholders provide a basis for the definition and articulation of subcategories (defined according to specific international agreements).The stakeholder categories just outlined are considered the main categories potentially impacting on the life cycle of the product.[33]

The subcategories are socially relevant topics or qualities which include human rights, work conditions, cultural heritage, poverty, disease, and political conflict.[34] Subcategories are divided based on stakeholder and impact categories and are evaluated by the use of inventory indicators (Figure 3).[35]

[32]Andrews, E. S., Barthel, L. P., Beck, T., Benoît, C., Ciroth, A., Cucuzzella, C., ... & Mazeau, P. (2009). Guidelines for Social Life Cycle Assessment of Products.: Social and socio-economic LCA guidelines complementing environmental LCA and Life Cycle Costing, contributing to the full assessment of goods and services within the context of sustainable development.

[33]UNEP/SETAC, 2009

[34]Hosseinijou, S. A., Mansour, S., & Shirazi, M. A. (2014). Social life cycle assessment for material selection: a case study of building materials. *The International Journal of Life Cycle Assessment*, *19*(3), 620-645.

[35]Benoît, C. (Ed.). (2010). *Guidelines for social life cycle assessment of products*. UNEP/Earthprint.

Table 1 shows the categories of stakeholders with their relevant subcategories[36]:

| Stakeholder categories | Subcategories |
|---|---|
| Employees | 1. Freedom of association and collective bargaining<br>2. Child Labour<br>3. Working hours<br>4. Forced labour<br>5. Equal opportunities / Discrimination<br>6. Health and Safety<br>7. Fair salary<br>8. Social Benefit / Social security |
| Local community | 1. Access to material resources<br>2. Access to immaterial resources<br>3. Delocalization and Migration<br>4. Cultural Heritage<br>5. Safe and Healthy living Conditions<br>6. Respect of Indigenous rights<br>7. Communities engagement<br>8. Local Employment<br>9. Secure Living Conditions |
| Society | 1. Public commitments to sustainability issues<br>2. Contribution to economic development<br>3. Prevention & mitigation of amend conflict<br>4. Technology development<br>5. Corruption |
| Consumer | 1. Health and Safety<br>2. Feedback mechanism<br>3. Consumer privacy<br>4. Transparency<br>5. End of life responsibility |
| Value chain actors not including consumers | 1. Fair competition<br>2. Promoting social responsibility<br>3. Supplier relationships<br>4. Respect of intellectual property rights |

**Table 1.**Stakeholder Classification from the United Nations Environment Programme Social Life Cycle Assessment (UNEP/SETAC) Guidelines.

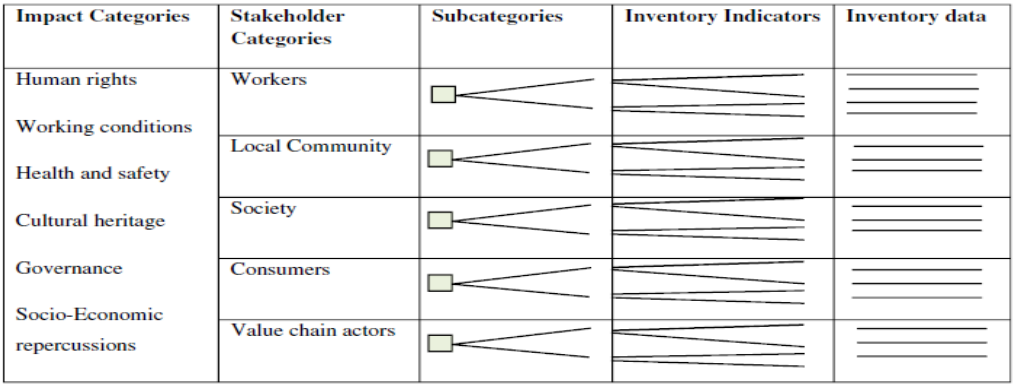


**Figure 3** Assessment system from categories to unit of measurement.

[36]UNEP/SETAC, 2009

Some inventory indicators and units of measurement/ reporting models may be utilized to evaluate every of the subcategories. Every inventory indicator purposely determines the data to be collected; in the suggested methodology, the definition of evaluation parameters, i.e., stakeholder categories, impact categories, subcategories and inventory indicators.[37]

## 2.3 An overview of the most cited S-LCA studies

Today, S-LCA literature is still quite recent and not very diversified; furthermore, the methodological approach at the base of a S-LCA is not universally standardized. For this reason, it is useful to provide more research analysis for highlighting methodological differences and needed developments, essential to improve the analytical method of S-LCA and to gain greater consensus.

Therefore, in order to better understand the state of the art and characteristics of S-LCA studies, in this chapter an overview of S-LCA is presented. The overview was carried out in June 2017. The search engines used in this review were: "Google Scholar", "Scopus" and the software "Ebsco". The extracted publication types only include journals articles in English language.

The study concentrates on the aggregate number of publications and the four different terms *"Social Life Cycle Assessment", "Social-lca*", "*Societal slca*" and "*SLCA case study*". The total dataset involves132 publications from 2000 to 2017.

The models and tools have been analysed through a comprehensive review of the existing literature on the subject. The review has been carried out using two level of analysis:

[37] UNEP/SETAC (2010).

- first a bibliometric analysis was carried out in order to highlight the role and impact of S-LCA studies within the scholarly communities,
- finally, a critical analysis allowed highlighting methodological differences and needs for future development of S-LCA.

The findings of the overview will be the key elements from which to start a future applicative study that will be carried out in order to valorize and analyze how the social aspects of products and their effective and potential, positive and negative, effects along the life cycle are linked to economic context.[38]

The extrapolated publications were analysed utilizing bibliographic information of the authors, publication years, journal names and citation frequency[39]. The data were extracted with the software 'Publish or Perish'[40].

### *2.3.1 The bibliometric analysis*

This analysis provides an overview on the development of the S-LCA method over the years and the development of publications.

Despite the Social-LCA is a discipline of engineering origin, it is trying to introduce a new approach to assessing the sustainability of a production process.

The idea is that one can embrace the knowledge and the need to quantify and interpret aspects and criticalities often overlooked in the life cycle of a good or service, fundamental to nourishing a holistic vision of sustainability.

Figure 2 shows the chronological development of the publications: it indicates that previous to 1993, few research activities have been realised as showed by the reduced number of annual publications. Until 2000, research not privileged the concept "societal-lca". Since 2005, the terms "social life cycle assessment"

[38] www.unep.fr/shared/publications/pdf/dtix1208xpa-lifecycleapproach-howbusinessusesit.pdf
[39]Schiederig, T., Tietze, F., & Herstatt, C. (2011). *What is Green Innovation? A quantitative literature review* (No. 63). Working Papers/Technologie-und Innovations Management, Technische Universität Hamburg-Harburg.
[40] www.harzing.com/resources/publish-or-perish

and “social-lca” became ‘influential’ and is at present the principal term (more than 30 publications in 2010). Since 2010, the term ‘Social Life Cycle Assessment” became most used in academic publications, with several publications for year. The term "S-LCA case study" is inadequate because major case studies are incorporated in theoretical and methodological studies for example in appendix or as an application (Figure 4).

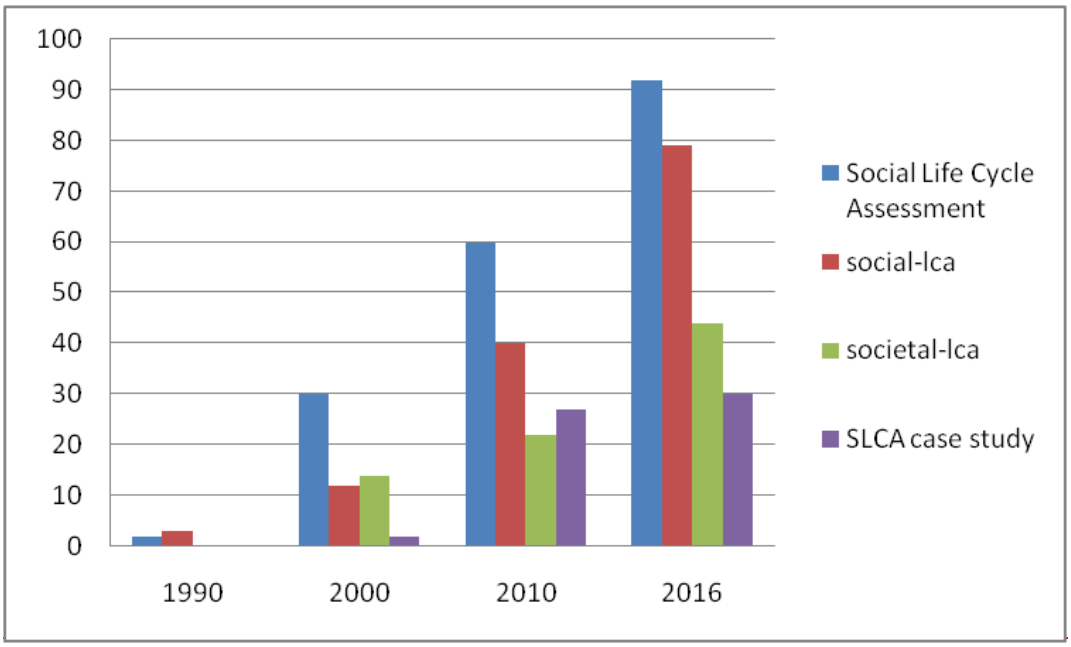


**Figure 4** Development of annual publications

The figure 4 shows that, in the last years, the attention to the S-LCA method has led to an increasing number of literatures that illustrate the applicability and usefulness of S-LCA methodologies to assess the social impacts associated with a product's life cycle.

The academic world offers several theoretical approaches that examine various methodological issues and aim to improve the effectiveness and efficiency of S-LCA. The figure 5 shows that the largest number of publications took place in 2015 (Figure 5).

For this reason, at the end of this first phase, of the 132 articles collected, 111 articles were selected (articles with at least 3 citations - Table 2). The assumption is that these articles, being at least cited three time by other scholars (and thus used in the development of other researches) were able to contribute, to some extent, to the development of S-LCA studies, becoming the literature strongholds.

These papers are scattered across several journals. By far, the top position journal is The International Journal of Life Cycle Assessment, with a total of 60 publications, followed by the Journal of Sustainability with 13 articles and Journal of Cleaner Production with 11.

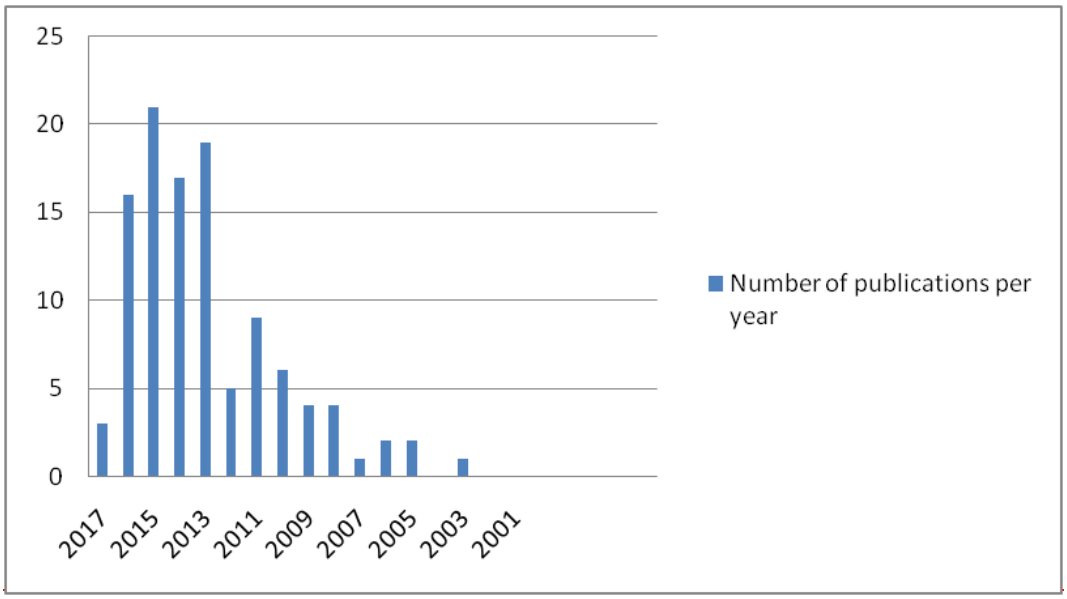


**Figure 5**Development of publications per year

**Table 2.** Articles with minimum 3 annual citations[41]

| Authors | Title | Years | Journal | Cites | Cites/year |
|---|---|---|---|---|---|
| Alsamawi, A. et al. | Social impacts of international trade on the Chinese transport sector | 2016 | Journal of Industrial Ecology | 3 | 3 |
| Andrews, E. et al. | Life Cycle Attribute Assessment | 2009 | Journal of Industrial Ecology | 54 | 6,75 |
| Aparcana, S., Salhofer, S. | Development of a social impact assessment methodology for recycling systems in low-income countries | 2013 | The International Journal of Life Cycle Assessment | 27 | 6,75 |
| Aparcana, S., Salhofer, S. | Application of a methodology for the social life cycle assessment of recycling systems in low income countries: three Peruvian case studies | 2013 | The International Journal of Life Cycle Assessment | 28 | 7 |
| Arcese, G.; Lucchetti, M.C.; Merli, R. | Modeling Social Life Cycle Assessment framework for the Italian wine sector | 2017 | Journal of Cleaner Production | 3 | 3 |
| Arcese, G.; Lucchetti, M.C.; Merli, R. | Social life cycle assessment as a management tool: methodology for application in tourism | 2013 | Sustainability | 34 | 8,5 |
| Arushanyan, Y. et al. | Lessons learned–Review of LCAs for ICT products and services | 2014 | Computers in Industry | 48 | 16 |
| Arvidsson, R. et al. | On the scientific justification of the use of working hours, child labour and property rights in social life cycle assessment: three topical reviews | 2015 | The International Journal of Life Cycle Assessment | 17 | 8,5 |
| Baumann, H. et al. | Does the production of an airbag injure more people than the airbag saves in traffic? | 2013 | Journal of Industrial Ecology | 20 | 5 |
| Norris, C.B. | Data for S-LCA | 2014 | The International Journal of Life Cycle Assessment | 39 | 13 |
| Benoît-Norris, C. et al. | Introducing the UNEP/SETAC methodological sheets for subcategories of S-LCA | 2011 | The International Journal of Life Cycle Assessment | 77 | 12,83 |
| Benoît, C. et al. | The guidelines for social life cycle assessment of products: just in time! | 2010 | The International Journal of Life Cycle Assessment | 355 | 50,71 |
| Benoit-Norris, C. et al. | Identifying social impacts in product supply chains: overview and application of the social hotspot database | 2012 | Sustainability | 97 | 19,4 |
| Settembre Blundo, D. et al. | The life cycle approach as an innovative methodology for the recovery and restoration of cultural heritage | 2014 | Journal of Cultural Heritage Management and Sustainable Development | 3 | 1 |
| Bocoum, I.; Macombe, C.; Revéret, J.C. | Anticipating impacts on health based on changes in income inequality caused by life cycles | 2015 | The International Journal of Life Cycle Assessment | 23 | 11,5 |
| Brent, A.C.; Labuschagne, C. | An appraisal of social aspects in project and technology life cycle management in the process industry | 2007 | Management of Environmental Quality: An International Journal, | 29 | 2,9 |
| Castellani, V.; Sala, S.; Mirabella, N. | Beyond the throwaway society: A life cycle-based assessment of the environmental benefit of reuse | 2015 | Integrated environmental assessment and management | 23 | 11,5 |
| Chang, Y.J. et al. | Environmental and social life cycle assessment of welding technologies | 2015 | Procedia CIRP | 19 | 9,5 |
| Chhipi-Shrestha, G.K. et al. | 'Socializing'sustainability: a critical review on current development status of social life cycle impact assessment method | 2015 | Clean Technologies and Environmental Policy | 37 | 18,5 |
| Chiu, M.C.; Chu, C.H. | Review of sustainable product design from life cycle perspectives | 2012 | International Journal of Precision Engineering and Manufacturing | 54 | 10,8 |
| Cinelli, M. et al. | Workshop on life cycle sustainability assessment: the state of the art and research needs—November 26, 2012, Copenhagen, Denmark | 2013 | The International Journal of Life Cycle Assessment | 7 | 1,75 |
| Croes, P.R.; Vermeulen, W.J.V. | In search of income reference points for SLCA using a country level sustainability benchmark (part 1): fair inequality. A contribution to the Oiconomy project | 2016 | The International Journal of Life Cycle Assessment | 4 | 4 |
| D'Andrea, L.; Declich, A.; Feudo, F. | Hidden societal implications of materials. Updating the awareness on what is at stake | 2014 | Matériaux & Techniques | 3 | 1 |
| De Luca, A.I. et al. | Social life cycle assessment and participatory approaches: a methodological proposal applied to citrus farming in Southern Italy | 2015 | Integrated environmental assessment and management | 38 | 19 |

[41]Harzing's Publish or Perish.

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|---|---|---|---|---|---|
| Dewulf, J. et al. | Toward an overall analytical framework for the integrated sustainability assessment of the production and supply of raw materials and primary energy carriers | 2015 | Journal of Industrial Ecology | 16 | 8 |
| Di Cesare, S.; Silveri, F.; Sala, S.; Petti, S. | Positive impacts in social life cycle assessment: state of the art and the way forward | 2016 | The International Journal of Life Cycle Assessment | 5 | 5 |
| Dong, Y.H.; Ng, S.T. | A modeling framework to evaluate sustainability of building construction based on LCSA | 2016 | The International Journal of Life Cycle Assessment | 3 | 3 |
| Dong, Y.H.; Ng, S.T. | A social life cycle assessment model for building construction in Hong Kong | 2015 | The International Journal of Life Cycle Assessment | 14 | 7 |
| Dreyer, L.C.; Hauschild, M.Z.; Schierbeck, J. | Characterisation of social impacts in LCA. Part 2: implementation in six company case studies | 2010 | The International Journal of Life Cycle Assessment | 32 | 4,57 |
| Dreyer, L.C.; Hauschild, M.Z.; Schierbeck, J. | A framework for social life cycle impact assessment (10 pp) | 2006 | The International Journal of Life Cycle Assessment | 393 | 35,73 |
| Ekener-Petersen, E. et al. | Potential hotspots identified by S-LCA—part 1: a case study of a laptop computer | 2013 | The International Journal of Life Cycle Assessment | 79 | 19,57 |
| Ekener-Petersen, E.; Höglund, J.; Finnveden, G. | Screening potential social impacts of fossil fuels and biofuels for vehicles | 2014 | Energy Policy | 30 | 10 |
| Ekener-Petersen,E.; Moberg, Å. | Potential hotspots identified by S-LCA–Part 2: Reflections on a study of a complex product | 2013 | The International Journal of Life Cycle Assessment | 32 | 8 |
| Ekvall, T. | Nations in S-LCA | 2011 | The International Journal of Life Cycle Assessment | 16 | 2,67 |
| Feschet, P. et al. | Social impact assessment in LCA using the Preston pathway | 2013 | The International Journal of Life Cycle Assessment | 63 | 15,75 |
| Finkbeiner, M. et al. | Towards life cycle sustainability assessment | 2010 | Sustainability | 284 | 40,57 |
| Foolmaun, R.K.; Ramjeeawon, T. | Comparative life cycle assessment and social life cycle assessment of used polyethylene terephthalate (PET) bottles in Mauritius | 2013 | The International Journal of Life Cycle Assessment | 65 | 16,25 |
| Franze, J.; Ciroth, A. | A comparison of cut roses from Ecuador and the Netherlands | 2011 | The International Journal of Life Cycle Assessment | 70 | 11,67 |
| Halog, A.; Manik, J. | Advancing integrated systems modelling framework for life cycle sustainability assessment | 2011 | Sustainability | 141 | 23,5 |
| Hauschild, M.Z; Dreyer, L.C.; Jørgensen, A. | Assessing social impacts in a life cycle perspective—lessons learned | 2008 | CIRP Annals-Manufacturing Technology | 103 | 11,44 |
| Hobson, K.; Lynch, N. | Ecological modernization, techno-politics and social life cycle assessment: a view from human geography | 2015 | The International Journal of Life Cycle Assessment | 4 | 2 |
| Hosseinijou, S.A.; Mansour, S.; Shirazi, M.A. | Social life cycle assessment for material selection: a case study of building materials | 2014 | The International Journal of Life Cycle Assessment | 56 | 18,67 |
| Hu, M. Et al. | An approach to LCSA: the case of concrete recycling | 2013 | The International Journal of Life Cycle Assessment | 26 | 6,5 |
| Hutchins, M.J.; Robinson, S.L.; Dornfeld, D. | Understanding life cycle social impacts in manufacturing: a processed-based approach | 2013 | Journal of Manufacturing Systems | 17 | 4,25 |
| Hutchins, M.J; Sutherland, J.W. | An exploration of measures of social sustainability and their application to supply chain decisions | 2008 | Journal of Cleaner Production | 546 | 60,67 |
| Iofrida, N. et al. | Can social research paradigms justify the diversity of approaches to social life cycle assessment? | 2016 | The International Journal of Life Cycle Assessment | 6 | 6 |
| Iribarren, D.; Vázquez-Rowe, I. | Is labour a suitable input in LCA+ DEA studies? Insights on the combined use of economic, environmental and social parameters | 2013 | Social Sciences | 13 | 3,25 |
| Jørgensen, A. | S-LCA—a way ahead? | 2013 | The International Journal of Life Cycle Assessment | 69 | 17,25 |
| Jørgensen, A.; Herrmann,I.T., Bjørn, A. | Analysis of the link between a definition of sustainability and the life cycle methodologies | 2013 | The International Journal of Life Cycle Assessment | 37 | 9,25 |
| Jørgensen, A. et al. | Methodologies for social life cycle assessment | 2008 | The International Journal of Life Cycle Assessment | 377 | 41,89 |
| Jørgensen, A.; Dreyer, L.C.; Wangel, A. | Addressing the effect of social life cycle assessments | 2012 | The International Journal of Life Cycle Assessment | 41 | 8,2 |

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| Jørgensen, A. et al. | Defining the baseline in social life cycle assessment | 2010 | The International Journal of Life Cycle Assessment | 88 | 12,57 |
| Jørgensen, A.et al. | Relevance and feasibility of social life cycle assessment from a company perspective | 2009 | The International Journal of Life Cycle Assessment | 63 | 7,88 |
| Jørgensen, A., Lai, L.C.H.; Hauschild, M.Z. | Assessing the validity of impact pathways for child labour and well-being in social life cycle assessment | 2010 | The International Journal of Life Cycle Assessment | 73 | 10,43 |
| Kloepffer, W. | Life cycle sustainability assessment of products | 2008 | The International Journal of Life Cycle Assessment | 507 | 56,33 |
| Kloepffer, W. | Life Cycle Assessment as Part of Sustainability Assessment for Chemicals (5 pp) | 2005 | Environmental Science and Pollution Research | 20 | 1,67 |
| Kloepffer, W. | Life-cycle based methods for sustainable product development | 2003 | The International Journal of Life Cycle Assessment | 216 | 15,43 |
| Lagarde, V.; Macombe, C. | Designing the social life cycle of products from the systematic competitive model | 2013 | The International Journal of Life Cycle Assessment | 28 | 7 |
| Lee, S.G.; Xu, X. | Design for the environment: life cycle assessment and sustainable packaging issues | 2005 | International Journal of Environmental Technology and Management | 57 | 4,75 |
| Lehmann, A. et al. | Integration of social aspects in decision support, based on life cycle thinking | 2011 | Sustainability | 33 | 5,5 |
| Lehmann, A. et al. | Social aspects for sustainability assessment of technologies—challenges for social life cycle assessment (SLCA) | 2013 | The International Journal of Life Cycle Assessment | 52 | 13 |
| Lucchetti, M.C.; Arcese, G. | Tourism management and industrial ecology: A theoretical review | 2014 | Sustainability | 8 | 2,67 |
| Macombe, C. et al | Social life cycle assessment of biodiesel production at three levels: a overview and development needs | 2013 | Journal of Cleaner Production | 86 | 21,5 |
| Manik, Y.; Leahy, J.; Halog, A. | Social life cycle assessment of palm oil biodiesel: a case study in Jambi Province of Indonesia | 2013 | The International Journal of Life Cycle Assessment | 63 | 15,75 |
| Martínez-Blanco, J. et al. | Social organizational LCA (SOLCA)—a new approach for implementing S-LCA | 2015 | The International Journal of Life Cycle Assessment | 19 | 9,5 |
| Martínez-Blanco, J. et al. | Application challenges for the social Life Cycle Assessment of fertilizers within life cycle sustainability assessment | 2014 | Journal of Cleaner Production | 77 | 25,67 |
| Mathe, S. | Integrating participatory approaches into social life cycle assessment: the SLCA participatory approach | 2014 | The International Journal of Life Cycle Assessment | 40 | 13,33 |
| Mattioda, R.A. et al. | Determining the principal references of the social life cycle assessment of products | 2015 | The International Journal of Life Cycle Assessment | 13 | 6,5 |
| Mjörnell, K. et al. | A tool to evaluate different renovation alternatives with regard to sustainability | 2014 | Sustainability | 18 | 6 |
| Moran, D. et al. | Global Supply Chains of Coltan: A Hybrid Life Cycle Assessment Study Using a Social Indicator | 2015 | Journal of Cleaner Production | 30 | 15 |
| Musaazi, M. K. et al. | Quantification of social equity in life cycle assessment for increased sustainable production of sanitary products in Uganda | 2015 | Journal of Cleaner Production | 21 | 10,5 |
| Neugebauer, S.; Forin, S.; Finkbeiner, M. | From life cycle costing to economic life cycle assessment—introducing an economic impact pathway | 2016 | Sustainability | 7 | 7 |
| Neugebauer, S. et al. | Enhancing the practical implementation of life cycle sustainability assessment–proposal of a Tiered approach | 2015 | Journal of Cleaner Production | 22 | 11 |
| Neugebauer, S. et al. | Impact pathways to address social well-being and social justice in SLCA—fair wage and level of education | 2014 | Sustainability | 29 | 9,67 |
| Norris, C.B.; Norris, G.A.; Aulisio, D. | Efficient assessment of social hotspots in the supply chains of 100 product categories using the social hotspots database | 2014 | Sustainability | 22 | 7,33 |
| Papong, S. et al. | Development of the Social Inventory Database in Thailand Using Input–Output Analysis | 2015 | Sustainability | 8 | 4 |
| Parent, J.; ì Cucuzzella, C.; Revéret, J.P. | Impact assessment in SLCA: sorting the sLCIA methods according to their outcomes | 2010 | The International Journal of Life Cycle Assessment | 99 | 14,14 |
| Parent, J.; ì Cucuzzella, C.; Revéret, J.P. | Revisiting the role of LCA and SLCA in the transition towards sustainable production and consumption | 2013 | The International Journal of Life Cycle Assessment | 42 | 10,5 |

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|---|---|---|---|---|---|
| Hunkeler, D. | Societal LCA Methodology and Case Study (12 pp) | 2006 | The International Journal of Life Cycle Assessment | 190 | 17,27 |
| Petti, L.; Campanella, P. | The S-LCA: the state of art of an evolving methodology | 2009 | The Annals of The "Ștefan cel Mare" University of Suceava. Fascicle of The Faculty of Economics and Public Administration | 12 | 1,5 |
| Pizzirani, S.; McLaren, S.J.; Seadon, J.K. | Is there a place for culture in life cycle sustainability assessment? | 2014 | The International Journal of Life Cycle Assessment | 12 | 4 |
| Sanchez Ramirez, P.K.; Petti, L. | Social life cycle assessment: methodological and implementation issues | 2011 | The Annals of The "Ștefan cel Mare" University of Suceava. Fascicle of The Faculty of Economics and Public Administration | 13 | 2,17 |
| Sanchez Ramirez, P.K. et al. | Subcategory assessment method for social life cycle assessment. Part 2: application in Natura's cocoa soap | 2016 | The International Journal of Life Cycle Assessment | 6 | 6 |
| Sanchez Ramirez, P.K. et al. | Subcategory assessment method for social life cycle assessment. Part 1: methodological frame work | 2014 | The International Journal of Life Cycle Assessment | 28 | 9,33 |
| Reitinger, C. et al. | A conceptual framework for impact assessment within SLCA | 2011 | The International Journal of Life Cycle Assessment | 72 | 12 |
| Ren, J. et al. | Prioritization of bioethanol production pathways in China based on life cycle sustainability assessment and multicriteria decision-making | 2015 | The International Journal of Life Cycle Assessment | 51 | 25,5 |
| Roos, S. et al. | A life cycle assessment (LCA)-based approach to guiding an industry sector towards sustainability: The case of the Swedish apparel sector | 2016 | Journal of Cleaner Production | 4 | 4 |
| Garrido, S.R. et al. | A overview of type I SLCA—making the logic underlying methodological choices explicit | 2016 | The International Journal of Life Cycle Assessment | 13 | 13 |
| Bork, C. A. S., Junior, D. J. D. B., de Oliveira Gomes, J. | Social life cycle assessment of three companies of the furniture sector | 2015 | Procedia CIRP | 5 | 2,5 |
| Siebert, A.; Bezama, A.; O'Keeffe, S.; Thrän, D. | Social life cycle assessment: in pursuit of a framework for assessing wood-based products from bioeconomy regions in Germany | 2016 | The International Journal of Life Cycle Assessment | 7 | 7 |
| Steen, B.; Palander, S. | A selection of safeguard subjects and state indicators for sustainability assessments | 2016 | The International Journal of Life Cycle Assessment | 5 | 5 |
| JW Sutherland, et al. | The role of manufacturing in affecting the social dimension of sustainability | 2016 | CIRP Annals | 7 | 7 |
| Swarr, T.E. | Societal life cycle assessment—could you repeat the question? | 2009 | The International Journal of Life Cycle Assessment | 40 | 5 |
| Tecco, N, Baudino, C.; Girgenti, V.; Peano, C. | Innovation strategies in a fruit grower's association impacts assessment by using combined LCA and s-LCA methodologies | 2016 | Science of The Total Environment | 4 | 4 |
| Thorstensen, E.; Forsberg, E.M. | Social Life Cycle Assessment as a resource for Responsible Research and Innovation | 2016 | Journal of Responsible Innovation | 3 | 3 |
| Traverso, M. et al. | Towards life cycle sustainability assessment: an implementation to photovoltaic modules | 2012 | The International Journal of Life Cycle Assessment | 67 | 13,4 |
| Ulgiati, S. et al. | Material, energy and environmental performance of technological and social systems under a Life Cycle Assessment perspective | 2011 | Ecological Modelling | 52 | 8,67 |
| Umair, S.; Björklund, A.; Petersen, E.E. | Social impact assessment of informal recycling of electronic ICT waste in Pakistan using UNEP SETAC guidelines | 2015 | Resources, Conservation and … | 47 | 23,5 |
| van Haaster, B. et al. | Development of a methodological framework for social life-cycle assessment of novel technologies | 2017 | The International Journal of Life Cycle Assessment | 3 | 3 |
| Wang, S.W.; Hsu, C.W.; Hu, A.H. | An analytical framework for social life cycle impact assessment—part 1: methodology | 2016 | The International Journal of Life Cycle Assessment | 5 | 5 |
| Weidema, B.P. | The integration of economic and social aspects in life cycle impact assessment | 2006 | The International Journal of Life Cycle Assessment | 248 | 22,55 |
| Weldegiorgis, F.S.; DFranks, D.M. | Social dimensions of energy supply alternatives in steelmaking: comparison of biomass and coal production scenarios in Australia | 2014 | Journal of Cleaner Production | 13 | 4,33 |
| Wilhelm, M. et al. | An overview of social impacts and their corresponding improvement implications: a mobile phone case study | 2015 | Journal of Cleaner Production | 18 | 9 |

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| Wu, R.; Yang, D.; Chen, J. | Social life cycle assessment revisited | 2014 | Sustainability | 57 | 19 |
| Wu,S. R. et al. | Causality in social life cycle impact assessment (SLCIA) | 2015 | The International Journal of Life Cycle Assessment | 5 | 2,5 |
| Yu, M.; Halog,A. | Solar photovoltaic development in Australia—a life cycle sustainability assessment study | 2015 | Sustainability | 17 | 8,5 |
| Zamagni, A. | Life cycle sustainability assessment | 2012 | The International Journal of Life Cycle Assessment | 83 | 16,6 |
| Zamagni, A.; Amerighi, O.; Buttol, P. | Strengths or bias in S-LCA? | 2011 | The International Journal of Life Cycle Assessment | 47 | 7,83 |
| Zamani, B. et al. | Hotspot identification in the clothing industry using social life cycle assessment—opportunities and challenges of input-output modelling | 2016 | The International Journal of Life Cycle Assessment | 4 | 4 |
| Zimmer, K. et al. | Assessing social risks of global supply chains: A quantitative analytical approach and its application to supplier selection in the German automotive industry | 2017 | Journal of Cleaner Production | 3 | 3 |
| Schneider, L. et al. | The economic resource scarcity potential (ESP) for evaluating resource use based on life cycle assessment | 2014 | The International Journal of Life Cycle Assessment | 58 | 19,33 |

The figure 5 shows that many articles has been published and there is an increasing tendency year after year. Most of the articles are published in Europe and the United States.

The most cited paper is the one by Hutchins M.J. and Sutherland J.W.[42] where the relationship between business decision-making and social sustainability is explored with attention initially focused on directly impacting national level measures. The paper reviews metrics, indicators, and frameworks of social impacts and initiatives relative to their ability to evaluate the social sustainability of supply chains. The paper evidences that the S-LCA method is crucial to allow companies to fully consider sustainability.

The bibliometric analysis has also highlighted that, among the top active scholars, there are two Italian international experts: Petti L. and Traverso M.. In the articles analyzed, there are different works by Petti. The most cited is "*Subcategory assessment method for social life cycle assessment. Part 1: methodological framework*[43]", which proposes an objective method for evaluating subcategories in Social Life Cycle Impact Assessment (S-LCIA). The paper uses the method SAM (Subcategory Assessment Method). The method allows evaluating both simple and complex products, in different contexts/countries throughout the value chain. SAM is today one of the most used methods in applying S-LCA.

Instead, the paper most cited of Traverso is "*Towards life cycle sustainability assessment*". The paper explores the current status of Life Cycle Sustainability Assessment (LCSA) for products and processes.

[42] Hutchins, M. J., & Sutherland, J. W. (2008). An exploration of measures of social sustainability and their application to supply chain decisions. *Journal of Cleaner Production*, *16*(15), 1688-1698.

[43] Ramirez, P. K. S., Petti, L., Haberland, N. T., & Ugaya, C. M. L. (2014). Subcategory assessment method for social life cycle assessment. Part 1: methodological framework. *The International Journal of Life Cycle Assessment*, *19*(8), 1515-1523.

Another paper of Traverso M., illustrates and clarifies the environmental, economic and social associated to two mineral fertilizers and one industrial compost.[44] This study is one of the main works applying the S-LCA Guidelines, as well as using the first database created for Social Life Cycle Assessments (SHDB) in a real case study.[45] The authors advise the importance of promoting the application of the S-LCA, because the social dimension has an important function in the evaluation of sustainability evaluate, and as there is no commonly agreed methodology.

Other previous reviews on S-LCA has been performed and published. For example, Jorgensen et al.[46] compares -LCA approaches in order to highlight methodological differences and general shortcomings. Some years later, Jorgensen[47] gives a quick summary of S-LCA's publications. Wu et al.[48] presented a complete list of recently-developed S-LCA frameworks, methods and characterization models, to support the development of methodology.

More recent reviews are those of Chhipi-Shrestha et al.[49] and Mattioda et al..[50] The first paper critically reviews the methodologies applied in S-LCIA and establishes its current development status by highlighting areas for improvement. The second article starts from the recognition of the importance of the social performance of sustainable products and the S-LCA approach as a potential tool to measure this performance. For a full overview of the available literature on S-

[44] www.ictaweb.uab.cat/pubs_detail.php?id=1264

[45] Martínez-Blanco, J., Lehmann, A., Muñoz, P., Antón, A., Traverso, M., Rieradevall, J., & Finkbeiner, M. (2014). Application challenges for the social Life Cycle Assessment of fertilizers within life cycle sustainability assessment. *Journal of cleaner production*, *69*, 34-48.

[46] Jørgensen, A., Le Bocq, A., Nazarkina, L., & Hauschild, M. (2008). Methodologies for social life cycle assessment. *The international journal of life cycle assessment*, *13*(2), 96.

[47] Jørgensen, A. (2013). Social LCA—a way ahead?.

[48] Wu, R., Yang, D., & Chen, J. (2014). Social life cycle assessment revisited. *Sustainability*, *6*(7), 4200-4226.

[49] Chhipi-Shrestha, G. K., Hewage, K., & Sadiq, R. (2015). 'Socializing'sustainability: a critical review on current development status of social life cycle impact assessment method. *Clean Technologies and Environmental Policy*, *17*(3), 579-596.

[50] Mattioda, R. A., Mazzi, A., Canciglieri, O., & Scipioni, A. (2015). Determining the principal references of the social life cycle assessment of products. *The International Journal of Life Cycle Assessment*, *20*(8), 1155-1165.

LCA and their classification see e.g. van Haaster et al.[51] that systematically discuss the main problems encountered when applying lifecycle thinking to social assessment in order to build a consistent framework for a number of indicators that is fully operationalized and aggregated, and to test the developed framework through application on a case study example.[52]

Also, Martínez-Blanco et al.[53] contributed to the advancement of the S-LCA.

Martínez-Blanco et al. suggest a new organizational vision to promote S-LCA, the social organizational LCA (SOLCA), because S-LCA is not yet widely implemented in practice. According to the authors, SOLCA helps to overcome several obstacles of S-LCA and, therefore, is a promising method for putting it into practice. But, also with this new method problems connected to data collection or problems to distribute and aggregate social aspect in the society are not overcome.

Many inputs to improve the structure of the S-LCA can be obtained by the revised articles. Some authors stress the significance of incorporating social aspects in an LCA; some concern to describe the main stages that make up the methodological framework; some stress the importance to dwell on the concept of indicator of social impact, or on the liability of the enterprise involved in the life cycle, or even, investigate the possibility of combining the S-LCA method with the environmental assessment of the life cycle of a product (LCA).[54]

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[51] van Haaster, B., Ciroth, A., Fontes, J., Wood, R., & Ramirez, A. (2017). Development of a methodological framework for social life-cycle assessment of novel technologies. *The International Journal of Life Cycle Assessment*, *22*(3), 423-440.

[52] Prosuite: Sustainability Assessment for Technology. Available online:www.prosuite.org

[53] Martínez-Blanco, J., Lehmann, A., Chang, Y. J., & Finkbeiner, M. (2015). Social organizational LCA (SOLCA)—a new approach for implementing social LCA. *The International Journal of Life Cycle Assessment*, *20*(11), 1586-1599.

[54]Sanchez Ramirez, P. K., & Petti, L. (2011). Social life cycle assessment: methodological and implementation issues. *The USV annals of economics and public administration*, *11*(1), 11-17.

For example, Weidema[55] demonstrates that world data are available for the calculation of the impacts of human activities in six 'damage categories', all linked with health. He suggests indicators, units of measurement, and an initial estimate of worldwide normalisation values for 'life and longevity' or 'health'.

Franze and Ciroth[56] used the UNEP/SETAC Guidelines to compare the impacts of rose production in Ecuador with the Netherlands, but also for potentially improving the circumstances of affected stakeholders. The objective is to identify differences and similarities in environmental and social life cycle modelling and both social and environmental hot spots in each of the life cycles. The consideration of different stakeholder groups with corresponding, very diverse themes allows a comprehensive analysis of the actual conditions. However, finding suitable indicators to measure the status of the subcategories may be challenging. They present their methodology for illustrating the results as an easy tool to identify the main social impacts of the life cycle[57], even if they are aware of the subjectivity of the method. In order to solve this problem, the authors encourage using international standard.

Foolmaun and Ramjeeawon[58] have analysed only two dimensions of sustainability, environmental and social, using the Life Cycle Management tool. The study investigated and compared the environmental and social impacts of four selected disposal alternatives of used PET bottles. The authors, in order to confirm the proposed method, apply the Franze and Ciroth method. The results obtained with both models are similar, so the proposed method can be considered

[55]Weidema, B. P. (2006). The integration of economic and social aspects in life cycle impact assessment. *The International Journal of Life Cycle Assessment*, *11*, 89-96.

[56] Franze, J., & Ciroth, A. (2011). A comparison of cut roses from Ecuador and the Netherlands. *The International Journal of Life Cycle Assessment*, *16*(4), 366-379.

[57] Franze, J., & Ciroth, A. (2011). A comparison of cut roses from Ecuador and the Netherlands. *The International Journal of Life Cycle Assessment*, *16*(4), 366-379.

[58]Foolmaun, R. K., & Ramjeeawon, T. (2013). Comparative life cycle assessment and social life cycle assessment of used polyethylene terephthalate (PET) bottles in Mauritius. *The International Journal of Life Cycle Assessment*, *18*(1), 155-171.

reliable. In addition, they also recognize that their method is simpler than others as Franze and Ciroth but is easy to adapt to other scenarios. Finally, their data collection system is based on interviews with stakeholders. If such information is missing, an alternative is required. But they do not propose another choice.

Instead, Mingming Hu et al[59] offer a method to put the LCSA framework into practice. This approach is illustrated with an on-going case study on concrete recycling. The case study reveals that the operational steps are particularly useful at the phase of determining the goal and scope, but the combined application of LCA, LCC and S-LCA at the project level proves not all the cost elements and only one social impact indicator can be modelled in the process-based LCA structure. Although this study offers many important phases for the LCSA idea, it is clear that additional case studies are needed to move LCSA into a practical framework for the examined of complicate sustainability questions.

The analysis here presented indicates, therefore, that an important part of S-LCA literature provides empirical evidence of S-LCA implementation efforts. There are several case studies that illustrate the applicability of S-LCA methodologies to a wide range of products from different sectors and for different purposes.

In particular, in the energy sector, S-LCA frameworks have been implemented to analyze impacts of a palm oil production system by Manik et al..[60] These authors proposed a new methodology for impact assessment in S-LCA. The methodology is based on multi-criteria decision analysis (MCA). The outcomes of the stakeholders' review show the critical social hotspots, which are the questions within the impact categories of working conditions and cultural heritage. The problem is that the authors do not discuss the validity of the

[59] Hu, M., Kleijn, R., Bozhilova-Kisheva, K. P., & Di Maio, F. (2013). An approach to LCSA: the case of concrete recycling. *The International Journal of Life Cycle Assessment*, *18*(9), 1793-1803.

[60] Manik, Y., Leahy, J., & Halog, A. (2013). Social life cycle assessment of palm oil biodiesel: a case study in Jambi Province of Indonesia. *The International Journal of Life Cycle Assessment*, *18*(7), 1386-1392.

method. Macombe et al.[61] examined the opportunities and development necessities for evaluating the social impacts of a biodiesel case study. The work is divided in three parts: company, regional, and state. The conclusion indicates that is not yet possible to carry out a complete S-LCA. Second the authors, the S-LCA divided in different parts would improve the methodology and empirical basis. In order to achieve social challenges are necessary actions at a different political level.

There is also a wide range of studies on S-LCA cases focusing on agricultural and dairy products. Through the implementation of S-LCA, Feschet et al.[62] find that improving banana exports will have a positive impact on the entire population of Cameroon. Instead, the study by Tecco et al.[63] aims to assess the introduction of innovation into agro-food systems by combining an environmental life cycle (LCA) assessment and a social life cycle assessment (S-LCA) to support the decision-making process of a fruit growers coop for the adoption of mulching and covering in raspberry farming.

Most recent are the studies of De Luca et al.[64] and Arcese et al.[65].

De Luca et al. apply a Life Cycle Sustainability Assessment (LCSA) method, by integrating LCA and LCC results as inputs in S-LCA in different crop systems of citrus growing in the Calabria (Italy). This is one the more relevant agricultural sectors at regional level; unfortunately, it is also well known for social problems, particularly for immigration workers and bad working conditions. Results have

[61]Macombe, C., Leskinen, P., Feschet, P., & Antikainen, R. (2013). Social life cycle assessment of biodiesel production at three levels: a literature review and development needs. *Journal of Cleaner Production*, *52*, 205-216.

[62] Feschet, P., Macombe, C., Garrabé, M., Loeillet, D., Saez, A. R., & Benhmad, F. (2013). Social impact assessment in LCA using the Preston pathway. *The International Journal of Life Cycle Assessment*, *18*(2), 490-503.

[63] Tecco, N., Baudino, C., Girgenti, V., & Peano, C. (2016). Innovation strategies in a fruit growers association impacts assessment by using combined LCA and s-LCA methodologies. *Science of The Total Environment*, *568*, 253-262.

[64] De Luca, A. I., Iofrida, N., Strano, A., Falcone, G., & Gulisano, G. (2015). Social life cycle assessment and participatory approaches: a methodological proposal applied to citrus farming in Southern Italy. *Integrated environmental assessment and management*, *11*(3), 383-396.

[65] Arcese, G., Lucchetti, M. C., & Massa, I. (2017). Modeling Social Life Cycle Assessment framework for the Italian wine sector. *Journal of Cleaner Production*, *140*, 1027-1036.

highlighted the impact categories contributing most to performance differences. Surely, the work offers useful idea to both local decision makers, such as agricultural entrepreneurs, and to those public decision makers that realize territorial planning strategies. Furthermore, this methodological application allowed the authors to test the feasibility of integrating LCA and LCC results as inputs in S-LCA to conduct a Life Cycle Sustainability Assessment (LCSA). However, the interview of stakeholders was the phase that took more time; consequently data gathering was conditioned by the disposability of sources and the collection of primary data.

Whereas, Arcese et al. give a theoretical basis for practical applications in wine sector in Italy that could be generalized as a starting point for S-LCA application in other agri-food sectors.

In addition, according to the S-LCA approach, many authors propose frameworks to evaluate waste management alternatives. In the study of Aparcana et al.[66] the goal is to determine the feasibility of applying this methodology by assessing the current social impacts of three Peruvian recycling systems based on two formalization approaches.

Catellani et al.[67] suggest a work on a second-hand shop: the major contribution to avoided impacts comes from the apparel sector, due to the high number of items sold, followed by the furniture sector.

From these studies it is clear that, the S-LCA was primarily utilized to examine products and production systems, it is possible to align it for the social

[66] Aparcana, S., & Salhofer, S. (2013). Application of a methodology for the social life cycle assessment of recycling systems in low income countries: three Peruvian case studies. *The International Journal of Life Cycle Assessment*, *18*(5), 1116-1128.

[67] Castellani, V., Sala, S., & Mirabella, N. (2015). Beyond the throwaway society: A life cycle-based assessment of the environmental benefit of reuse. *Integrated environmental assessment and management*, *11*(3), 373-382.

evaluation of several sectors and social issues can be valorized after the assessment.

Other studies investigate the social implications of manufacturing products. Indicative examples are Ekener-Petersen and Finnveden.[68] Their case study presents the social hotspots of a laptop but also identifies it is probable to achieve a S-LCA on a common complex product through the UNEP/SETAC Guidelines. The effort in locating data and the need for simplifications of the methodology are the principal questions that necessity other developments.

Wilhelm et al.[69] present a mobile phone case study. The aims of the work are to identify the social impacts across the life cycle of mobile phones and to investigate opportunities to improve those impacts.

Mesas et al.[70] use a combined approach S-LCA and ELCA to determine sanitary pads' social equity and environmental impacts. Recommendation is that Sub-Saharan African countries should encourage policies that support local design and manufacturing of sustainable products rather than being reliant on imported products which can have higher environmental impacts and lower social equity benefits.

Instead, Chang et al.[71] carry out Life Cycle Assessment and Social Life Cycle Assessment in assessing probable social and environmental effects of the welding technologies in Germany. But this work is not as an overall process comparison, because, in the LCA method, only four impact categories are showed to compare the processes and S-LCA is limited to focusing on workers,

[68] Ekener-Petersen, E., & Finnveden, G. (2013). Potential hotspots identified by social LCA—part 1: a case study of a laptop computer. *The International Journal of Life Cycle Assessment, 18*(1), 127-143.

[69] Wilhelm, M., Hutchins, M., Mars, C., & Benoit-Norris, C. (2015). An overview of social impacts and their corresponding improvement implications: a mobile phone case study. *Journal of Cleaner Production*, *102*, 302-315.

[70] Musaazi, M. K., Mechtenberg, A. R., Nakibuule, J., Sensenig, R., Miyingo, E., Makanda, J. V., ... & Eckelman, M. J. (2015). Quantification of social equity in life cycle assessment for increased sustainable production of sanitary products in Uganda. *Journal of Cleaner Production*, *96*, 569-579.

[71] Chang, Y. J., Sproesser, G., Neugebauer, S., Wolf, K., Scheumann, R., Pittner, A., ... & Finkbeiner, M. (2015). Environmental and social life cycle assessment of welding technologies. *Procedia CIRP*, *26*, 293-298

and the corresponding salary and health risks caused by fume and, due to lack of quantitative data, health risks from radiation, heat and noise are not considered.

However, the outcomes show that the wage status of welders is still satisfactory. The manual processes lead at different potential risk of welders' health respect the automatic processes. Another sector that shows typical social issues is the fashion world, and particularly the textile industry. Few, however, are the authors who studied the social aspects of the textile industry, following an S-LCA approach. For example, a book, by Koszewska, M.[72], provides a wide range of case studies among with LCA applications in the textile and clothing industries are reported. The book examines the key developments of LCA in the textile and clothing industries, but even in this case, no evidence of S-LCA implementations according to the UNEP guidelines[73] can be identified.[74]

A further work that took care of the green orientations in the textile sector, developed by Roos et al.[75] focuses on the collection of a set of social indicators with the prospective to include various stakeholders' preferences, without making an application of S-LCA. Instead, Zamani et al.[76] suggest a cradle-to-gate input/output-based S-LCA, referred to the Swedish clothing consumption as a case study. The purpose is to investigate the influence of the cut-off rule and the definition of "hotspots" in social hotspot assessment. A second purpose was to comprehend social hotspots of Swedish clothing on a national level. The application of S-LCA on the clothing production supply chain offered a clearer

[72]Koszewska, M. (2015). Life cycle assessment and the environmental and social labels in the textile and clothing industry. *Handbook of Life Cycle Assessment (LCA) of Textiles and Clothing*, 325.

[73] UNEP/SETAC, 2009

[74]Koszewska, M. (2015). Life cycle assessment and the environmental and social labels in the textile and clothing industry. *Handbook of Life Cycle Assessment (LCA) of Textiles and Clothing*, 325.

[75] Roos, S., Zamani, B., Sandin, G., Peters, G. M., & Svanström, M. (2016). A life cycle assessment (LCA)-based approach to guiding an industry sector towards sustainability: The case of the Swedish apparel sector. *Journal of Cleaner Production*, *133*, 691-700.

[76] Zamani, B., Sandin, G., Svanström, M., & Peters, G. M. (2016). Hotspot identification in the clothing industry using social life cycle assessment—opportunities and challenges of input-output modelling. *The International Journal of Life Cycle Assessment*, 1-11.

picture of the social hotspots than with traditional process-based S-LCA. The work identified various essential parameters in applying an input/output-based S-LCA. The outcomes highlighted that the cut-off values and identification of hotspots in relation to risk levels can directly influence the results. A weakness of the study was the limited set of social indicators, based on indicators prioritized by consumers.

One of the most recent articles in the textile sector is that of van der Velden and Vogtländer.[77] The scope of this study is to compare production processes and production chains of clothing products, through S-LCA, by introducing the socio-economic costs (s-eco-costs) method for monetization of external socio-economic burden for workers.

Finally, even if the textile industry is strategic for the "made in Italy", representing a productive sector of huge importance for the economy of the country, the overview highlighted that there is a unique work that regards the social aspect in the Italian textile industry (but not using the S-LCA method): Dansero and Caldera.[78] With this research report the authors aim to give an overview of the textile and clothing sector (or textile-fashion) in Italy and in Piedmont (Biella), analyzing social problems and opportunities in terms of relations with the environment.

The overview proves that several innovative and original approaches have been advanced over the years, but they aren't yet comprehensive and complete and some sectors are very little investigated.

[77] van der Velden, N. M., & Vogtländer, J. G. (2017). Monetisation of external socio-economic costs of industrial production: A social-LCA-based case of clothing production. *Journal of Cleaner Production*, *153*, 320-330.

[78] Dansero, E.; Caldera, G. (2012). Green economy e tessile: chi passa per la cruna dell'ago?.Ph.d., University of Turin, Department of Culture, Politics, Society,

### *2.3.2Acritical analysis*

S-LCA is a methodology subject of a lively debate in the research community and, as can be expected for a new development, some criticism has been pointed out.[79]

As already mentioned, the S-LCA has the same methodological structure of LCA, but, in the S-LCA we can assists, for example, to differences in the definition of the product system and of the system boundaries. If the product system in LCA is given from the processes that characterize the different stages of the product life cycle, from raw material extraction to final disposal, in S-LCA it is represented by the companies involved in the life cycle within of which the various industrial processes take place. In S-LCA, then, the analysis is no longer performed at the process level, but considers the companies involved in the life cycle and, in particular, it focuses on the latter's behavior towards the people concerned.[80] This is connected to the fact that several social effects are not associated to the processes that make the product or service system, however with the conduct that runs the process itself; as claimed by Dreyer[81] and other authors, this means that the causal link cannot be, as in LCA, between process and impact, but between business conduct and impact.[82]

However, analyzing the impacts at the firm level instead of process, makes it difficult to establish the link between impacts and product; the link between the conduct of an enterprise and the product's life cycle is not, in fact, directly

[79]Brent, A. C., & Labuschagne, C. (2007). An appraisal of social aspects in project and technology life cycle management in the process industry. *Management of Environmental Quality: An International Journal*, *18*(4), 413-426.
[80]Dreyer et al., 2006 - Jørgensen et al., 2008 - Hauschild - Dreyer - Jørgensen, 2008
[81] Dreyer, L., Hauschild, M., & Schierbeck, J. (2006). A framework for social life cycle impact assessment (10 pp). *The International Journal of Life Cycle Assessment*, *11*(2), 88-97.
[82]Jørgensen, A., Le Bocq, A., Nazarkina, L., & Hauschild, M. (2008). Methodologies for social life cycle assessment. *The international journal of life cycle assessment*, *13*(2), 96.

quantifiable, at least not as the physical link between process and product.[83] Therefore, a first issue appears to be how to put in connection the social indicators to the functional unit of the product process.

In order to solve the problem and allocate the social impacts created by the companies to evaluate the product or service a share factor is used which represents the weight given to the individual company in the chain of the product or service.[84] The quantitative link to the functional unit is difficult, but the social indicator results are representative of the product system "share" in terms of the activity variable.[85]

Therefore, as affirmed by Petti & Campanella[86], for allocation policy is used the share factor by which a weight is attributed to the single company in the supply chain. Particularly, Dreyer et al.[87] suggest that a part of the total amount of effects produced by the enterprise should be assigned to the evaluated product or service, and that the part should be definite by the weight that the company is given in the product's or service's total product chain.

The share factor can be determined in different ways; it could be based, for example, on the physical weight (the contribution to the physical weight of the product), on the cost (the contribution to the cost of the product), on the creation of value (the contribution to the value of the product) or on the number of hours of labour costs per unit of product functional, and the choice depends on two criteria: it is necessary that the distortion, naturally introduced by the share

[83]Dreyer, L., Hauschild, M., & Schierbeck, J. (2006). A framework for social life cycle impact assessment (10 pp). *The International Journal of Life Cycle Assessment*, *11*(2), 88-97.
[84]Dreyer, 2006 - Hauschild - Dreyer - Jørgensen, 2008 - Jørgensen et al., 2008
[85]Parent, J., Cucuzzella, C., & Revéret, J. P. (2010). Impact assessment in SLCA: sorting the sLCIA methods according to their outcomes. *The international journal of life cycle assessment*, *15*(2), 164-171.
[86] Petti L., Campanella P. (2009), The Social LCA: the state of the art of an evolving methodology, *The Annals of the "Stefan cel Mare" University of Suceava*. Fascicle of the Faculty of Economics and Public Administration, vol. 9, n. 2-10.
[87]Dreyer, L., Hauschild, M., & Schierbeck, J. (2006). A framework for social life cycle impact assessment (10 pp). *The International Journal of Life Cycle Assessment*, *11*(2), 88-97.

factor, both known and accepted, and the data and information necessary for the calculation of the share factor should be available for all companies of the product chain.[88] However, often happens that not all business processes are involved in the life cycle of the analyzed product / service, so it is not necessary to implement the allocation policy because it is evaluated using the company as a whole.

Also the boundaries of the product system is no longer straightforward. The necessity for company specific information has effects for the identifications of the product system in S-LCA, i.e. which phases of the product process must to be included.[89] To evaluate the behaviour of companies in the life cycle of the product/service, more detail data is needed.

Despite the importance of system boundaries, according to Dubois-Iorgulescu et al.[90] the justifications for system boundaries setting is many times lacking or not systematized. The authors recommend more rigorous documentation of system boundaries setting.

In fact, it may be useful to know the geographical location and the sector in which it operates. This information allows the detection of the behaviour commonly found in that specifically region and or sector, and on this basis, makes it probable, what is the conduct of the analysed company. But it may also happen that companies operating in the same territory and producing the same type of product/service have different social impacts towards one or more stakeholders. While nation or region-specific information about the product chain may allow an inaccurate evaluation, a final evaluation must be based on

[88]Dreyer, 2006 - Hauschild - Dreyer - Jørgensen, 2008 - Jørgensen et al., 2008

[89]Jørgensen, A., Le Bocq, A., Nazarkina, L., & Hauschild, M. (2008). Methodologies for social life cycle assessment. *The international journal of life cycle assessment*, *13*(2), 96.

[90] Dubois-Iorgulescu, A. M., Saraiva, A. K. E. B., Valle, R., & Rodrigues, L. M. (2016). How to define the system in social life cycle assessments? A critical review of the state of the art and identification of needed developments. *The International Journal of Life Cycle Assessment*, 1-12.

company-specific data for the more influential companies in the product chain.[91] In order to obtain specific information from a company, attentions could be focused at those phases of the life cycle where the manufacturer has the major influence, and the share factor could then be based on the material costs and product price for the company in the product chain.[92] On this topic, Sureau[93] highlights that the use stage and the relations between value chain actors receive less attention than the production stage; in fact, authors identify possible areas for improvement on uneven coverage of the stakeholder.

Generally, it is the manufacturer that identifies its suppliers of raw materials and services. The more the relationship is directed, the stronger the influence it can exercise as a client. The S-LCA focus on the direct suppliers, but in several situations, significant aspects lie upstream and, thus, the product manufacturer has to employ a more indirect influence and feeble. Each significant social aspect in the material phase is inserted in the S-LCA, and observation of the first tier of suppliers is considered as minimum; or in the disposal stage the S-LCA also includes social impacts. Usually, obtaining this information is extremely difficult if the analysis concerns a product that operates globally.

Certainly, the greatest limitation is inherent in the very nature of social phenomena and their effects; social values, affecting human values, are in fact prevailing as a qualitative type and, as such, are difficult to evaluate, quantify and organize. To date, there is no commonly accepted social impact assessment method above all because the assessment of social impacts and benefits is very

[91]Dreyer, L., Hauschild, M., & Schierbeck, J. (2006). A framework for social life cycle impact assessment (10 pp). *The International Journal of Life Cycle Assessment*, *11*(2), 88-97.

[92] Dreyer, L., Hauschild, M., & Schierbeck, J. (2006). A framework for social life cycle impact assessment (10 pp). *The International Journal of Life Cycle Assessment*, *11*(2), 88-97.

[93] Sureau, S., Mazijn, B., Garrido, S. R., & Achten, W. M. (2017). Social life-cycle assessment frameworks: a review of criteria and indicators proposed to assess social and socioeconomic impacts. *The International Journal of Life Cycle Assessment*, 1-17.

subjective and controversial as cultural aspects, diverse values and lifestyles can affect how social problems are perceived. Surely, the social dimension of sustainability is a very complex issue and even today, this is one of the major problems associated with S-LCA.

Social indicators may be of various types. A first classification, for example, divides them into central (called midpoint indicators) and final (called endpoint indicators), difference that relates to the position indicator in the path of impact.[94]

The creation of jobs, for example, is not considered, in general, as a goal in itself, but, by contributing to the family income and the consequent reduction of poverty, it can improve health conditions of the family which can, therefore, be regarded as a final target. The creation of work could be considered a central indicator and the health condition a final indicator.[95]

When it comes to impact assessment and integration, there is not one particular impact evaluation method suggested in the UNEP/SETAC Guidelines. In fact, S-LCA does not say nothing on how to address identified social effects, neither does provide knowledge on if a product should be achieved or no. It can only give elements of thought for a decision on the production of a product. The international scientific community has defined this differently, with the purpose of achieving a comprehensive set able to answer to the necessity of the study; for example, Jørgensen et al.[96] indicate a matrix structure of indicators for the

[94]Benoît, C., Norris, G. A., Valdivia, S., Ciroth, A., Moberg, A., Bos, U., ... & Beck, T. (2010). The guidelines for social life cycle assessment of products: just in time!. *The international journal of life cycle assessment*, *15*(2), 156-163.
[95]Jørgensen, A., Le Bocq, A., Nazarkina, L., & Hauschild, M. (2008). Methodologies for social life cycle assessment. *The international journal of life cycle assessment*, *13*(2), 96.
[96] Jørgensen, A., Le Bocq, A., Nazarkina, L., & Hauschild, M. (2008). Methodologies for social life cycle assessment. *The international journal of life cycle assessment*, *13*(2), 96.

different impact categories divided into subcategories as fixed by international guidelines[97].

Franze and Ciroth[98] underlined the subjectivity of the process. In order to resolve this issue, they encourage utilizing international standard to perform a S-LCA study as much transparent as possible. They presented their methodology for illustrating the effects as an easy instrument to identify the principal social impacts of the life cycle. By applying their technique to a case study, they concluded that, despite some problems, it is possible to evaluate social impacts.

In overall, suggestions of using the so-called performance reference points, such as internationally set thresholds, appear to be indicated by different authors.

The analysis of the papers has shown that some authors use, in addition to social indicators, some elements that help to better characterize the context in which a company operates. For example, on the principles of Rio +20 Corporate Sustainability Forum, whereby correct behaviour is to be supplemented by the continued improvement and sharing of best practice, Ramirez et al.[99] focus their attention on if a company promotes good practices in the value chain.

In additional, Dreyer et al.[100] and Ramirez et al.[101] consider the social, political, and economical ambient of the companies analysed. They highlight that the social performance of organizations is conditioned by their operating environment and that certain geographical contexts and sectors are more challenging in enforcing social performance. Dreyer et al. show a "*multicriteria*

[97]UNEP/SETAC, 2009

[98] Franze, J., & Ciroth, A. (2011). A comparison of cut roses from Ecuador and the Netherlands. *The International Journal of Life Cycle Assessment*, *16*(4), 366-379.

[99]Ramirez, P. K. S., Petti, L., Haberland, N. T., & Ugaya, C. M. L. (2014). Subcategory assessment method for social life cycle assessment. Part 1: methodological framework. *The International Journal of Life Cycle Assessment*, *19*(8), 1515-1523.

[100] Dreyer, L. C., Hauschild, M. Z., & Schierbeck, J. (2010). Characterisation of social impacts in LCA. Part 2: implementation in six company case studies. *The International Journal of Life Cycle Assessment*, *15*(4), 385-402.

[101]Ramirez, P. K. S., Petti, L., Haberland, N. T., & Ugaya, C. M. L. (2014). Subcategory assessment method for social life cycle assessment. Part 1: methodological framework. *The International Journal of Life Cycle Assessment*, *19*(8), 1515-1523.

*indicator model*" to evaluate the social effects that derive from labour rights issues. This framework uses the guidelines of International Labour Organizations (ILOs) to estimate the social impacts of products. Attention is drawn to some aspects such as: forced labour, discrimination, child labour and barriers to freedom of association. The purpose of Dreyer is to clarify and organize the current S-LCA methodologies and questions related to the identification of criteria and indicators to estimate the social impact of products. Instead, Ramirez et al. propose the subcategory assessment method (SAM), which is based on a four-level scale (A, B, C, or D), pegged on a compliance level, which they name "basic requirement" (BR). Successively, the method is applied it to a real product (Natura's cocoa soap).[102]

Dreyeret al. and Ramirez et al. thus propose two different ways of assessing potential social impacts. For Dreyer et al., companies operating in the most hostile territories should be granted a better score than if they were operating in a more positive environment. From the perspective of Ramirez et al., companies with poor corporate performance and operating in an adverse context are the worst rated when it comes to their risk of generating social impacts.[103]

Then, Norris et al.[104] consider social and socio-economic impacts leading to bad health. Hunkeler[105] solved the problem of relating social impacts with the functional unit by means of the working time spent to produce the fraction of the final product in a factory or at the field, etc. Knowing the working hours per

[102] Ramirez, P. K. S., Petti, L., Brones, F., & Ugaya, C. M. L. (2016). Subcategory assessment method for social life cycle assessment. Part 2: application in Natura's cocoa soap. *The International Journal of Life Cycle Assessment*, *21*(1), 106-117.

[103] Garrido, S. R., Parent, J., Beaulieu, L., & Revéret, J. P. (2016). A literature review of type I SLCA—making the logic underlying methodological choices explicit. *The International Journal of Life Cycle Assessment*, 1-13.

[104] Benoît-Norris, C., Vickery-Niederman, G., Valdivia, S., Franze, J., Traverso, M., Ciroth, A., & Mazijn, B. (2011). Introducing the UNEP/SETAC methodological sheets for subcategories of social LCA. *The international journal of life cycle assessment*, *16*(7), 682-690.

[105] Hunkeler, D. (2006). Societal LCA methodology and case study (12 pp). *The International Journal of Life Cycle Assessment*, *11*(6), 371-382.

functional unit and using national statistics it can be calculated how many hours a person has to work for eating, housing, education, etc. This evaluation can be considered as a societal impact assessment, whereas the unweighted working hours belong to the inventory.[106] But the framework proposed has only data is included on using employment for measurement of indicators. A possible solution can be that of included the social sustainability in the management of the life cycle by means of guidelines and checklists; as it is the case for the environmental dimension, in fact, it is expected that they can improve the availability of quantitative data, making it more feasible, in the future, the procedure of calculation of social indicators.[107]

In the before 2000s, an additional contribution to the debate was achieve by Klöpffer[108] and Weidema[109] on the question of how S-LCA should be integrated or adaptation with E-LCA method.[110] Various social indicators have been proposed, such as health impacts (positive and negative), additional employment[111] and Quality Adjusted Life Years[112] (QALY).[113] Site-specific evaluations have also been debated for, as the impacts concern to company behaviour and should thus be evaluate on-site.[114] An important event in the progress of S-LCA was the releasing of the UNEP/SETAC S-LCA Guidelines.[115] These were generated inside the Life Cycle Initiative, collaboration among the

[106]Nilsson-Lindén, H., Baumann, H., Rosén, M., & Diedrich, A. (2014). Organizing life cycle management in practice: challenges of a multinational manufacturing corporation. *The International Journal of Life Cycle Assessment*, 1-15.
[107] Hunkeler, D. (2006). Societal LCA methodology and case study (12 pp). *The International Journal of Life Cycle Assessment*, *11*(6), 371-382.
[108] Klöpffer, W. (2003). Life-cycle based methods for sustainable product development.
[109] Weidema, B. P. (2006). The integration of economic and social aspects in life cycle impact assessment. *The International Journal of Life Cycle Assessment*, *11*, 89-96.
[110]Klöpffer 2003; Weidema 2006
[111]Hunkeler, D. (2006). Societal LCA methodology and case study (12 pp). *The International Journal of Life Cycle Assessment*, *11*(6), 371-382.
[112]Weidema, B. P. (2006). The integration of economic and social aspects in life cycle impact assessment. *The International Journal of Life Cycle Assessment*, *11*, 89-96.
[113]Norris, C. B. (2014). Data for social LCA.
[114]Dreyer, L. C., Hauschild, M. Z., & Schierbeck, J. (2010). Characterisation of social impacts in LCA. Part 2: implementation in six company case studies. *The International Journal of Life Cycle Assessment*, *15*(4), 385-402.
[115]Benoit and Mazijn 2009; Benoit et al., 2010

United Nations Environmental Programme[116] and the Society of Environmental Toxicology and Chemistry.[117] The Guidelines are the result of a clear and wide practice, connecting many pertinent stakeholders from the academic, public and business branch.

Despite the efforts of the authors, for the S-LCA use qualitative data, methodologies and indicators remains a limit. The limitations relate, above all, to the nature of social effects. They can hardly be quantifiable. It is not easy to aggregate social effects using a single calculation rule. The aggregation of qualitative indicators and various methodologies requires expert judgment and so far, few have succeeded.

According to the requirement of ISO, the impact assessment must be quantifiable. For this reason, Dreyer et al. specified a framework of S-LCA in 2006 that is able to equip a quantifiable result of the assessment. They describe the life cycle of S-LCA as a collection of companies where industrial activities take place[118]. In additional, Dreyer, Hauschild, and Schierbeck[119] have pointed out, talking about the S-LCA, the concept of the responsibility of the companies involved in the life cycle. These authors, in outlining the structure of the S-LCA, have highlighted the importance of the behaviour of the companies involved in the life cycle, giving more weight to the activities in the foreground and to people involved. The methodological framework that they have considered is meant to be applied to companies that want to minimize the adverse impacts, which are produced in the chains of the product, on people's lives and it is

[116]UNEP/SETAC

[117]Catherine Benoit, *La Construction Socio Technique d'uneBanque de DonnéesenAscv: La Double Herméneutiqueen Action*, Universityof the Montréal, 2015

[118]Dreyer, L., Hauschild, M., & Schierbeck, J. (2006). A framework for social life cycle impact assessment (10 pp). *The International Journal of Life Cycle Assessment*, *11*(2), 88-97.

[119]Dreyer, L. C., Hauschild, M. Z., & Schierbeck, J. (2010). Characterisation of social impacts in LCA. Part 2: implementation in six company case studies. *The International Journal of Life Cycle Assessment*, *15*(4), 385-402.

focused, in peculiar, on those activities that the company has the capacity to control with their own management solutions. They propose a framework that is based on input/output modelling of social issues, yet no proposal has been done for indicator data (except for an example). In their contribution to the framework for the S-LCA, the authors seem to reject the possibility of using generic data within the methodology because the boundaries of the system in a S-LCA must be determined on a case by case basis and are related on the influence that the producer carries on various activities in the chain of the product.

This methodology evaluation measurement can be an obstacle for the practitioners: how does one collect the data for S-LCA from the related companies within the life cycle of a particular product? Unlike, Jorgenson et al.[120] argued that the generic data is more applicable and accurate that the site-specific data. In additional, also Hunkeler[121] discusses on the relevance of allocating social impacts to precise products instead of working with them on the base on the suppliers list. In this study Hunkeler modelled S-LCA using socio-economic data from the national censuses and public databases that can supply a much greater section size for researchers that site-specific data. For Hunkeler, such a large section size seems to improve the precision of the estimation procedure in S-LCA.[122]

In response to this, it's true that S-LCA can never deal with all the effects of social changes in product life cycles, because the methods proposed so far allow for a global assessment and there are always unforeseeable effects at different

[120] Jørgensen, A., Le Bocq, A., Nazarkina, L., & Hauschild, M. (2008). Methodologies for social life cycle assessment. *The international journal of life cycle assessment*, *13*(2), 96.

[121]Hunkeler, D. (2006). Societal LCA methodology and case study (12 pp). *The International Journal of Life Cycle Assessment*, *11*(6), 371-382

[122]Muthu, S. S. (Ed.). (2014). *Social life cycle assessment: an insight*. Springer.

times.[123]But, in my opinion, in the S-LCA for allocating social impacts to precise products, the best solution is to use the site-specific data, to supply a view more credible on real social impact of the products. Provided that reliable data are available.

Other central issues are the availability and collection of data. The biggest limitation of the S-LCA, in fact, is the ability to access data, as it can happen that only a fraction of the requested data is available in the form elaborated by statistical sources or otherwise; or that input-output data is not yet available for different processes and activities; or still, that different upstream chains are involved, especially in the case of complex industrial products.[124]

In opposition to Environmental LCA, the S-LCA is extremely site-specific in its data requirements, and the value of conducting S-LCA on the basis of generic product chains is normally limited.[125] There is a substantial lack of social data organized at the regional level, as official data is often at national level.

So, there are not many databases and this makes it difficult to apply the methodology. So far, one of the few databases made accessible to social data is The Social Hotspot Database[126] (SHDB)[127]. It offers social data for S-LCA hotspot evaluations on country level, and in a lot of cases also on sector level. The sector-level data are obtained for 57 predetermined sectors. The existence of

[123]Macombe, C., Leskinen, P., Feschet, P., & Antikainen, R. (2013). Social life cycle assessment of biodiesel production at three levels: a literature review and development needs. *Journal of Cleaner Production*, *52*, 205-216.

[124]Grießhammer, R., Benoît, C., Dreyer, L. C., Flysjö, A., Manhart, A., Mazijn, B., ... & Weidema, B. (2006). Feasibility study: integration of social aspects into LCA.

[125]Dreyer, L. C., Hauschild, M. Z., & Schierbeck, J. (2010). Characterisation of social impacts in LCA. Part 2: implementation in six company case studies. *The International Journal of Life Cycle Assessment*, *15*(4), 385-402

[126]The Social Hotspot Database (SHDB) was the first database created for Social Life Cycle Assessments, launched in 2009. It provides social risk data on a sector and country level. A key aspect of the project has been to ensure that users have full transparent access to information about working conditions and impacts and global supply chains.

[127]Benoît-Norris, C., Vickery-Niederman, G., Valdivia, S., Franze, J., Traverso, M., Ciroth, A., & Mazijn, B. (2011). Introducing the UNEP/SETAC methodological sheets for subcategories of social LCA. *The international journal of life cycle assessment*, *16*(7), 682-690.

sector level data in the SHDB descends on the disposability and pertinence of such data for every area.[128]

Therefore, it is only doable to acquire data on product group level, not for specific products. No data on specific production plants or sites are usable either. The database has a predetermined structure consisting of five social categories and a sequence of correlated social themes.[129] For every topic, there are several numbers of correlated indicators for which data are collected.

It should be noted, however, that the information collected before the birth of the S-LCA can be used in an S-LCA study, as confirmed by Jorgenson, but finding relevant data takes a lot of time and different skills.

Consequently, conducting a S-LCA study is still expensive and it requires to the professional a social background and a strong experience. Considering these limitations, for companies, is it advantageous investing so many resources in comparison to the value of the outcome? While being a completely legitimate issue, it is possible that as more complete and articulated databases on social data evolve, as for E-LCA, the connection among difficulties and result will modify its usefulness.

## 2.4 Conclusions: strengths and weaknesses of the S-LCA method

In a sustainability assessment context, S-LCA is relatively new and more research should be done in order to improve the technique and to achieve a general consensus. The implementation of S-LCA has showed its strengths and weaknesses. The necessity to have qualitative and quantitative indicators in the

[128] Sala, S., Vasta, A., Mancini, L., Dewulf, J., & Rosenbaum, E. (2015). Social Life Cycle Assessment-State of the art and challenges for supporting product policies.

[129]Benoît-Norris, C., Vickery-Niederman, G., Valdivia, S., Franze, J., Traverso, M., Ciroth, A., Mazijn, B. (2011) Introducing the UNEP/SETAC methodological sheets for subcategories of social LCA, The International Journal of Life Cycle Assessment, 16 (7), 682-690

S-LCA implementation can create difficulties in a comparison of two and more products as well as the necessity to contextualize at local level the impact. Indeed, it is quite important to know where the process occurs to define the level of the impact, e.g. the legal working hours are not the same in all countries in the world. The ILO convention on working hours has not been signed from several countries such s Austria, Switzerland, Japan and US.

As already mentioned, social effects are difficult to quantify and organize, due to their typical nature. For this reason, quantitative assessment requires generalization, because various social effects, especially perceptions of health and safety or hope, can vary greatly from one country to another.[130]

However, it should be clear that often well-being is strongly influenced directly by state action and indirectly by product chains. The S-LCA study must demonstrate that the company's farms, in that particular context/territory, have been able to significantly improve the welfare state of the employees and/or the population.

Moreover, it should be kept in mind that the S-LCA evaluates not only social positive but also negative impacts. When monitoring a company that operates in rich countries, for example, in addition to pollution, it may be useful to measure damage caused by heavy or under pressure works (such as back problems or stress problems).

Finally, a strong limitation of the method is the availability of data and their quality. Researchers have at their disposal a limited availability of data, or their total absence in different processes or activities; furthermore, obtaining primary data is extremely difficult if the analysis concerns a company that operates globally and in different nations.

[130]Macombe, C., Leskinen, P., Feschet, P., & Antikainen, R. (2013). Social life cycle assessment of biodiesel production at three levels: a literature review and development needs. *Journal of Cleaner Production*, *52*, 205-216.

For this reason, future developments are needed to improve the technique and databases related to the S-LCA method.

In spite of the premature condition of the science, it is intuitive that S-LCA has the potential to help crucially to the eco-efficiency and sustainable realization and consummation of products from a social point of view[131]. S-LCA will grow in significance and relevance because the sustainability becomes ever more important and necessary. The S-LCA, unlike the LCA, does not aim at assessing only negative social impacts, but allows a global assessment of the company, highlighting the added social value of the company in the country where it operates and not only. The importance of the consideration of social aspects in the context of the life cycle of a product must therefore be understood first of all at the theoretical level by the individual.[132] Only a responsible company that has really understood the importance of social aspects and possible impacts that may cause the company's activities on the various stakeholders, will really work hard to try to avoid such damage or at least mitigate them and only in this way, the company will be able to enjoy all the benefits that will be recorded, for example, in the relationship with customers or employees, which, of course, will work with more enthusiasm in a better context.[133]

In conclusion, a global method which includes environmental, economic and social impacts, to get a complete picture of the situation, is needed. Because each study separately can give us a wrong idea of which alternative is better than the other or less harmful.[134] When economic and environmental issues of one of the alternative products are well balanced, social aspects can be weak, and vice

[131]Paragahawewa, U., Blackett, P., & Small, B. (2009). Social life cycle analysis (S-LCA): some methodological issues and potential application to cheese production in New Zealand. *Report by Agresearch*

[132] UNEP, 2009

[133]Uddin, M. B., Tarique, K. M., & Hassan, M. (2008). Three dimensional aspects of corporate social responsibility.

[134]Franze, J., & Ciroth, A. (2011). A comparison of cut roses from Ecuador and the Netherlands. *The International Journal of Life Cycle Assessment*, *16*(4), 366-379

versa.[135] Together with LCA and LCC, S-LCA is a tool that can help inform decision making for sustainable development. Therefore, says Becker[136], the Social Impact Assessment should be discussed first of all as a moral obligation, which it must be understood and acquired not only by the individual, but also by companies operating in the market.

Many organizations already consider environmental and social aspects in sustainability reporting but not yet from a life cycle perspective. The great strength of the method, however, is that of creating a full review on a product, going to add the social aspects to the environmental and economic aspects.

Therefore, the LCSA including a S-LCA allows companies to consider the sustainability comprehensively (extended with LCC and LCA analysis). Indeed, the S-LCA provides information on potential social impacts that the activities in the life cycle of their products or services can cause on people; allowing companies to conduct, easily, its business in a socially responsible manner.

[135]Vinyes, E., Oliver-Solà, J., Ugaya, C., Rieradevall, J., & Gasol, C. M. (2013). Application of LCSA to used cooking oil waste management. *The International Journal of Life Cycle Assessment*, *18*(2), 445-455.
[136] Becker, H. A. (2001). Social impact assessment. *European Journal of Operational Research*, *128*(2), 311-321.

# Paper II

# Social Life Cycle Assessment of a textile product: the Case Study of “San Lorenzo Group” (Italy)

## 3.1 Introduction

This study presents the first application of the Social Life Cycle Assessment to a textile product made in Sicily (Italy), according to the Social Life Cycle Assessment guidelines (UNEP). The main goal is to assess and present the social values of a product manufactured in a particular territorial area where the presence of an industry represents the main source of employment. The first part of the study is an overview of the current state of the art of the S-LCA and its implementation to textile products. In the implementation, particular attention is paid in identifying the positive impacts and in highlighting the strengths and weaknesses of the method when applied in this specific sector. The functional unit of the study is one a garment knitted in a soft blend of wool and cashmere, produced by a textile company located in Sicily (Italy). The flow unit consists of 495 items of clothing. The system boundaries of the study include all phases from cradle-to-gate; from raw material production through fabric/accessory production to the manufacturing process of the product itself at the company. Background and foreground processes are taken into account using specific and generic data. Two stakeholder groups have been taken into consideration (workers and local communities) as those that can better represent the company's value in the territory. The analysis carried out on the functional unit of the study allowed to assess social performance related to the specific textile product, but also to outline the general behaviour of the company. Indeed, results highlighted that the studied company applies a careful and well-structured local social policy; but it does not adopt special measures to prevent and/or reduce social problems towards its suppliers and other business partners through the supply chain.

## 3.2 The San Lorenzo Group company

### *3.2.1 The company's history: the Vision and Mission*

The San Lorenzo Group is a world leader of high fashion. Brain, heart and soul of this jewel is Filippo Miracula.[137]The selected company has a strong social dimension; this is well represented in the vision of the San Lorenzo Group, which is: "*The fortune of a man is another man*". This vision clearly results from the fact that clothing-manufacturing processes are labour intensive, involving processes that require a high degree of operator competence. The company adopts a proper and successful policy of human resource management based on respect for and development of human capabilities.

Indeed, being able to deal with people also involves understanding cultural issues, bearing in mind that the culture of an organisation is the combined effect of the values, beliefs, attitudes, traditions and behaviour of its members. The quality aspects, required by the market, include all those activities that the San Lorenzo Group uses to direct, control and coordinate the company, to ensure that requirements are actually being met.

The strong link that this company has within the territory is also stressed by the fact that when the Sicilian textile industry seemed destined to disappear and thousands of young people were forced to emigrate abroad, the San Lorenzo Group could have moved elsewhere, but it has resisted, remaining in San Marco d'Alunzio (Messina), a lovely village situated in the Nebrodi - Sicilian mountains, in an area that does not have adequate infrastructure. (See Fig. 1)

This fact has an important significance for the local community and it should be measured and communicated.

[137] www.youtube.com/watch?v=3uHtgg6VCWM

The company knows well the problems of every season and all criteria for the presentation of collections to the market and, in order to be always successful, every department and every employee make theirs every need of the customers, thanks to the total flexibility of the work of women, men, of the whole divisions and of the structures with the awareness of the exclusive needs of times, events, trade flows in the fashion industry.[138]

**Figure 1** San Lorenzo Group

### *3.2.2 The ingredients of success*

The successful venture and the dream realized highlight a large entrepreneurial capacity of the San Lorenzo Group's owner, Filippo Miracula.

The company has not suffered the devastating effects of the crisis in the textile industry because the San Lorenzo Group was established with a clear mission: to create the high-quality clothing for clients in national and international markets.

For Filippo Miracula, the strength is word of mouth and this has enabled the company to endure and grow. Thanks to its strategy focused on high-quality clothing for clients in national and international markets, the company has not suffered the devastating effects of the crisis in the textile industry and the San

[138] www.sanlorenzoconfezioni.com

Lorenzo Group is now the center of a constellation of workshops scattered around almost all the Nebrodi villages and its customers include all major Italian fashion brands and others. It makes more than 250 thousand garments per year, always aiming for high level of craftsmanship and quality. (Fig 2 San Lorenzo Group Logo)

For the San Lorenzo Group counts the value of the old tailor's craft. Hence the trust to brands such as Louis Vuitton, Zegna, Armani, Calvin Klein, Canali, Dior, Donna Karon, Ferrè, Kenzo, Leilian, Valentino e Agnona, finding in San Lorenzo Group technically modern facilities and a rich experience craftsman.

Moreover, Herno,[139] the company of which it is a shareholder of control Claudio Marenzi[140], is a partner in a project already started involving the creation of a network of ready-made clothing from Capo d'Orlando, in the province Messina, up to Randazzo, in the province of Catania. For decades, the San Lorenzo Group has collaborated with Herno. Since 2009, they have managed to bring from Romania in Sicily some types of processes: relocation to the contrary, bringing even the most talented workers.[141]


**Figure 2** San Lorenzo Group Logo

[139] www.youtube.com/watch?v=LtE7ZdD6I50
[140] President of "*Italian Fashion System*"
[141] www.youtube.com/watch?v=wzRJxz1bQAg

### *3.2.3 The company structure*

The clothing sector is characterized by high labour intensity; high presence of specialized employees and manufacturing technology remains linked to the industrial version of the home sewing machine.

So this is a traditional mature industry that has not been able to protect themselves from advancing low-wage countries through technological innovations such as in the other sectors. Both clothing sector that knitting, do not have the economies of scale, due to the low degree of standardization of the production for the needs of seasonal flexibility.

The main stages of the production process that are common to all apparel segments are:

- Cutting;
- Stitching;
- Ironing;
- Distribution – Shipment.

Each stage is preceded by intermediate moments that complete the production cycle. Below, we will proceed to the description of these processes, highlighting those little touches that make the Heads of High Quality produced by San Lorenzo. The organization of San Lorenzo Group is committed in assisting its customers at every stage of the management cycle providing the full-service, in order to support the production. Through the acquisition of job order, the management of the order, the relationship with all customers' divisions, from projects' management to the contact with technical directors, fashion designers, modellers, logistics and administration.

### *3.2.3.1 Cutting*

The cutting of the fabric does not happen immediately, but behind it there is a preparation and accuracy that the company offers to its customer, avoiding errors and reducing costs for the company and for the customer. In this phase, priority is given to the organization of the material needed to prototype and sample (See fig. 3).

**Figure 3**San Lorenzo Group Warehouse

The orders are processed through the cut bubble, i.e. a card that indicates the number of accessories, the fabric, the measurements and the number of products necessary to meet the customer's order. The cutting bubble is sent to the CAD, where the paper patterns, sent by the clients, are scanned.

After checking the technical-design features of the various pieces that make up the model, it passes to the placement of the paper patterns on the fabric (See fig. 4).

**Figure 4**Automatic Cutting

Successively, it proceeds to cutting techniques; the San Lorenzo Group employs two techniques: automatic cutting and manual cutting.

Automatic cutting is a technique common to all companies operating in the textile industry and is intended for the production of large quantities of articles of clothing. In addition to automatic cutting, "San Lorenzo Group" also offers manual cutting, for the production of small amounts, which are typically the most valuable.

Upon completion of the cutting of the fabric, the various components obtained are numbered and sent to the Stitching department (See fig. 5).

However, sometimes the company in the face of rather large quantities may subcontract packaging to another external company.

**Figure 5**Automatic Cutting

***3.2.3.2Stitching***

The sewing phase assumes features details, because the company makes several types of seams. The most widely appreciated seam is "Double-Face".

The "Double-Face" stitching finish present in the product analysed consists in: "*blind-stitching by hand of the internal seams and of the external finishing of a garment along the hems of the fabric whose width is split in half for a depth of about 12 millimetres,* (see fig. 6), *blind-stitching is what gives the product its high artisan quality and takes up about 75% of the time necessary to make a garment. It is carried out entirely by hand, with needle and thread, by seamstresses living in the towns of the Nebrodi area who preserve and renew the ancient art of tailoring in this day and age of industrial modernity".*[142]

[142]www.sanlorenzo.it or www.robertocorpina.it

**Figure 6** Double-Face machine

This procedure is what gives San Lorenzo Group's products absolutely extraordinary quality and fineness. With this technique, the company offers a high quality artisan and inimitable garment.[143] A further type of stitching concerns lined and/or unlined fabric.

The difference between the two types of processing lies in the fact that "double-face" should only be finished by hand (See Fig. 7), while the garments made of other fabrics are finished by machine. It is "double-face" that allows the creation of clothes that can reveal the beauty and preciousness of their fabric, both from outside and inside, without reverse and without seems to be hidden under linings or necklines.

"Double-face" is an example of the excellent and exclusive workmanship of the San Lorenzo Group.

[143] www.sanlorenzo.it or www.robertocorpina.it

**Figure 7** Stitching department

### *3.2.3.3 Ironing*

This is the final phase in the garment finish. The function of this phase of the process is to give the final look to the clothes. Once ironed the garment is subjected to a quality check to verify that no mistakes were made during the previous processes (See fig. 8)

**Figure 8** Ironing Department

Unlike the sewing, there is no method of diversity with respect to the type of fabric or garment, rather than the approach operation. The ironing phase occurs by breaking down operations in the department. It starts, in fact, by the worker assigned to the ironing of the garment shoulders to get the worker in charge of the overall ironing of the garment.

Following, there is the testing of the products, the garment is subjected to a general control for the identification of problems deriving from the production cycle such as, for example, lack of a button or inaccurate seam; and in a quality control through which occurs that the garment meets the technical characteristics required by the customer such as, for example, the measurement of a sleeve (See Figures 9 and 10).

**Figure 9**Ironing Board

**Figure 10**Ironing Department

On acceptance, any failed garments are reported to the customer that determines whether they should be repaired or intended to clothe of second grade. Garment rather than have successfully passed the check is sent to the shipping department. Scrupulousness during the manufacturing: every detail is performed by the help of modern latest generation equipment, but especially by the hands of craftsmen trained through the tradition of cutting, sewing and devoted to pass on their own

work heart, good taste, sensitiveness and effective intelligence. Each label entrusts its own projects and its productions to San Lorenzo Group, aware it can rely on the total availability of service and respect of the times, besides the ability necessary to understand and meet the opportunity to make interventions useful to improve work performance and technique of production.

#### *3.2.3.4 Distribution - Shipment*

In this phase, workers are involved in this stage, first of all, preparing the tag which indicates the type of fabric, the work order, the size and the customer, along with the single garment accessories. The finished garment is then identified by the tag.

Clothes are arranged according to size, they are then divided according to the number of sizes required by the customer and packaged (See fig. 11).

**Figure 11**Distribution - Shipment department

Thanks to the delivery note, the target countries of prepared garments for that particular customer are identified. Once these operations are completed, shipping takes place, almost always using a private carrier.

## 3.3 S-LCA of a textile product

The reference framework for the study is defined by the Guidelines for Social Life Cycle Assessment of Products[144], which reflects the structure of the standardized Life Cycle Assessment method. The S-LCA presented here assesses the social performance of a selected textile product and its impact, by adopting, for the characterization phase, the SAM method (Subcategory Assessment Method)[145]. The reference points for the implementation of SAM method are defined on the basis of norms and of the socio-economic and geographic context.[146]

The S-LCA allows for a more complete assessment of the social value of a product and offers the opportunity to shift the focus, rather than only on qualitative data, onto semi-quantitative and quantitative data relating to the social dimension, making the evaluation process more transparent and comprehensive.[147]

The development of this approach is the consideration that a social impact arises when a product interacts with the surrounding system and therefore gives rise to positive or negative consequences[148]. As a result, both the product and the company are analyzed in relation to their ability to contribute positively or negatively to a security zone, identified as "well-being".[149]

[144] UNEP / SETAC, 2009
[145] Sanchez Ramirez et al., 2014
[146] UNEP / SETAC, 2009
[147] Campanella, Petti, 2009
[148] Zamagni et al ., 2011.
[149]Weidema, 2006

This tool involves greater control of product social value and, if used consistently, can help the company to draw up its annual report on social and sustainable development and become a real reporting tool.[150]

### *3.3.1 Goal and scope definition and description of the product*

The purpose of a S-LCA study may correspond to different needs, which can range from the definition of the purchase specifications needed for a marketing and/or communication goal and labelling, to the development of public policies[151].

The evaluation of S-LCA focuses on the product and therefore need to construct and evaluate a product system. The product system is often depicted by a flow chart, formed by process chains that describes the main sequence of production.[152]

Another key issue regarding the first phase is the definition of the functional unit and the system boundaries.[153] Therefore, it plays an important role the definition of the product object in the study, the functional unit and the definition of the main objectives.

The goal of this study is to assess the main positive and negative social impacts related to a specific Italian textile product in order to consider the various social values of the product manufactured in a company that has a strong link with the territory and to highlight the strengths and weaknesses of the methodology in this specific sector. The purpose and ultimate scope of the analysis is to provide a useful tool for identifying the aspects to be taken into account by the company's strategic decision planning.

[150] Campanella, Petti, 2009
[151] UNEP and SETAC, 2009
[152] UNEP and SETAC, 2009
[153]Griesshammer et al., 2006

The definition of the boundaries of the system, as defined by the methodology of the S-LCA and the UNI ISO 14040, is needed to identify and determine the unit processes to be included in the study itself. It aims to define what are the basic processes for obtaining the product or service and to establish to what extent the study expands and then, what is included in the analysis.[154]

The functional unit of the study is one a garmentknitted in a soft blend of wool and cashmere (60% wool and 40% cashmere). The flow unit consists of 495 items of capes.It is used as a winter jacket to protect against cold and to be elegant at the same time (Figure 12). The design is accentuated with military-inspired polished golden metal buttons. The whole manufacturing process of the garment was carried out from August 2016 to October 2016.

**Figure 12** The textile product object of the study

Considering the numerous orders that the company receives from its customers, this garment was randomly chosen by the authors in order to represent general manufacture of the company.

The product analyzed contains characteristics common to almost all the products manufactured within the San Lorenzo Group. Indeed, it involves all the process

[154]UNEP and SETAC, 2009

units of the company (Cutting; Stitching; Ironing; Distribution – Shipment), common to almost all the products manufactured within the San Lorenzo Group. While, the raw materials (fabrics and accessories) are the only elements that differentiate one garment from another. In this study, in fact, the risk analysis was carried out taking into account the countries of origin of the fabrics and accessories of the selected garment.

The system boundaries follow a cradle-to-gate approach and include the stages of production of the raw materials, the production of fabrics and accessories, and the production process of the San Lorenzo Group for the manufacturing of the object of the study. Figure 13 shows the system boundaries of the study.

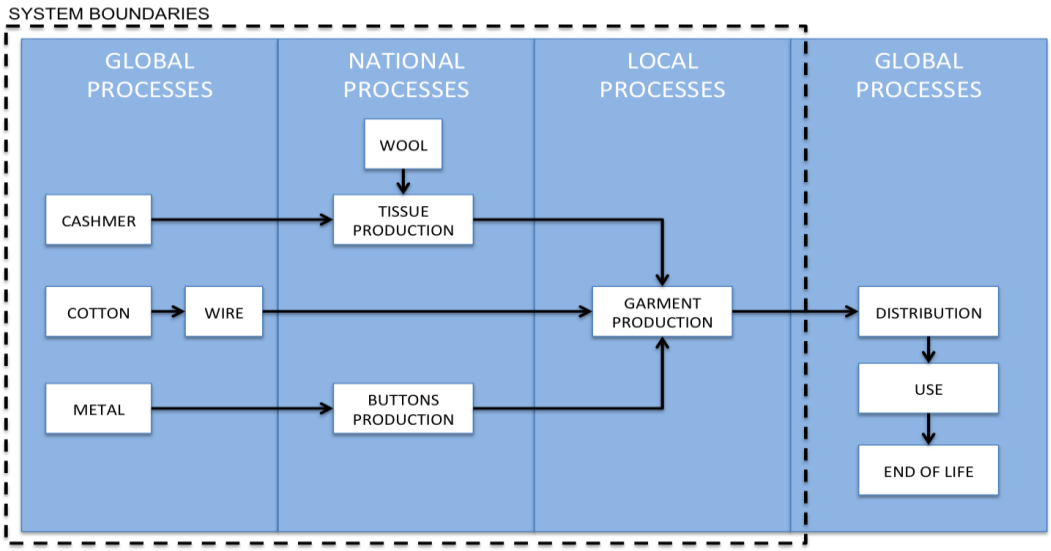


**Figure 13**System boundaries considered in the implementation

The S-LCA method defined by UNEP/SETAC (2009) suggests the involvement and assessment of five stakeholder categories (Table 1): "*stakeholder category is a cluster of stakeholders that are expected to have shared interests due to their similar relationship to the investigated product systems*"[155]. In addition, the guidelines provide a further element, Methodological Sheets, which are complementary documents of the UNEP/SETAC guidelines and better define the

[155] UNEP/SETAC, 2009

indicators to be used for each of the subcategories and suggest data sources and database. In the present study, for local processes, attention is focused on two of these stakeholder categories: "Workers" understood as actors directly involved in the production of the 495 capes; and "Local community" designating people living in the same territory where the San Lorenzo Group is located who are somehow affected in their role as users of local resources[156]. This choice will really emphasize the added value of the San Lorenzo Group in the local context in which it operates.

Given that, the study aims to highlight the social aspects of a product manufactured in a company that has a strong link with the territory. On the contrary, for national and global processes, data have been gathered through the Social Hotspots Database (SHDB), for which five Social Impact Categories have been assessed: Labour Rights and Decent Work, Health & Safety, Human Rights, Governance and Community Impacts.

### *3.3.2 Inventory Analysis*

In accordance with ISO 14040 and ISO 14044, the inventory analysis phase consists of data collection and calculation procedures to quantify relevant incoming and outgoing flows from a product system, in compliance with the objective and the scope.

Data collection includes both primary (at company level – local processes) and secondary data (at country–specific sector level – global and national processes). Although social impacts are mainly due to company behavior and the main scope of the analysis is to evaluate its influence on territorial values, country and sector

[156]De Luca, A. I., Iofrida, N., Strano, A., Falcone, G., & Gulisano, G. (2015). Social life cycle assessment and participatory approaches: a methodological proposal applied to citrus farming in Southern Italy. Integrated environmental assessment and management, 11(3), 383-396.

specific data are also taken into account; secondary data are taken into account for background processes through the use of the Social Hotspot Database.

For the foreground processes, primary data was gathered through questionnaires specifically designed for each stakeholder group (questionnaires are attached as an appendix), and structured with questions focused on evaluating each impact category.

To find information and necessary social data for the conduct of S-LCA study, questionnaires were prepared for each stakeholder (attached as an appendix), and structured with questions can examine each impact category. Three different questionnaires were used:

- Company questionnaire,
- Workers' questionnaire, and
- Local Community questionnaire.

The three questionnaires principally intend to obtain a triangulation of data received. The Company questionnaire was completed by the Human Resources Manager directly. The questionnaire consisted of 89 questions specifically aimed at evaluating the inventory data of each sub-category examined. The Workers' questionnaire was submitted, through direct interview, to company employees and the community questionnaire was completed directly by a sample of local citizens and institutions through direct interview**.**

Referring to the Local community, designating actors living in the same territory where the San Lorenzo Group is located, the questionnaire has the main objective of checking whether problems have arisen with the local community. In addition, it seeks to highlight and interpret a possible contribution of the company to the local community in question. The prepared Two questionnaires were prepared in this case as well: one for the company, completed by the head

of human resources, the other by several representatives of the local community for triangulation purposes. These include the mayor, opposition councilors, the priest and a sample of the citizens of San Marco d'Alunzio. The sample includes all the people that are somehow affected by the presence of the company on the territory. Consequently, in their role of residents at San Marco d'Alunzio, they can best express their opinion on the interaction of the company with the territory.

As regards the workers' questionnaire, the respondents are only those directly involved with the manufacturing of the functional unit, represented by 20 men and 23 women, of whom 12 people are aged between 18 and 30, 15 people are aged between 30 and 45, 12 people are aged between 46 and 55, and only 3 people are more than 55 (one worker did not answer the question). These respondents represent 20.8% of the total number of the company's employees, and approximately reflect the gender structure of the company's employees.

For background processes, secondary data were gathered through the Social Hotspots Database (SHDB). The database was created by New Earth over 3 years. It comprehends a Global Input-Output (IO) model resulting from the Global Trade Analysis Project, a Worker Hours Model developed utilising annual wage payments and wage rates by country and sector, and Social Theme Tables consist of 22 themes within five Social Impact Categories: Labour Rights and Decent Work, Health & Safety, Human Rights, Governance and Community Impacts. The data tables recognize social risks for over 100 indicators. Both the ranking of worker hour intensity and the risk levels across multiple social themes for the Country Specific Sectors (CSS) within a product category supply chain are utilized to estimate Social Hotspots Indexes (SHI) using an additive

weighting method. The CSS with the highest SHI are highlighted as social hotspots within the supply chain of the product in question.[157]

The primary data gathering was carried out in strong synergy with the San Lorenzo Group; the only problem was obtaining data and information from the customer that commissioned the garment from the San Lorenzo Group. Some assumptions had to be made in reference to the place of production of certain commodities (wool and metal buttons). Consequently, the countries of production of raw materials are assumed to be: Mongolia (for cashmere); Italy (for wool and metal buttons); Germany (for wire).

In addition, through the SHDB, the analysis was also extended to the textile process carried out in Italy.

#### *3.3.2.1 Impact categories.*
#### ***Subcategory: working hours***

The main purpose of the questions addressed to the company and the workers, regarding this subcategory, is to investigate the observance of working hours laid down by law, and highlight any anomalies.

In this regard, questions have been provided both for workers and for the company, in detail there are 11 questions put to the workers and 8 questions put to the company.

*Question one: "How many days do you work in a week?".*

Respondents could choose from four alternatives:

- Less than 4
- 5

[157] Clara Valente, Ingunn Saur Modahl and SynnøveRubach, Social Life Cycle Assessment: case studies from the textile to the nanotechnology sector; Ostfold Research, Stadion 4, N-1671 Kråkerøy, Norway.

- 6
- More than 6

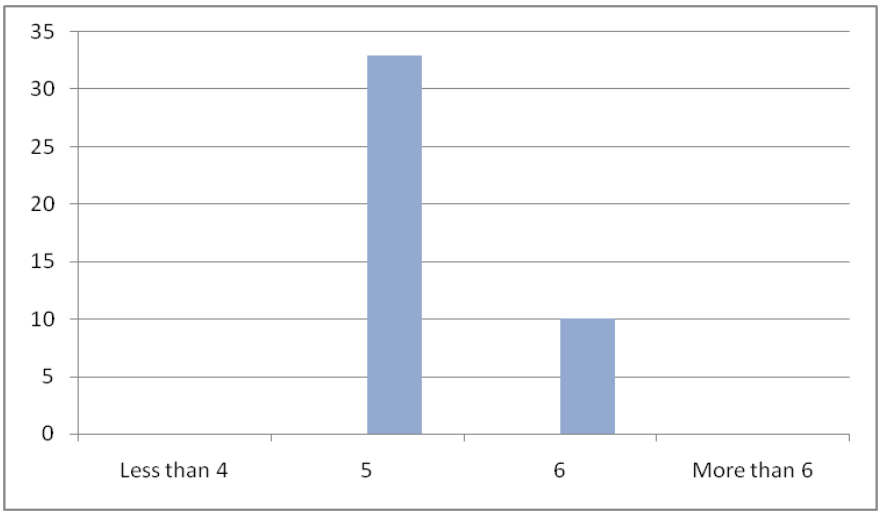


**Figure 14**Working in a week

From the figure 14it appears that no-one works four days a week, 33 people work 5 days a week and 10 people are employed for 6 days a week. No-one answered more than six days a week.

In this regard, art. 31 of the national collective bargaining agreement[158] establishes a rest period of 24 consecutive hours, preferably on Sundays, and for underage workers 2 rest days provided or otherwise not less than 36 consecutive hours. From the data collected we see that this feature is fully respected by the company and Sunday is a rest day scheduled for everyone.

Question 2:*"How many hours do you work a day on average?"*

Respondents could choose from three alternatives:

- 8
- More than 8
- Less than 8

[158]www.confterziario.it/CCNL/Industria/Tessili%20Industria.pdf

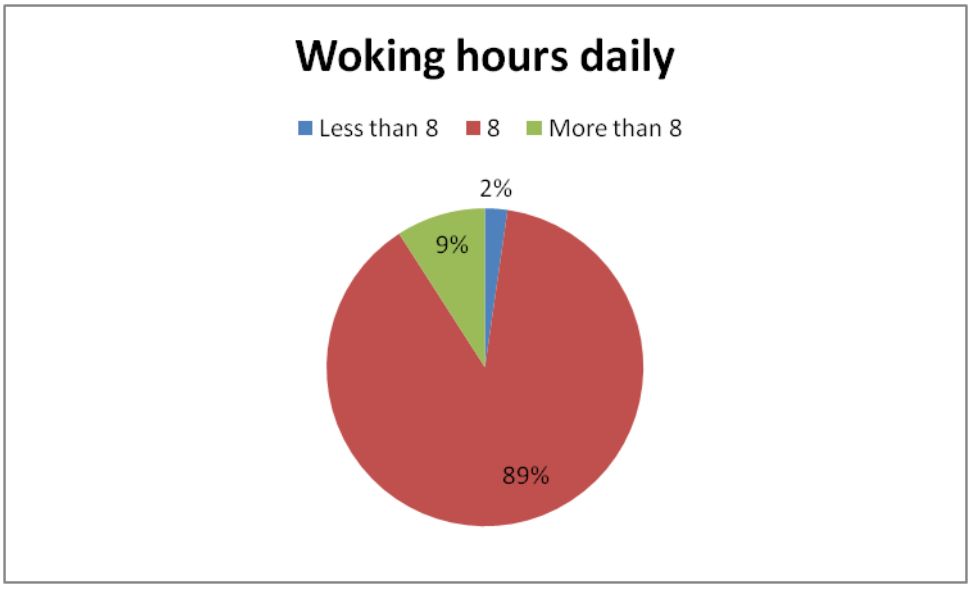


**Figure 15**Working hours daily

From the figure 15, 39 respondents work an average of 8 hours a day, four respondents work more than 8 hours a day and 1 person less than 8 hours.

Compliance with the legal limits for working time will be discussed subsequently.

The third question*: "How many working hours do you work in a week?"*.

It also includes three alternatives:

- 40;
- more than 40;
- less than 40.

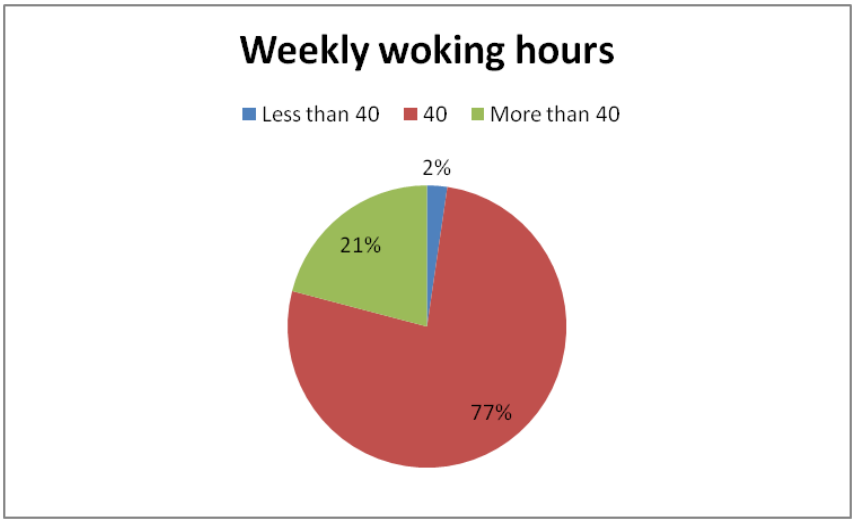


**Figure 16**Weekly working hours

The company has indicated ordinary 40 hours per week performed by its employees. From the figure 16, it shows how employees, 33 employees said they work 40 hours a week, 9 said they work more than 40 hours a week and one worker declared less than 40 hours.

In this light, Sections 3 and 4 of Decree n. 66/2003 fixed 40 hours per week as the normal working hours. Collective labour agreements may establish a shorter duration and relate the normal working hours to the average duration of work within a period not exceeding one year[159]. The average length of working time cannot in any case exceed, for each seven-day period, forty-eight hours, including overtime.

It should be specified that the period in which the data collection was carried out was characterized by a period of reduced production, in which nearly all workers (excluding those who have a part-time job) had a daily schedule of no more than 8 hours a day.

In fact, the fourth question required to indicate the months of the year when employee work more: *"Indicate the months of the year when production is more intense":*

[159] Legislative Decree of April 8, 2003, n. 66

- January;
- February;
- March;
- April;
- May;
- June;
- July;
- August;
- September;
- October;
- November;
- December.

All workers indicated January, June, July, November and December as the months in which the production is more intense.

Data were collected during the period August / October 2016.

Question 5, *"How many days of rest do you have in a week?"*, has three alternatives:

- 1;
- 2;
- more than 2.

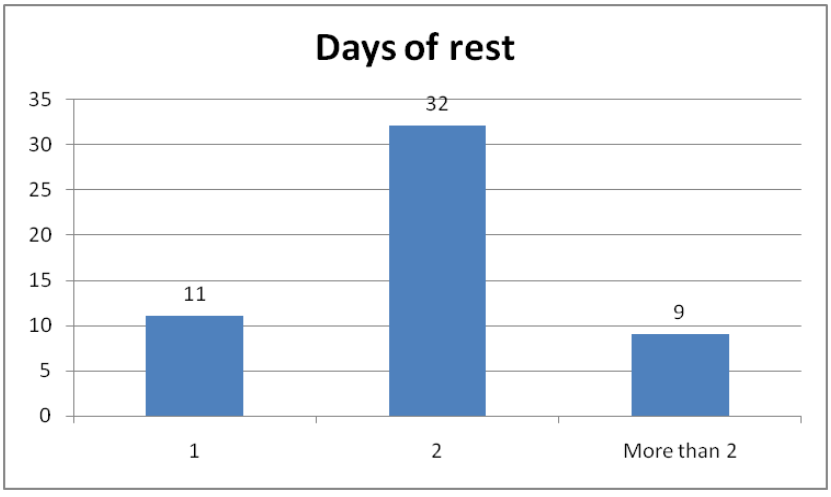


**Figure 17**Days of rest

In this case, 11 workers are entitled to a day off, 32 workers to two days and no employee more than two days (See Fig. 17). This confirms respect of the rules on rest days.

Question 6*: "On average, how many hours of overtime do you perform?"*, respondents could choose from three alternatives:

- 2;
- over 2;
- less than 2.

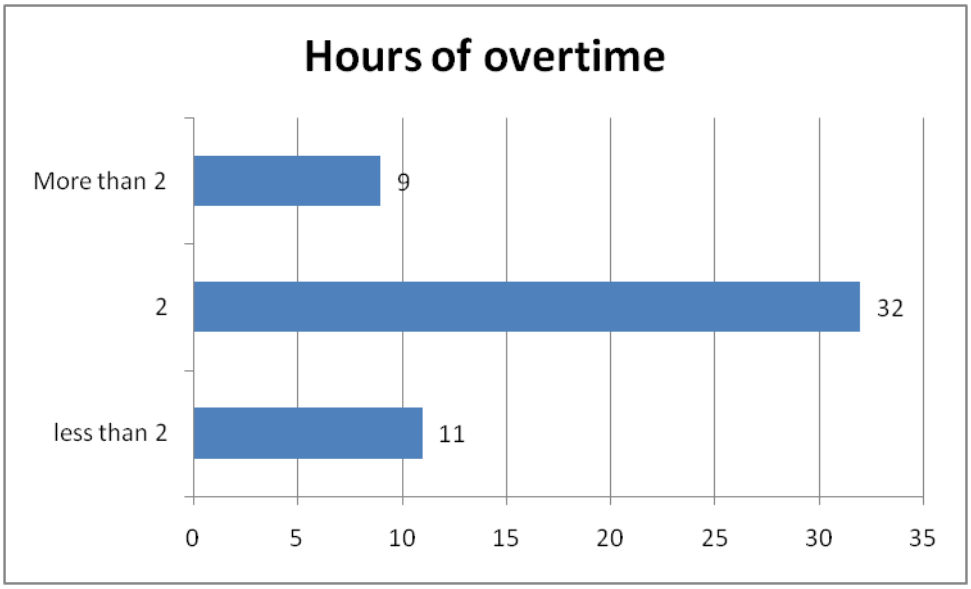


**Figure 18** Hours of overtime

According to figure18, 4 workers said they carry out two hours of overtime, 7 workers perform more than two hours of overtime, 19 workers perform less than 2 hours overtime, while 1 person answered none and 11 workers did not answer the question.

In the questionnaire Company were present 4 questions related to overtime:

1. *What is the percentage of workers who perform and receive overtime?*
2. *How many hours of overtime per week performed by the workers?*
3. *How many hours of overtime per year carried out by the workers?*

*4. On average, how many working hours per week carried out by the workers?*

The first question was answered 10% -15% on average. The second question was answered on average 30 hours a week. To the third question the response was on average 1600 hours. The fourth question 40 hours a week.

The company tried to give precise answers to these questions, although it is difficult to determine accurately the overtime hours performed by employees, because work is variable throughout the year.

From the point of view of the national collective bargaining agreement, also in this case, accurate data or better standards are not provided. According to art. 38 of the national collective bargaining agreement[160] workers can do up to two hours of overtime a day, which must be requested by the employer in cases of obvious need. In reference to the break during the working hours and lunch break were administered the following questions:

- Question 7*: "How long is the break during working hours?"*
- Question 8*: "If yes, how long they last and how often?";*

Most respondents indicated that there are no breaks during working hours except for the lunch break.

With regard to the time, all workers answered one hour, and in fact the lunch break lasts one hour; while as regards the "place", at the question 10*: "*Where is lunch eaten*?"*, respondents could choose from three alternatives:

- in the canteen;
- at home;
- in company, but not in the canteen.

[160] Contratto Collettivo Nazionale Di Lavoro Per I Dipendenti Da Aziende Artigiane Tessili Ed Affini. Available online: www.associazionealar.it/CCNL/Artigianato/Tessili%20Artigianato.pdf

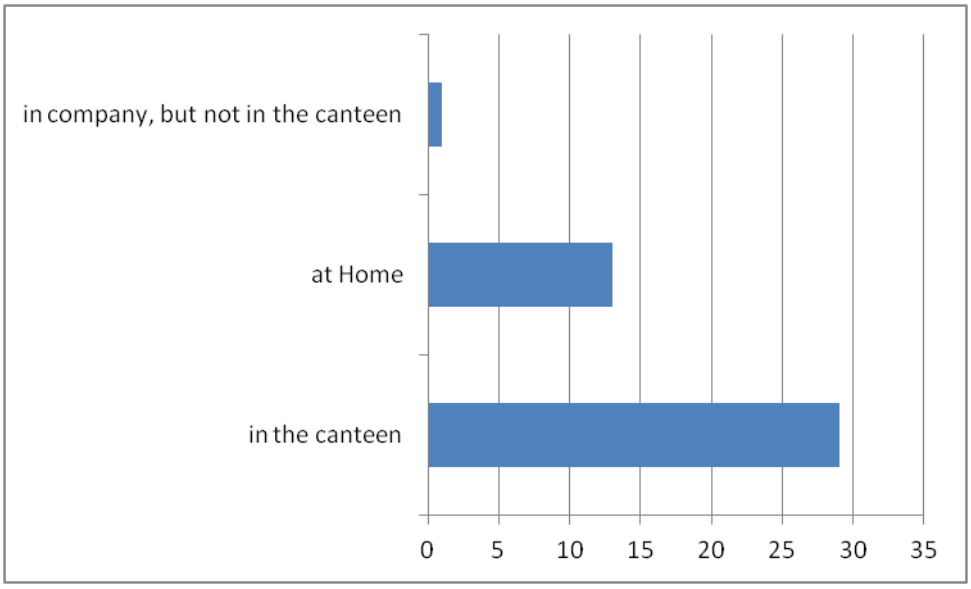

**Figure 19** Place for the lunch

According to figure 19, 29 respondents consume lunch in the canteen, 13 respondents consume lunch at home and only 1 person consumes lunch in the Company, but not in the canteen.

It was found that during the whole of the working day there is only one break, dedicated to the lunch break:

- from 12:00 to 13:00 for workers;
- from 13:00 to 14:00 for employees in offices.

Two time breaks exist because the canteen could not accommodate all employees simultaneously.

In relation to the latter question, the national collective bargaining agreement does not say anything about it, since these are generally company internal management features and the San Lorenzo Group is well structured because it allows full respect for human physical needs.

The company, regarding this subcategory, was subjected to another question, present in each sub-category, in order to test a possible proactive action towards its suppliers and / or other business partners. The relevant question, asked: *"Does*

*the company promote the respect of working hours prescribed by law towards its suppliers (or to the companies in the value chain)?"*, the company responded in a negative way.

***Sub-category: child labour***

Through this subcategory is meant to test the presence or absence in the company of child labour, indicating by this expression, workers who are aged less than that established by law. Article 13 of the national collective[161] bargaining agreement provides that paid work may not be offered to those who have not completed the period of compulsory education, or who are under 16 years old.

To the first question: *"Are there child labourers in the company where you work?"*, all respondents answered negatively.

Although the company, in the questions that were addressed in this subcategory states that there is no worker under the age of 18 years.

The company does not adopt special measures to prevent and/or reduce child labour and does not promote proactive actions towards limiting and protection towards its suppliers and or other business partners.

***Subcategory: Health and Safety***

This subcategory and questions prepared for questionnaires, have the fundamental objective to investigate the compliance with the measures on health and safety and on the prevention of any disease and/or injury in the workplace, in relation to Articles of the Negotiable, the DPR 27 April 1955 n. 547, the DPR 19 March 1956 n. 303.

[161]www.confterziario.it/CCNL/Industria/Tessili%20Industria.pdf

The questionnaire consists of 15 questions for workers and 25 for the Company. Most of the questions put to the workers had as alternative response: yes/no, and some of them, however, were open questions that provided a space to answer freely.

To the question: *"In carrying out your task, do you use tools or dangerous tools?"*, 30 respondents answered no and 13 respondents answered yes.

To the question: *"Do you use machinery to carry out your task?"*, 29 respondents answered yes and 14 respondents answered no. All tools and machinery they use could be dangerous if not used wisely.

To the question: "*Do you consider risky your activity*?", 37 respondents answered no and 6 respondents answered yes.Again, respondents do not perceive any particular risk in connection with their work activity, despite it being exhausting work. In succession to this question, there is another one asking: *"Do you use appropriate equipment to protect yourself against health risks*?": 16 respondents said yes, 27 respondents said no and only one subject did not answer the question. Article 71 of the Consolidated Safety Act[162] stipulates that it is the duty of the employer to have the means and the necessary equipment for the prevention of potential risks and duty of the workers is to comply with these requirements.

Most workers interviewed did not present any special clothing except for an orange lab coat for women and blue for men.

*Question 16: "Is your workplace there is noise pollution?"*

[162] Gazzetta Ufficiale n. 101 del 30 aprile 2008 - Suppl. Ordinario n. 108, *D.lgs. 9 aprile 2008, n. 81 Testo coordinato con il D.Lgs. 3 agosto 2009*, n. 106; www.lavoro.gov.it.

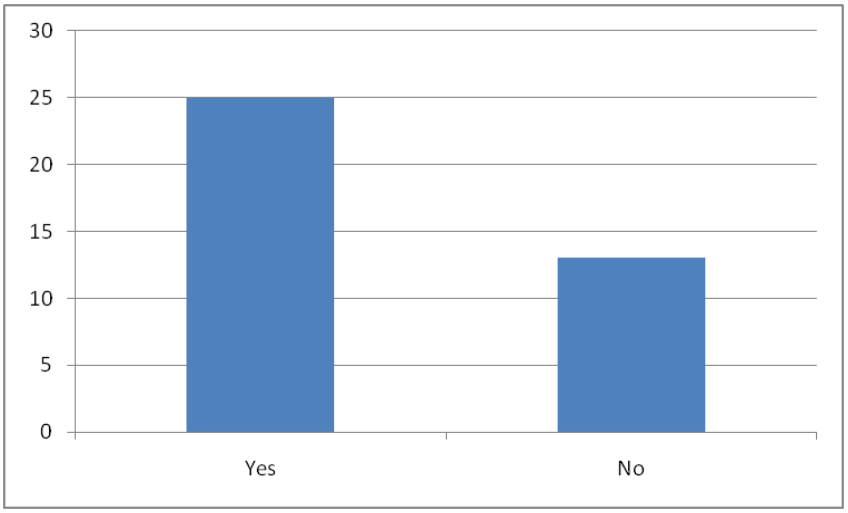

**Figura20**Noise pollution

The figure 20 shows that 25 respondents answered yes, 13 respondents answered no and 5 respondents did not answer.

The question itself, The San Lorenzo group responded negatively to this question. This shows a gap between the information provided.

Risk assessment in the workplace is regulated by Legislative Decree n. 81\08 as amended by implementing Directive 2003/10/EC. According to Article 190 of this Decree, the employer must assess the personal daily occupational exposure of each individual worker. Calculation of this parameter may be achieved through the measurement of the noise of the machines and equipment present in the company, related then to the residence time of the worker in the workplace.

During the inspection, a strong presence of noise pollution was found, especially in the cutting department.

To the question: *"Are you covered by health insurance?"*, 100% of respondents answered in the affirmative. All, in fact, have an employment contract and all are covered by health insurance for any injuries and/or illnesses. Moreover, from 2015, for employees with at least four years of service and their families additional medical care is available at health facilities in the area, at the expense of the San Lorenzo Group. This initiative in some way embodies the mission of

the San Lorenzo Group in social aspects, with particular attention towards its employees and their families, especially to protect their health.

To the question: *"Do you perform tasks that can be harmful to your health?",* 32 respondents answered no, 10 answered yes and only one respondent did not answer. In the next question: *"Are you at risk of injuries during your work duty? If yes which one?",* only 3, of the 10 respondents who answered yes, indicated injuries with needles or scissors or being victims of accidents as a consequence of the machinery used. The remaining 32 said they did not perceive any dangers in connection with the work activity.

In the following question: *"Can you freely expose any problems to the owner?"* 40 respondents answered yes and 3 respondents answered no.

In fact, when asked to indicate the prescribed manner, 38 out of 40 workers responded by speaking about the problems personally to the management. This confirms the high degree of availability and willingness to dialogue on the part of the owner.

On the question: *"Does the company offer you courses of training/update on health and safety?*", Employees all answered yes. The company invests and trains its employees in connection with accident prevention programs; they are held every 3/5 years in the company.

The company with respect to this subcategory showed:

- the presence of a formal policy on health and safety, according to law, characterized by information and training;
- the realization of a Risk Assessment Document aimed at preventive measures and protection (energy and evacuation plan, emergency signs, fire doors, etc.);

- the presence of preventive measures and emergency procedures for accidents and/or injuries, Intervention by First Aid and Communications INAIL;
- the presence of preventive and emergency procedures in the sector of chemical substances (dry stain remover for tissues), as shown by the SDS;
- the presence of programs and training plans in terms of accidents for workers through business training that takes place every five years;

Finally, the company does not promote to its suppliers (or to the value chain companies) compliance with the health and safety rights of workers required by law.

In general, it can be said that the company complies with the main health and safety in the workplace in order to safeguard the safety of its employees.

These rules are contained in the Consolidated Security, the DPR April 27 1955 n. 547 "Regulations for the prevention of accidents at work" and the Presidential Decree on March 19 1956 n. 303 "*General requirements for the hygienic*". In particular, referring to the latter normative data, the Company respects and has adapted its structure business (in the 2000) in relation to art. 36-37-39, which respectively provide for the availability of drinking water, the presence of showers and toilets.

***Subcategory: fair wages***

The sub-category in question, refers to the important topic of remuneration. The questionnaires have been structured in order to investigate about the "good conduct" of the company in relation to qualitative and quantitative distribution of wages.

The first question asked to respondents, was to get information about the type of business. All respondents said they were workers. The questionnaire consists of four questions for workers and 14 for the company. To the second question: "*Which kind of employment contract have you got?*", based on the proposed alternatives, figure 21 shows the results obtained.

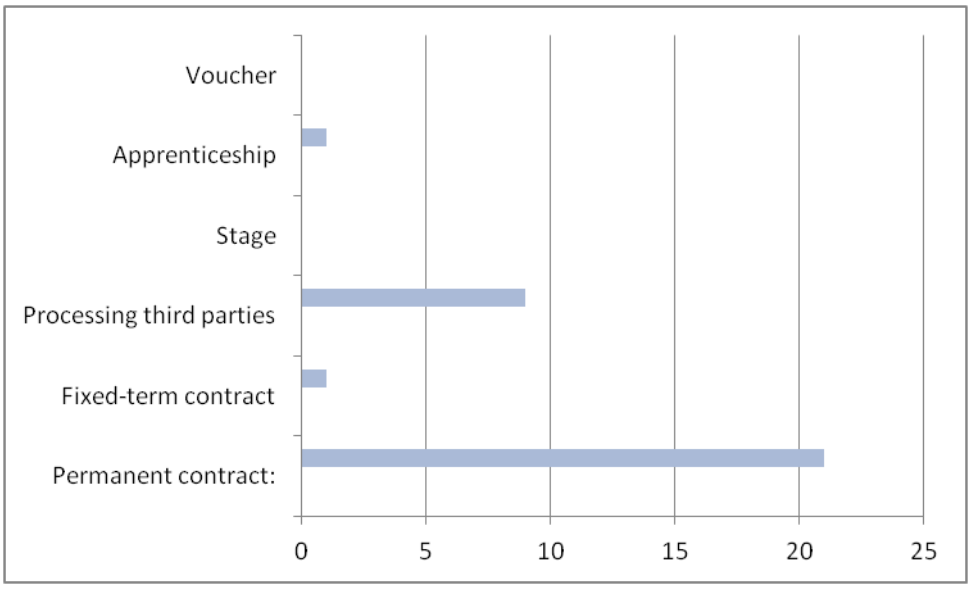


**Figure 21**Employment contracts

Almost all of the respondents claimed to have a permanent contract, only one of them has an apprenticeship contract, 9 have a third account contract and 11 employees did not answer the question; All types of contracts provided for by art. 10 of the national collective[163] bargaining agreement.Confirmed by the company, which also declares use of another type of contract: Stage using the "Shops of Trade and Innovation Project" funded by Italy Jobs.

To the question: "*How often is the salary paid?*", 36 respondents reported each month and only 7 respondents said they receive payment of wages every 45 days. The company claims to pay its employees every month.So there is a

[163]www.confterziario.it/CCNL/Industria/Tessili%20Industria.pdf

discrepancy between the claims, but certainly all are regularly paid and there is evidence through payroll, pay slips, bank transfers, though not always in a regular manner.

To the question: "*Can you meet the basic needs with your current salary?*", to this question, the company response is yes.

To the same question, the company response is yes. The next question on how does the company is able to monitor such a statement has put: "applying the minimum wage provided for by the collective bargaining table."

Surely it is rather a personal question and depends on the lifestyle led by the interviewee. However, the question shows that, almost all of them are satisfied with their salary.

In this regard, National Collective Bargaining Agreement[164] (art. 22):

- the company did not provide any information about the salary received by the manager;
- the value of the minimum wage in relation to the administrative sector amounted to € 8.06 per hour;
- the value of the minimum wage for production, in relation to the duties carried out by the workers is 4.52 EUR/Hour, while the supervisor earns 6.99 EUR/Hour.

The company therefore complies with the criteria imposed by the National Collective Agreement.[165]

Finally, the company does not promote to its suppliers (or to the companies in the chain of value) providing fair wages to their own employees.

[164] www.ebac-campania.org/media/attachments/ccnl/CCNL_Tessile_-_Abbigliamento_-_Calzature.pdf

[165] www.ebrau.it/public/file/ApprProf_DOC/settori/TESSILI%20E%20ABBIGLIAMENTO%20_%20Aziende%20Artigiane/CCNL,%20per%20i%20dipendenti%20dalle%20imprese%20artigiane%20dei%20settori%20tessile%20abbigliamento%20e%20calzaturiero.pdf

***Subcategory: rights of association and collective bargaining***

In this section, the freedom of association for workers and trade union membership is discusses. The questionnaire consists of two questions for the company and for the employees.

To the question: "*Are you member of any trade union association?*", all respondents answered no: this is also confirmed by the company.

Since membership of trade unions by workers is free, it cannot be said that the company circumvents the law. Membership of trade unions and the appointment of representatives in the company is desirable, but not mandatory.

***Subcategory: equal opportunity / discrimination***

To the question, "*Do you notice any form of discrimination?"*, all respondents answered negatively.

To the question: *"Is there a policy of equal opportunities within the company?*", 35 responded yes, 3 in a negative way, while 5 did not respond. Respondents feel a sense of security from the owner of the company and feel protected in case of "*ill-treatment*". The company says that there is no formal policy in this regard although it offers full availability to dialogue and resolution of any problems.

To the question: "*Have there been cases of discrimination over the past five years?*", 36 respondents answered no, 5 did not respond. The company confirms the general trend, stating that in the last five years there have been no cases of discrimination.

To the question: *"Are there women who work in the company?*", 41 said yes and 2 people did not respond. In fact, during the inspection, the presence of women in the company was clear; indeed, they are in the majority.

The company states that the number of women in the company is 134, while there are 74 men. In addition, several women are in leadership positions. In addition, there is a woman with a disability.

Finally, the company does not promote to its suppliers (or to the value chain companies) compliance and the creation of equal conditions.

***Subcategory: forced labour***

As defined in the ILO Convention. 29 of the 'International Labour Organization[166], forced labour is understood as all work or service exacted under the threat of sanctions and for which the person has not offered himself voluntarily. Although a convention of the International Labour Organization calls for an abolition of forced labour, it is still practiced in some countries. In certain other nations forced labour is regulated by law. In Italy forced labour was abolished in 1957[167]. The questionnaire consists of 4 questions for workers and 4 questions for the company.

To the question: "*Does the employment contract provide for: wages, salaries, other?*", 35 respondents answered in the affirmative, 1 subject said no, 6 subjects gave no response and 1 employee added other under "*Productivity Bonus*". The company responded affirmatively to the same question.

To the question: "Is that clear who signed the contract in its entirety?", 42 respondents said yes and only one no. The company confirms that all employees have understood the meaning of each part of the signed contract, responding to the doubts and questions posed by employees.

To the question: "*Is the worker free to resign at any time?*", 39 respondents answered yes, 1 no and 3did not respond. The company instead declares that the

[166]International LabourOrganization, 2012
[167]International LabourOrganization, 2012

worker is free to resign at any time, within the limits laid down by law, articles 70 and 71 of the national collective[168] bargaining agreement according to which 2 months' notice is required for termination and a month for resignation.

The company also says not to hold personal documents of the worker and does not promote to its business partners policies that prohibit forced labour.

To the question: "*How soon will you retire?*", one interviewee said, "in less than 10 years", 32 respondents in more than 20 years and 3 subjects did not respond. This statement is justifiable given the high level of young workers, or under the age of 55. Of the 43 respondents, 12 employees are below the age of 30, 15 aged between 30 and 44 years and 12 aged between 45 and 55 years.

Finally, the company claims to provide the following social benefits:

- Retirement;
- Subsidy for disability / illness / injury;
- Subsidy for dependents;
- Paid maternity or paternity leave;
- Education and Training;
- Holiday / vacation;
- Right to Education;
- Other (month's bonus salary).

The employees interviewed in relation to the above benefits, all claim to receive contributions (retirement), health care, education and maternity/unpaid paternity leave, end of year bonus, as most are permanent workers. Three also said they make use of study permits. While 11 workers did not provide any response. These results are shown in figure 22. In general, it can be said that the

[168] www.confterziario.it/CCNL/Industria/Tessili%20Industria.pdf

company complies with the requirements set out in art. 45 of the national collective bargaining agreement.[169]

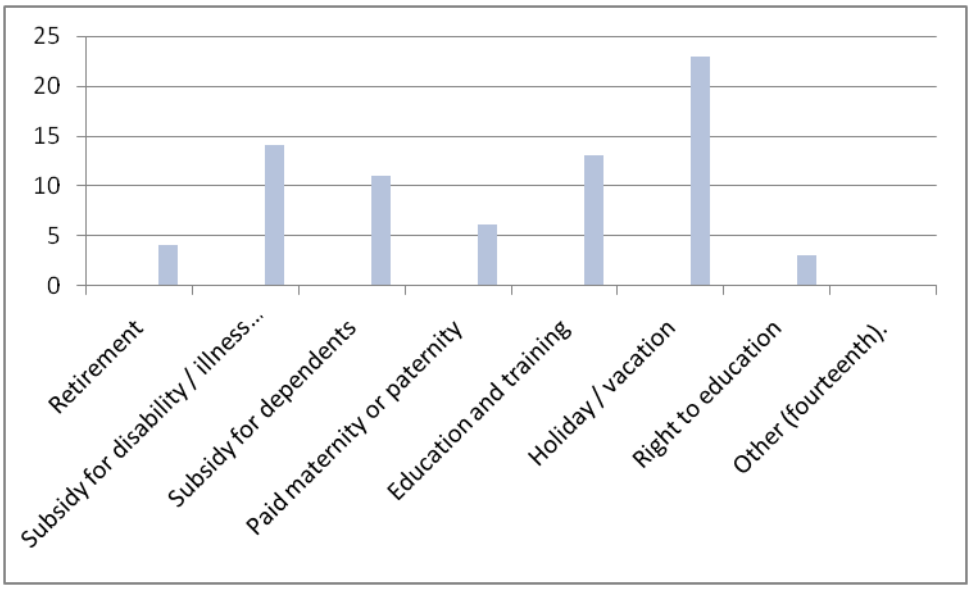


**Figure22** Social Benefits

***3.3.2.2 Analysis of the questionnaires. Stakeholders: Local Communities***

The main objective of the questionnaires concerning that second stakeholders, is to check whether problems have arisen with regard to the local community. In addition, it seeks to highlight and interpret a possible contribution of the company to the local community in question.

The prepared questionnaires are two: one for the company, whose completion is entrusted to the head of human resources, the other by several representatives of the local community needed for triangulation. These include the mayor, opposition councillors, the priest and a sample of the citizens of San Marco d'Alunzio.

Even in this case, the questions are structured according subcategories indicated by UNEP and SETAC (2009) and have the characteristic of being open all, so as to give the interviewee full freedom of response.

[169]www.confterziario.it/CCNL/Industria/Tessili%20Industria.pdf

***Subcategory: commitment to the local communities***

The purpose of this sub category is to verify whether the company participates actively and is committed to the promotion and development of the local community.[170]

To the question: "*Is there a policy and / or practice of the company in favour of the local community?*", both the company and the representative of the local community answered no, nor are meetings held between the company and the residents the local community, as confirmed by the representative of the local community.

To the question: "*Does the company support the initiatives of the local community?*", the company and the representative of the local community said yes. The company also says that its work consists in the sponsorship of events organized by the municipality.

But, the company does not promote to its suppliers these practices towards the commitment of local community.

***Subcategory: cultural heritage***

This subcategory aims identifying the company's commitment to the enhancement and/or the local cultural heritage protection.[171]

To the question: "*Does the company finance/support/promote cultural, artistic events or local cultural heritage?*", the company and the community representatives gave an affirmative answer.

Furthermore, the company declares that it finances and promotes cultural and artistic events such as making charitable collections, making a financial

[170]Methodological Sheets, UNEP / SETAC, 2010
[171]Methodological Sheets, UNEP / SETAC, 2010

contribution, to the restructuring of some churches located in San Marco d'Alunzio.[172] Various representatives of the local community who were interviewed also confirm this. Beyond these statements, it should be highlighted that the mere fact of being a company that carries out a particular type of hand processing, double-face, is already a factor in promoting the cultural heritage.

The San Lorenzo Group also contributes to cultural heritage promotion in neighbouring towns, indeed it has helped to create the Museum of Sicilian Costume and Fashion at Mirto (ME), and attended a conference aimed at enhancing the traditions and the revival of the textile industry in the Nebrodi area, at Sant'Agata di Militello (ME).

Finally, the company does not promote policies towards its suppliers and business partners and/or practices aimed at respecting the cultural heritage.

***Subcategory: local employment***

The sub-category in question wants to investigate about the company's willingness to take on local workers and to avail themselves of local suppliers.[173]

The company, based on the answers provided, claims that 86%[174] of its employees come from the same area, which extends in a radius of 60 km from the enterprise. However, the San Lorenzo Group does not use local suppliers, because it is not possible. Representatives of the local community also confirm this.The company has 206 workers including 178 Italians and 28 from Romania (although resident in San Marco d'Alunzio). In addition, the company does not promote its local employment practices to its business partners.

[172]San Marco d'Alunzio is part of the circuit of the most beautiful towns in Italy, inside the Nebrodi Park. It is a village with 22 churches, the largest number of churches in any town in the province of Messina

[173] Methodological Sheets, UNEP / SETAC, 2010

[174] The company has 206 workers including 178 Italians and 28 from Romania (although residents in San Marco d'Alunzio).

***Subcategory: access to intangible resources***

The subcategory in question tends to inquire about the company's commitment oriented to encourage and provide to the local and foreign communities[175] greater access to intangible resources.[176]

The company claims (and most of the representative of the local community confirm) to offer services to its employees, residing in San Marco d'Alunzio, literacy courses and Italian language lessons for non-Italian employees, in order to create real integration among employees not only in the factory but also in the community in which they live. In support of this, every Wednesday, the parish priest of San Marco d'Alunzio, gives foreign employees of the San Lorenzo Group the chance to hold Orthodox celebrations. The company claims that this has been possible thanks to the intervention of the owner of the San Lorenzo Group, Filippo Miracula.

### *3.3.3Impact assessment: evaluation of the social performance*

Evaluating and interpreting social performance is often difficult and frequently presents a great challenge. To date, few methods and tools that help the assessment of social impacts on a global scale and over several tiers of a product supply chain are available[177]. An example is the social impact assessment method Type 1 presented by the UNEP/SETAC guidelines[178]. It consists of a two-step assessment: 1) data are related to subcategories (carried out using performance reference points); 2) the subcategories can be consolidated into one category that may be human well-being or equity of relationship.

[175]Foreign community working in the farm, mostly from Romania.
[176]Methodological Sheets, UNEP / SETAC, 2010
[177]Jørgensen, A.; Hauschild, M. Z.; Jørgensen, M. S.; Wangel, A. *Relevance and feasibility of social life cycle assessment from a company perspective*,The International Journal of Life Cycle Assessment 14(3):204-214 · May 2009
[178] UNEP/SETAC, 2009

To provide a more objective assessment, in this study SAM method (type I) is used to evaluate the primary data from the company, and the SHDB (type I) to evaluate the secondary data of the upstream supply chain.[179]

SAM is based on the framework from UNEP/SETAC guidelines and employs a four-level scale for each subcategory. This method allows an organization to be analysed according to its behaviour considering 4 levels (A, B, C and D)[180] to which a numeric scale is associated (Table 1), which transforms the qualitative data into quantitative data, providing a method to semi-qualitative characterization.

**Table 1**Subcategory Assessment Method (SAM)[181]

| Level | A | B | C | D |
|---|---|---|---|---|
| Assessment | 4 | 3 | 2 | 1 |

SAM evaluates the social profile of organizations involved in the product life cycle in relation to the satisfaction of Basic Requirements (BR). The BR are defined according to the indicators contained in the Methodological Sheets[182] (Table 2):

- level A means that the organization demonstrates proactive behaviour towards the basic requirement, as it promotes and fulfils the requirement also towards its suppliers or value chain;

[179]Ramirez P. K. S., Petti L., Ugaya C. M. L.,(2012) Subcategory Assessment Method (SAM) for S-LCA consumer stakeholder: *method and application on a family Italian winner*, in: 6th SETAC World Congress/SETAC Europe 22nd Annual Meeting, Berlin, Germany.

[180] Ramirez, P. K. S., Petti, L., & Ugaya, C. M. L. (2012). Subcategory Assessment Method (SAM) for S-LCA: stakeholder "worker" and "consumer". *What is sustainable technology? The role of life cycle-based methods in addressing the challenges of sustainability assessment of technologies*, 65.

[181] Ramirez, P. K. S., Petti, L., & Ugaya, C. M. L. (2012). Subcategory Assessment Method (SAM) for S-LCA: stakeholder "worker" and "consumer". *What is sustainable technology? The role of life cycle-based methods in addressing the challenges of sustainability assessment of technologies*, 65.

[182] UNEP/SETAC, 2013

- the organization that respects the basic requirement shall be assessed in the level scale B;
- classes C and D identify the aspects that do not meet the basic requirement.[183]

**Table 2**Subcategory Assessment Method (SAM) for S-LCA: level and definition

| Level | Definition |
|---|---|
| A | the organization shows a proactive behaviour than the basic requirement, as it promotes and fulfils the requirement also towards its suppliers or value chain |
| B | the organization respects the basic requirement |
| C | the organization present inconsistency or there are no evidence that respects the basic requirements |
| D | the organization presents high several non compliance with the ILO norms. |

But, it should be pointed out that SAM assesses organizations in relation to BR's performance: this does not allow highlighting positive actions beyond BR favoring continuous improvement. Moreover, SAM application may reflect different interpretations in relation to what is the understanding of the evidence; in these cases, it is suggested to perform a sensitivity analysis.[184]

Despite these limits, the method allows objectivity in analyzing the organization's behavior through the life cycle of the product. It can transform qualitative data into quantitative data.[185]

[183] Sanchez Ramirez, P. K.; Petti, L.; Lie Ugaya, C. M., *Subcategory Assessment Method (Sam) For S-Lca: Stakeholder "Worker" and "Consumer"*, 65-71, 2012

[184]Ramirez, P. K. S., Petti, L., Haberland, N. T., & Ugaya, C. M. L. (2014). Subcategory assessment method for social life cycle assessment. Part 1: methodological framework. *The International Journal of Life Cycle Assessment*, *19*(8), 1515-1523.

[185]Ramirez, P. K. S., Petti, L., Haberland, N. T., & Ugaya, C. M. L. (2014). Subcategory assessment method for social life cycle assessment. Part 1: methodological framework. *The International Journal of Life Cycle Assessment*, *19*(8), 1515-1523.

The goal of the S-LCA study is to assess the main social impacts related to a specific Italian textile product in order to consider the various social values of the product manufactured in a company that has a strong link with the territory. Indeed, from the results summarized in table 3, in reference to the product object of the study, it is clear that the San Lorenzo Group has embarked on the path of social responsibility, establishing a strong relationship with its employees and the territory.

**Table3.** Evaluations at company level- Method SAM

| Stakeholders | Subcategory | Level | Assessment |
|---|---|---|---|
| Worker | Freedom of Association and Collective Bargaining | C | 2 |
| | Child Labour | B | 3 |
| | Working Hours | B | 3 |
| | Forced Labour | B | 3 |
| | Equal Opportunities/ Discrimination | A | 4 |
| | Fair Wages | B | 3 |
| | Health and Safety | A | 4 |
| | Social and Social Security Benefits | A | 4 |
| Local Community | Commitment To Local Communities | B | 3 |
| | Cultural Heritage | A | 4 |
| | Local Employment | B | 3 |
| | Access to Intangible Resources | A | 4 |

This has enabled the achievement of numerous benefits, including improving business performance, reducing operating costs, enhancing image and reputation, increasing sales and customer loyalty, increasing productivity and quality, increased ability to attract and retain employees and improvements in relations with public authorities. The quality of life of the individuals outside of the firm (strongly linked to the company's life) represents a competitive advantage and produce a durable condition of harmony.[186]

Analyzing the results obtained (Table 3), it can be said that the studied company, for the product analyzed, try to have a positive impact on the company's environment focusing on the security, the integration and the sociality aspects. Of course, a positive work environment involves greater satisfaction on the part of workers and therefore greater commitment and better performance. This has also enabled the company to win over people who find consistency between their own values and those of the company, thus allowing on the one hand reduction of the costs of recruitment and selection and, on the other hand, employment of people consistent with what the company represents.

The results related to the analyzed product highlight that the studied company is a socially responsible company, which takes into account the expectations of its workers, assuming an attitude inclined to meet their needs (in terms of safety, pay and career). In respect the unit functional, it has adopted appropriate policies to develop and to consider staff as a component of its competitive advantage. Thanks to these policies, the company has a qualified, engaged and committed staff, with all the advantages that derive from this.

For the manufacture of the product object of the study, the company embarked on a path of social responsibility, establishing a strong relationship with its

[186]Aquilani, B., Silvestri, C., Ioppolo, G., & Ruggieri, A. (2017). The challenging transition to bio-economies: Towards a new framework integrating corporate sustainability and value co-creation. *Journal of Cleaner Production.*

employees and the territory. For example, the company hires home workers, thus making it possible for older workers or people who are not able to move to maintain their economic independence, carrying on the tradition of “double-face” needlework. In addition, results highlighted that the workers do not perceive their work activity as dangerous. Indeed, no accidents have been recorded in the past five years, consequence the company seems to apply all the measures relating to health and safety. The organization not only respects the national law on health and safety, but it does provide, at his expense, additional health coverage to older employees and their families.

Moreover, the company implements a policy in favor of the local community; during the year, the company sponsors events organized by the municipality. The company promotes and finances cultural and artistic events such as making charitable collections, making a financial contribution to the restructuring of some churches located in San Marco d'Alunzio. Beyond these situations, it should be highlighted that the mere fact of being a company that carries out a particular type of hand processing, double-face, is already a factor in promoting the cultural heritage. This has allowed new generations to learn a precise art of sewing, which was in danger of being abandoned. The studied company also contributes to the promotion of cultural heritage in neighboring villages; indeed it has helped to create the Museum of the Sicilian Costume and Fashion at Mirto (ME), and attended a conference aimed at enhancing the traditions and the revival of the textile industry in the Nebrodi, at Sant'Agata di Militello (ME).

Finally, the company provides its employees with a company canteen, company nursery and various corporate buses for transporting employees from neighboring towns. In addition, for workers residing in San Marco d'Alunzio, the study case offers literacy courses and Italian language lessons for non-Italian

employees, in order to create real integration among employees not only in the factory but also in the community in which they live. In support of this, every Wednesday, the parish priest of San Marco d'Alunzio gives foreign employees of the case study the chance to hold Orthodox celebrations.

However, the table 3 shows that the only point in which the company obtained a "C" concerns “Freedom of Association and Collective Bargaining”. Since membership of labour unions by workers is free, it cannot be said that the company evades the law.[187] The abstention by workers is probably due to the fact that they do not feel the need to join the labour union since they already feel protected and respected by the company. Besides, analysis of the questionnaires highlights the lack of proactive action against suppliers and other players in the value chain of the company. For this reason, it was thought an evaluation of the supply chain stages in the country-specific sector (background processes) of the object of the study should be carried out.

For the background processes, generic data were gathered through the SHDB system in order to identify a first-cut list of prioritized potential social impacts over the entire product category supply chain. In particular, the SHDB, developed by Benoît-Norris among others[188], is a Web Portal that opens up a world of social impact information for use by corporate directors, investors, product designers, supply chain managers, policy makers, academic researchers, international organizations, and others. Interactive and visual, the new Web Portal offers transparent information about social risks and opportunities in 227 countries and 57 sectors. It draws upon hundreds of data sources such as the International Labour Organization, the World Health Organization, the U.S.

[187]International Labour Organisation (Ilo). Available Online: Http://Www.Laboursta.Ilo.Org.

[188] Norris, G. A.; Benoit-Norris, C. (2015). The Social Hotspots Database Context of the SHDB. In *The Sustainability Practitioner’s Guide to Social Analysis and Assessment*, Common Ground, Murray, J.; Mcbain, D.; Wiedmann, T, 52-73

Department of Labour and State, the World Bank, and more.[189] SHDB data are characterized according to the level of risk or opportunity (four-level scale) of an occurring social aspect instead of the real positive or negative impact experienced. The characterization levels are determined based on distributions of data for all countries or by consensus among experts. For S-LCA general knowledge on where the production activities are taking place is necessary, because of societal, political and cultural differences. The SHDB Social Theme Tables list indicator data and qualitative information characterized according to the level of risk (low, medium, high, and very high).[190] Sector data is not applicable or available for all indicators but is used when relevant and accessible, like for child labour and wage rates.

The textile industry in Italy may generate moderate social impacts in the supply chain. Table 5 shows the average weighted risk across all issues for each theme within the category: Low risks were weighted at 0, Medium at 1, High at 5, and Very High at 10. The CSS of interest are the country of production of raw materials. According to the sources considered[191], table 4 and 5 indicate the issues with very high risk at the country level in the countries involved.

[189]Norris, G. A.; Benoit-Norris, C. (2015). The Social Hotspots Database Context of the SHDB. In *The Sustainability Practitioner's Guide to Social Analysis and Assessment*, Common Ground, Murray, J.; Mcbain, D.; Wiedmann, T, 52-73.

[190] Rodríguez-Serrano, I., & Caldés, N. (2017). 6 The potential contribution of solar thermal electricity (STE) in Mexico in the light of the Paris Agreements. *Environmental and Economic Impacts of Decarbonization: Input-Output Studies on the Consequences of the 2015 Paris Agreements*, 108.

[191]The Global Risks Report 2017 12th Edition. Available online: www.weforum.org/docs/GRR17_Report_web.pdf.

**Table 4.**Characterization results- Method SHDB- sectors and textile process in Italy

| | Theme | Characterized Issue | Country-specific sector | Risk Value | Characterized Results |
|---|---|---|---|---|---|
| *Labour rights& Decent work* | Working Time | Risk of excessive working time by sector | Italy (wool)<br>Italy (Metal production)<br>Italy (textile process) | 1,000<br>1,000<br>1,000 | Medium<br>Medium<br>Medium |
| | Freedom of association and collective bargaining | Risk that a country lacks or does not enforce Freedom of Association rights | Italy (wool)<br>Italy (Metal production)<br>Italy (textile process)) | 1,000<br>1,000<br>1,000 | Medium<br>Medium<br>Medium |
| | Labour Laws | Risk that country does not provide adequate labour laws | Italy (wool)<br>Italy (Metal production)<br>Italy (textile process) | 0,753<br>0,505<br>0,505 | Low<br>Low<br>Low |
| | Child labour | Risk of Child Labour in sector, Total | Italy (wool)<br>Italy (Metal production)<br>Italy (textile process) | No data<br>No data<br>No data | No Data<br>No Data<br>No Data |
| | Forced Labour | Risk of Forced Labour by Sector | Italy (wool)<br>Italy (Metal production)<br>Italy (textile process) | 0,258<br>0,258<br>0,258 | Low<br>Low<br>Low |
| *Health and Safety* | Occupational Injuries & Deaths | Risk of no access to an Improved Source of Drinking Water-total | Italy (wool)<br>Italy (Metal production)<br>Italy (textile process) | 7,750<br>5,500<br>5,500 | High<br>High<br>High |
| | Occupational Toxics & Hazards | Risk of loss of life years by airborne particulates in occupation | Italy (wool)<br>Italy (Metal production)<br>Italy (textile process) | 2,448<br>2,448<br>2,448 | Medium<br>Medium<br>Medium |
| *Human Rights* | Gender Equity | Risk of Gender inequality by Sector based on representation in the workforce | Italy (wool)<br>Italy (Metal production)<br>Italy (textile process) | 1,006<br>1,006<br>1,006 | Low<br>Low<br>Low |
| | Human Health Communicable Diseases | Risk of Mortality from Communicable Diseases | Italy (wool)<br>Italy (Metal production)<br>Italy (textile process) | 1,805<br>1,805<br>1,805 | Medium<br>Medium<br>Medium |
| | Human Health Non communicable Diseases and other health risks | Risk of Mortality from Non-communicable Diseases | Italy (wool)<br>Italy (Metal production)<br>Italy (textile process) | 0,384<br>0,384<br>0,384 | Low<br>Low<br>Low |
| | Indigenous Rights | Risk that indigenous people are negatively impacted at sector | Italy (wool)<br>Italy (Metal buttons)<br>Italy (textile process) | No Evidence<br>No Evidence<br>No Evidence | Low<br>Low<br>Low |
| *Governance* | Corruption | Risk that corruption is a hindrance to doing business in a country | Italy (wool)<br>Italy (Metal production)<br>Italy (textile process)) | 3,402<br>3,402<br>3,402 | Medium<br>Medium<br>Medium |
| | Legal System | Overall Risk of fragility in the legal system | Italy (wool)<br>Italy (Metal production)<br>Italy (textile process) | 1,800<br>1,800<br>1,800 | Medium<br>Medium<br>Medium |
| *Local Community* | Access to Improved Sanitation | Risk of no access to an Improved Source of Sanitation | Italy (wool)<br>Italy (Metal production)<br>Italy (textile process) | No data<br>No data<br>No data | No Data<br>No Data<br>No Data |
| | Access to Improved Drinking Water | Risk of no access to an Improved Source of Drinking Water-total | Italy (wool)<br>Italy (Metal production)<br>Italy (textile process) | No data<br>No data<br>No data | No Data<br>No Data<br>No Data |
| | Access to Hospital Beds | Risk that there are too few hospital beds to support population | Italy (wool)<br>Italy (Metal production)<br>Italy (textile process) | 1,000<br>1,000<br>1,000 | Low<br>Low<br>Low |

**Table 5.**Characterizationresults- Method SHDB

| | Theme | Characterized Issue | Country-specific sector | Risk Value | Characterized Results |
|---|---|---|---|---|---|
| *Labour rights& Decent work* | Working Time | Risk of excessive working time by sector | Mongolia | No data | No Data |
| | | | Italy (wool) | 1,000 | Medium |
| | | | Italy (Metal production) | 1,000 | Medium |
| | | | Germany (wire) | 1,000 | Medium |
| | Freedom of association and collective bargaining | Risk that a country lacks or does not enforce Freedom of Association rights | Mongolia | 5,333 | High |
| | | | Italy (wool) | 1,000 | Medium |
| | | | Italy (Metal production) | 1,000 | Medium |
| | | | Germany (wire) | 1,000 | Medium |
| | Labour Laws | Risk that country does not provide adequate labour laws | Mongolia | 5,202 | High |
| | | | Italy (wool) | 0,753 | Low |
| | | | Italy (Metal production) | 0,505 | Low |
| | | | Germany (wire) | 0,505 | Low |
| | Child labour | Risk of Child Labour in sector, Total | Mongolia | 7,500 | Very High |
| | | | Italy (wool) | No data | No Data |
| | | | Italy (Metal production) | No data | No Data |
| | | | Germany (wire) | No data | No Data |
| | Forced Labour | Risk of Forced Labour by Sector | Mongolia | 1,000 | Medium |
| | | | Italy (wool) | 0,258 | Low |
| | | | Italy (Metal production) | 0,258 | Low |
| | | | Germany (wire) | 0,258 | Low |
| *Health and Safety* | Occupational Injuries & Deaths | Risk of no access to an Improved Source of Drinking Water-total | Mongolia | 2,000 | Medium |
| | | | Italy (wool) | 7,750 | High |
| | | | Italy (Metal production) | 5,500 | High |
| | | | Germany (wire) | 0,010 | Low |
| | Occupational Toxics & Hazards | Risk of loss of life years by airborne particulates in occupation | Mongolia | 5,278 | High |
| | | | Italy (wool) | 2,448 | Medium |
| | | | Italy (Metal production) | 2,448 | Medium |
| | | | Germany (wire) | 2,448 | Medium |
| *Human Rights* | Gender Equity | Risk of Gender inequality by Sector based on representation in the workforce | Mongolia | 1,571 | Low |
| | | | Italy (wool) | 1,006 | Low |
| | | | Italy (Metal production) | 1,006 | Low |
| | | | Germany (wire) | 0,151 | Low |
| | Human Health Communicable Diseases | Risk of Mortality from Communicable Diseases | Mongolia | 1,140 | Medium |
| | | | Italy (wool) | 1,805 | Medium |
| | | | Italy (Metal production) | 1,805 | Medium |
| | | | Germany (wire) | 0,741 | Low |
| | Human Health Non communicable Diseases and other health risks | Risk of Mortality from Non-communicable Diseases | Mongolia | 3,753 | Medium |
| | | | Italy (wool) | 0,384 | Low |
| | | | Italy (Metal production) | 0,384 | Low |
| | | | Germany (wire) | 0,741 | Low |
| | Indigenous Rights | Risk that indigenous people are negatively impacted at sector | Mongolia | 2,600 | Medium |
| | | | Italy (wool) | No Evidence | Low |
| | | | Italy (Metal buttons) | No Evidence | Low |
| | | | Germany (wire) | No Evidence | Low |
| *Governance* | Corruption | Risk that corruption is a hindrance to doing business in a country | Mongolia | 5,002 | High |
| | | | Italy (wool) | 3,402 | Medium |
| | | | Italy (Metal production) | 3,402 | Medium |
| | | | Germany (wire) | 0,010 | Low |
| | Legal System | Overall Risk of fragility in the legal system | Mongolia | 7,000 | High |
| | | | Italy (wool) | 1,800 | Medium |
| | | | Italy (Metal production) | 1,800 | Medium |
| | | | Germany (wire) | 0,406 | Low |
| *Local Community* | Access to Improved Sanitation | Risk of no access to an Improved Source of Sanitation | Mongolia | 5,000 | High |
| | | | Italy (wool) | No data | No Data |
| | | | Italy (Metal production) | No data | No Data |
| | | | Germany (wire) | No data | No Data |
| | Access to Improved Drinking Water | Risk of no access to an Improved Source of Drinking Water-total | Mongolia | 3,337 | Medium |
| | | | Italy (wool) | No data | No Data |
| | | | Italy (Metal production) | No data | No Data |
| | | | Germany (wire) | No data | No Data |
| | Access to Hospital Beds | Risk that there are too few hospital beds to support population | Mongolia | No data | No Data |
| | | | Italy (wool) | 1,000 | Low |
| | | | Italy (Metal production) | 1,000 | Low |
| | | | Germany (wire) | 0,010 | Low |

In most cases, the differences range within different levels (e.g. from low to very high). According to the results, in table 5, the cashmere sector appears to be the most relevant sector along the supply chain for this textile product. A difficulty is identified for Working Time, in Mongolia: the indicator is not available. Regarding 'working time', the risk value is higher for Italy and Germany, because we must consider that countries having a better counting and reporting system are being penalized when they are compared, for example, with emerging countries.[192]

In recent years, in Mongolia the textile industry has contributed to the growth of the economy: Mongolia has thus become the third cashmere producer in the world; with a total world share of 30% (it is not a coincidence that Italy is increasing trade relations between the two countries precisely in this area).[193]

In general, in Mongolia some of the themes for the various categories are at the medium level. However, the results still show various "hot" social problems, such as: Access to Improved Sanitation (5,000); Legal System (7,000); Corruption (5,002); Occupational Toxics & Hazards (5,278); Access to Improved Sanitation (5,000) and especially Child Labour is a very important social problem (7,500).

Despite Mongolia being one of the emerging countries, in the small rural communities everybody lends a hand in the management of the family and cattle. Hence, for most children it is almost impossible to receive a complete

[192]Martínez-Blanco, J., Lehmann, A., Muñoz, P., Antón, A., Traverso, M., Rieradevall, J., &Finkbeiner, M. (2014). Application challenges for the social Life Cycle Assessment of fertilizers within life cycle sustainability assessment. *Journal of cleaner production*, *69*, 34-48.

[193] A study of value delivery system in Mongolian cashmere industry: from brand equity perspective. 2008.

education.[194] Consequently, this situation has created a major social disease, child labour, despite it being expressly forbidden.

On the other hand, in Italy and Germany, the results for all stakeholders do not appear to have a uniform trend for different subcategories. Germany (Wire) is the country with social problems at low levels. In Italy, despite being a developed country, both the Metal product and Wool sectors have various difficulties at the Governance level and Health and Safety level. These two issues are considerable social problems. Corruption seems to be a particularly chronic problem in Italian society. Corruption not only creates injustice, but also severely damages the country's economic life; Italians should regain the values of responsibility and respect for the rules.

As shown in table 4, the analysis was also extended to the textile process carried out in Italy. The results confirm the same social problems identified in Italian sectors analyzed: Metal product and Wool sectors. Using only the SHDB national-data, the results underlined only the classic social issues in Italy already mentioned in the other sectors. On the contrary, using the primary data and the SAM method, it was possible to highlight that the presence of the San Lorenzo Group allows a better social condition (i.e. job-creation and its best practice), in fact the area in which the company is localised is not so critical.

Considering that the product object of the study was randomly selected by the authors (and not by the company) and that it has similar characteristics to almost all the products produced within the company, it is possible to extend the evaluation of the product to the whole social behavior of the company. In reference to the local community, the evaluation is at the company level, because

[194]Department of Labour's. Findings on the worst forms of child labour. Available online: www.dol.gov/sites/default/files/documents/ilab/reports/childlabour/findings/2015TDA.pdf

the perception of the respondents is not related to the single product, but to the whole company production process.

Therefore, through an overall evaluation of all phases, it is noted that the study case, both at corporate and local levels, applies a careful and well-structured social policy, obtaining a positive assessment by applying the SAM method (Table 3). Yet, the company does not adopt special measures to prevent and/or reduce social problems and does not promote proactive actions towards limiting and protecting its suppliers and or other business partners. Surely, the application of S-LCA, would be very beneficial for the company as it may identify those suppliers and customers with the best social performance, in order to guide decision-making and promote projects and sustainability pathways, through evaluation of the entire life cycle of the product.

## 3.4Limits of the study

There are few studies on textiles industry focused on the measurement of the social impacts of clothing products, even if the textile sector, in the last years, is facing a huge challenge in terms of social impacts especially working conditions, child labour and so on. Choosing the right tool to suit the needs of different players in the field of sustainability is very much crucial.[195]

S-LCA can be used for the measurement of the social impacts of textiles and clothing products but some weaknesses still affect the method and its implementation in this context. The main problem refers to a limited availability of data, or their total absence in different processes or activities.[196] Also in this

[195] Muthu, S. S. (2017). Evaluation of Sustainability in Textile Industry. In *Sustainability in the Textile Industry* (pp. 9-15). Springer Singapore.

[196]Benoît-Norris, C., Vickery-Niederman, G., Valdivia, S., Franze, J., Traverso, M., Ciroth, A., &Mazijn, B. (2011). Introducing the UNEP/SETAC methodological sheets for subcategories of social LCA. *The international journal of life cycle assessment*, *16*(7), 682-690.

case study problems[197]have been encountered in finding information from customers and suppliers of the company being analyzed.

This limitation, however, have been overcome through an approach based on the two values levels. So far, the papers in the literature apply the SAM and SHDB methods distinctly; the SAM method is used to parse the primary data (company level), while the SHDB method is used to analyze generic data (national and global). This approach is not new been already similarly implemented in Padilla-Rivera et al.[198], Vuaillat et al.[199], and Martínez-Blanco et al..[200]

But at the same time, the combined useof these two methods lead to a fundamental shortage: the SAM method allows for a true impact analysis, while with the SHDB method only a risk analysis is obtained and it is not possible to aggregate the results.

In addition, the SHDB is one of the few databases that can be found in literature; this shows a further shortage of S-LCA: both databases and indicators are difficult to find, especially at a small business level.[201] However, this challenge could be resolved with improved future databases.[202]

Another limitation is the impossibility of the company to check their suppliers for lack of means and power. This is a specific characteristic of the textile and

[197]Martínez-Blanco, J., Lehmann, A., Muñoz, P., Antón, A., Traverso, M., Rieradevall, J., &Finkbeiner, M. (2014). Application challenges for the social Life Cycle Assessment of fertilizers within life cycle sustainability assessment. *Journal of cleaner production*, *69*, 34-48.

[198]Padilla-Rivera, A.J., Güereca, L.P., Morgan, J.M., Noyola, A., 2013. Social life cycle assessment: a comparison of waste treatment facilities in Mexico. In: International Seminar on Social LCA, May 06e07, Montréal, Canada. Available at: www.ciraig.org/en/evenement/seminaire_ACVs/acv-sociale_programme_conf_e.php.

[199]Vuaillat, M., Jouanne, G., Le Pochat, S., &Yousnadj, D. (2013, May). Environmental and social life cycle assessment of a new biobased material in Brazil. In *Proceedings of the 3rd International seminar in Social LCA, 6-7 May 2013, Montreal, Canada*.

[200]Martínez-Blanco, J., Lehmann, A., Muñoz, P., Antón, A., Traverso, M., Rieradevall, J., &Finkbeiner, M. (2014). Application challenges for the social Life Cycle Assessment of fertilizers within life cycle sustainability assessment. *Journal of cleaner production*, *69*, 34-48.

[201]Franze, J., &Ciroth, A. (2011). A comparison of cut roses from Ecuador and the Netherlands. *The International Journal of Life Cycle Assessment*, *16*(4), 366-379.

[202]Lehmann, A., Zschieschang, E., Traverso, M., Finkbeiner, M., & Schebek, L. (2013). Social aspects for sustainability assessment of technologies—challenges for social life cycle assessment (SLCA). *The International Journal of Life Cycle Assessment*, *18*(8), 1581-1592.

clothing industry, in which manufacturing firms (generally SMEs) have a limited power to control the decisions along the supply chain, generally controlled by multinationals or the big fashion companies. Often, market games are so strong that they do not allow a company to prefer a supplier rather than another or to be able to test whether that vendor applies a sustainability policy.

Surely, there are further difficulties for a significant and reliable application, mainly due to the complexity of social indicators selection and the weighting system between the three pillars of sustainability. But, the great strength of the methodology is that of creating a full review on a product, going to add the social aspects of the latter to the environmental and economic aspects.

## 3.5Conclusions

The implementation of the Social Life Cycle Assessment method, defined by the UNEP/SETAC S-LCA guidelines, to a specific Italian textile product highlighted that local processes fully respect human needs and local communities. Indeed, the firm has embarked on a path of local social responsibility, establishing a strong relationship with its employees and the territory. But, the textile production chain is complex and long, thus preventing the company from adopting special measures to prevent and/or reduce social problems at national/global level and does not promote proactive actions towards limiting and protecting its suppliers and/or other business partners.

This shows that the problem is not at the local level, but problems arise at the national/global level. The studied company is located downstream in the production chain, while the customers, the giants of the textile sector, do not demonstrate any attention to the social aspects. In particular, the analysis shows

that in multinationals the concept of social sustainability is not prominent; it is not a priority.

Greater investments are needed, so that companies can learn the necessary culture in order to understand that sustainability is a competitive key factor for businesses in all economic sectors, because it increases the added value of a company, especially in terms of image and credibility, in addition to improving the relationship with all stakeholders.

The company perceived positively the results obtained, and has decided to match the social results with the environmental certifications that owns, in order to improve its visibility and commitment to the local community.

In reference to the S-LCA method, this study combines, but not integrates, two approaches for the social impact assessment: SAM method and SHDB, involving diverse stakeholders. These different approaches gave greater efficiency and efficacy to the application of S-LCA as a decision-making tool. The decision maker may choose the decision alternatives leading to the most favorable social impacts.

However, assessment of the social impacts of a product, through the assessment of its life cycle, which is still not extensively used, lacks proper quantitative indicators. Indeed, the methodology presents certain complications, above all in relation to the procedures of application (e.g., data retrieval, a limited availability of data, or their total absence in different processes or activities). The difficulty is to link social indicators with the functional unit of the system/product to make them convenient and considerable. Precisely for this reason, the current

qualitative and semi-quantitative approaches suffer from a lack of quantitative and well-defined indicators.[203]

At the same time, the S-LCA allows companies to conduct its business easily in a socially responsible manner, helps companies to identify further improvement goals and encourages the company's social performance with a life cycle perspective. In particular, the social sustainability is a priority and competitive key factor for businesses in all economic sectors, because it increases the added value of a company, especially in terms of image and credibility, in addition to improving the relationship with all stakeholders.[204] However, there are still difficulties for significant and reliable application of the S-LCA, consequently, further developments are still needed to improve the S-LCA technique.

[203]Peri, G., Rizzo, G., & Traverso, M. (2010). Is there a need for more effective quality awards for agritourisms?. *World Applied Sciences Journal*, *10*(Tourism & Hospitality), 153-163.
[204]Leavy, B. (2013). VenkatRamaswamy–a ten-year perspective on how the value co-creation revolution is transforming competition. *Strategy& Leadership*, *41*(6), 11-17.

# Paper III

# Life Cycle Assessment of an Italian Textile Product: the case study of “San Lorenzo Group” (Italy)

## 4.1 Introduction

The textile industry is one of the most important sectors worldwide due to its high economic performance. Indeed, according to the market research report carried out by the IBIS world (2017), the global apparel manufacturing presents a revenue of 700 billion USD in 2017, with a growth rate of 4.5% from 2012 to 2017, and it presented 5.8 million employees in 2015[205;206].

Regarding the European context, the clothing and textile sectors accounted for about 177,600 companies in 2016, and the leading producers are represented by, Italy, that is the main producer with more than 50,000 companies, followed by Germany, United Kingdom, France and Spain[207]. This sector contributed for 3.4% of the manufacturing sector, 3.8% of the economic value added and 6.9% of the industrial employment, in 2012, in Europe[208]. Nevertheless, the textile industry is also responsible for high environmental impacts, representing one of the most polluting sectors[209]. These environmental impacts occur throughout the whole life cycle from raw material production to the disposal practices[203]. In particular, the main environmental consequences are related to the electricity and water consumption, chemical consumption and transportation[206]. For instance, the cotton textile products annually cause about 107.5 million tonnes of $CO_2$ equivalent, corresponding to the emissions of all passenger cars in New York for two years[210].

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[205]IBISworld. (2017). https://www.ibisworld.com/industry-trends/global-industry-reports.
[206]Muthu, S. S. (Ed.). (2017). *Sustainability in the Textile Industry*. Springer Singapore.
[207]Statista. (2017). https://www.statista.com/statistics/417761/eu-europeanuniontextileclothingmanufacturing-companies/
[208]Nunes, L. J. R., Matias, J. C. O., & Catalão, J. P. S. (2013, September). Economic evaluation and experimental setup of biomass energy as sustainable alternative for textile industry. In *Power Engineering Conference (UPEC), 2013 48th International Universities'* (pp. 1-6). IEEE.
[209]Resta, B., Gaiardelli, P., Pinto, R., & Dotti, S. (2016). Enhancing environmental management in the textile sector: An Organisational-Life Cycle Assessment approach. *Journal of Cleaner Production*, *135*, 620-632.
[210]Kirchain, R., Olivetti, E., Miller, T. R., & Greene, S. (2015). Sustainable apparel materials. *Materials Systems Laboratory, Massachusetts Institute of Technology, Cambridge*.

Recently, the textile industries are more involved in the improvement of the sustainability performance of their production systems because of the high demand for environmental-friendly products[211]. In this context, an example is represented by the OEKO-TEX® certification, that is a standard developed in 1992 (Switzerland) and specialized in textile products. This standard concerns in testing all the production stages from raw materials to the final products and it can be obtained by companies that do not use harmful substances which can cause damage for the environment (environmental quality assurance) and health. The OEKO-TEX® certification has involved about 8,500 companies in 80 countries[212;213].

Currently, there are different methods for assessing the environmental impacts of products and for improving their performance by considering a life cycle perspective. In this context, the Life Cycle Thinking is one of the most important approaches for evaluating the sustainability of a product and it allows to assess the environmental, social and economic impacts of a product among its whole life cycle. Regarding the assessment of the environmental impacts, the Life Cycle Assessment is undoubtedly one of the most appreciated tools to assist product-related decision-making.

The LCA method has been largely applied in the textile sector in order to assess different stages of the production process, such as the agricultural phase and fibre production, textile processing, use and disposal. Yacout et al. (2016) assessed the environmental impacts of the synthetic fibres' manufacturing process, by quantifying regional and global impacts, and proposing improvement practices for their reduction. The analysis underscored that the main impacts are

[211]Resta, B., Gaiardelli, P., Pinto, R., & Dotti, S. (2016). Enhancing environmental management in the textile sector: An Organisational-Life Cycle Assessment approach. *Journal of Cleaner Production*, *135*, 620-632.
[212]Muthu, S. S. (Ed.). (2017). *Sustainability in the Textile Industry*. Springer Singapore.
[213]OEKO-TEX® https://www.oeko-tex.com/en/business/certifications_and_services/ots_100/ots_100_start.xhtml.

connected to the fossil fuel depletion related to the high energy consumption for the production[214]. Parisi et al. (2015) applied the LCA method to evaluate the environmental impacts of new strategies for textile industry in comparison to classical dyeing processes. The results underscored that environmental benefits can be obtained through the reduction of energy, water and raw materials consumption[215]. Baydar et al. (2015) compared the environmental impacts of Eco T-shirts produced from organically grown cotton and processed with green dyeing recipe, and conventional T-shirts. The elimination of nitrogen and phosphorus containing chemical based fertilizers used for the production of conventional cotton allowed a high reduction of the environmental impacts, considering, in particular, the aquatic eutrophication impact category. The results also showed that the highest environmental impacts are related to the Global Warming Potential (GWP) due to the use phase, both Eco T-shirts and conventional ones. The authors pointed out that the utilisation of sustainable raw materials in all life cycle stages of cotton textile products may allow the reduction of the environmental impacts[216]. Sandin et al. (2013) assessed water and land use impacts of five wood-based textile fibre production scenarios and carried out a comparison with two cotton production scenario. The aim was to account forum certainties in the future location of operations. The results highlighted that the water use impacts are directly related to the location of operations, indeed the water extracted from water stressed environments leads to higher impacts. Furthermore, the land use impacts are mainly related to the

[214]Yacout, D. M., El-Kawi, M. A., & Hassouna, M. S. (2016). Cradle to gate environmental impact assessment of acrylic fiber manufacturing. *The International Journal of Life Cycle Assessment*, *21*(3), 326-336.
[215]Parisi, M. L., Fatarella, E., Spinelli, D., Pogni, R., & Basosi, R. (2015). Environmental impact assessment of an eco-efficient production for coloured textiles. *Journal of Cleaner Production*, *108*, 514-524
[216]Baydar, G., Ciliz, N., & Mammadov, A. (2015). Life cycle assessment of cotton textile products in Turkey. *Resources, Conservation and Recycling*, *104*, 213-223.

transformation of natural land[217]. Walser et al. (2011) performed a cradle-to-grave LCA in order to nanosilver T-shirts with conventional T-shirts with and without biocidal treatment. The results in terms of climate footprint shows that the environmental impacts of a nanosilver T-shirt are higher than a conventional T-shirt. The authors also highlighted that lower washing frequencies can decrease the environmental impacts related to the nanosilver T-shirt production[218]. Barber and Pellow (2006) carried out a detailed inventory of resource inputs for New Zealand merino wool an assessed its total energy use. The results showed that main impacts of merino wool fibre production, in terms of energy use are due to the on-farm activities which contributed for two thirds of carbon dioxide emissions[219]. Morley et al. (2006) assessed and compared the recycling, recovery and reuse processes for different second-hand clothing. The analysis highlighted that the reuse of clothing allowed higher environmental benefits over recycling or disposal[220]. An important activity for environmental-friendly textile product was represented by the EU COST Action 628 that had the aim to produce industrial environmental data of textiles in Europe and to propose tools for comparing present technologies and practices with cleaner applications, in the context of the best available technologies (BAT). The action also proposed criteria for the Environmental Product Declaration (EPD)

[217]Sandin, G., Peters, G. M., & Svanström, M. (2013). Moving down the cause-effect chain of water and land use impacts: An LCA case study of textile fibres. *Resources, Conservation and Recycling*, *73*, 104-113.
[218]Walser, T., Demou, E., Lang, D. J., & Hellweg, S. (2011). Prospective environmental life cycle assessment of nanosilver T-shirts. *Environmental science & technology*, *45*(10), 4570.
[219]Barber, A., & Pellow, G. (2006, November). LCA: New Zealand merino wool total energy use. In *5th Australian Life Cycle Assessment Society (ALCAS) Conference* (pp. 22-24).
[220]Morley, N., Slater, S., Russell, S., Tipper, M., & Ward, G. D. (2006). Recycling of low grade clothing waste. *Oakdene Hollins, Salvation Army Trading Company, Nonwovens Innovation and Research*.

standards to be applied in the textile sector. These criteria were evaluated through the application of the LCA method[221].

The literature overview has underscored that the environmental performance related to the textile sector have been largely evaluated. Nevertheless, there is a lack of information regarding the assessment of the textile product's sustainability considering the environmental, social and economic pillars. In this context, the aim of this paper is to assess the potential environmental impacts of a specific product (garment knitted) made by a textile factory (San Lorenzo Group) operating in Sicily (Italy) and located in San Marco d'Alunzio (Messina), through the LCA method. The results from this paper allow, on the one hand, to develop a first assessment of the environmental consequences related to the investigated product, on the other, to broaden the previous study presented into the paper II, in which the social impacts, positive or negative, related to the same product, were evaluated. The scope of these two papers is to carry out a first evaluation of the San Lorenzo Group company by combining and analysing the social and environmental performance, since the social and environmental assessment and reporting is still an uncommon business practice in Sicilian companies.

## 4.2 Material and methods

The potential environmental impacts of the garment knitted made by the textile factory San Lorenzo Group was assessed by applying the LCA method. LCA is a standardised tool that allows to assess the potential environmental impact associated with a product, service or process throughout its entire life cycle, from

[221]Nieminen, E., Linke, M., Tobler, M., & Vander Beke, B. (2007). EU COST Action 628: life cycle assessment (LCA) of textile products, eco-efficiency and definition of best available technology (BAT) of textile processing. *Journal of Cleaner Production*, *15*(13), 1259-1270.

raw material extraction and processing, through manufacturing, transport, use and final disposal[222]. In accordance with ISO standards an LCA study an LCA study is structured of four iterative phases: goal and scope definition, inventory analysis, impact assessment and interpretation[223;224].

### *4.2.1 Goal and scope definition*

The goal of this study is to assess the potential environmental impacts related to the life cycle of a garment knitted made by the San Lorenzo Group company in order to obtain detailed information regarding the environmental burden of this product.

In order to evaluate the environmental impacts of the garment knitted, the LCA here presented is carried out by following, "or trying to follow", the same structure, in terms of functional unit, system boundaries and assumptions, adopted in the paper II.

The functional unit selected to carry out the analysis is one garment knitted in a soft blend composed of 60% wool and 40% cashmere. The flow unit for the LCA consists of 495 items of clothing. This garment was randomly chosen by the authors in order to represent the general manufacture of the company. The product analysed presents characteristics common to almost all the products manufactured within the San Lorenzo Group and it involves all the process units of the company. While, the raw materials (fabrics and accessories) are the only elements that differentiate one garment from another.

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[222]Guinée, J. B. (2002). Handbook on life cycle assessment operational guide to the ISO standards. *The international journal of life cycle assessment*, *7*(5), 311.

[223]International Organisation for Standardisation (ISO). ISO 14040:2006. Environmental Management – Life Cycle Assessment – Principles and Framework; International Standards Organisation: Geneva, Switzerland.

[224]International Organisation for Standardisation (ISO). ISO 14044:2006. Environmental Management – Life Cycle Assessment – Requirements and Guidelines; International Standards Organisation: Geneva, Switzerland.

The system boundaries (Figure 1) are defined by following a cradle-to-gate approach, from the raw material extraction and processing to the San Lorenzo Group gate. The system boundaries are selected according to the paper II and include:

- Global processes, in which the production at a global level of the raw materials, such as cashmere, cotton, wire and metal, is included;
- National processes, in which the production, in Italy, of wool (raw material), tissue (made by refining cashmere and wool) and buttons, is considered;
- Local processes, in which the assembling and the final production of the garment knitted, in the San Lorenzo Group company, are included.

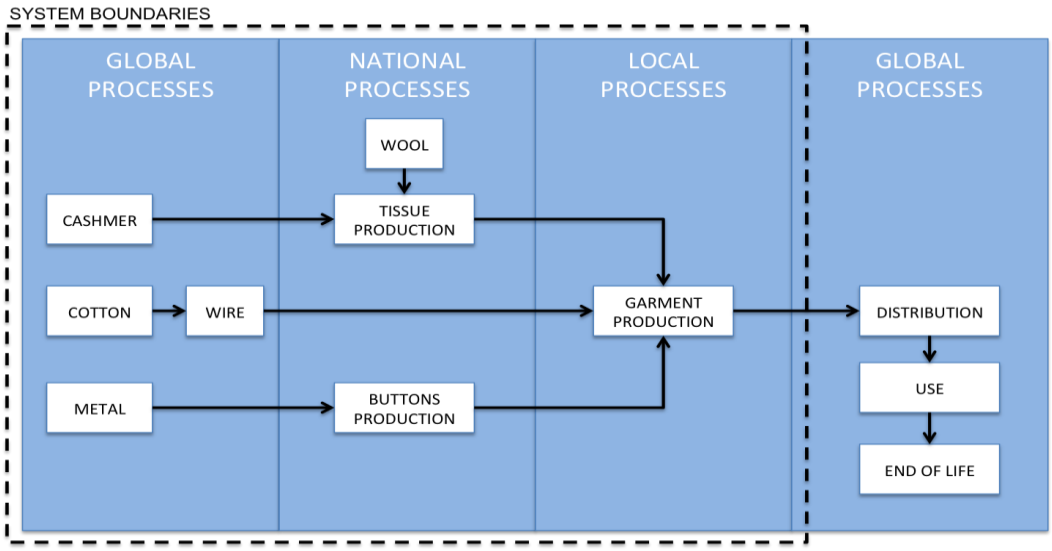


**Figure 1:**System boundaries.

The LCA is performed by including six different phases that are referred to the three-process level considered in to perform the S-LCA: 1) Raw material production; 2) Transport T1; 3) Material manufacturing; 4) Transport T2; 5) Garment production; 6) Transport T3. The detailed description of the six phases is reported into the section 4.2.2.

Some processes are omitted from the analysis because of the lack of specific data and information. In particular, the processes related to the recycling of the waste produced from the packaging of the materials (tissue, buttons, wire, etc.) sent to the San Lorenzo Group for the final assembling and the production of the garment are not included in the system boundaries and only their transport to the recycling plant is included.

Furthermore, the analysis is carried out by considering some assumptions:

- according to the S-LCA performed into the paper II, cashmere is produced in Mongolia, that represents the main producer of cashmere worldwide, and wool is produced in Italy. Due to a lack of inventory data for cashmere production and in particular for its related agricultural and manufacturing processes in Mongolia, in the LCA here presented the production processes of cashmere and wool are considered as the same and data related to wool production in New Zealand is assumed the same for the production in Mongolia and in Italy. This assumption also represents a limit of the analysis because it does not allow to correctly follow the structure proposed for the S-LCA and it may cause a bias when the results from both, LCA and S-LCA tools, are evaluated;
- the amount of raw materials is assumed as the same used to produce the final products;
- for the textile refinement (cashmere and wool), secondary data related to the processes for the refinement of cotton are assumed as the same for wool and cashmere;
- for raw material production and some of the manufacturing material plants, hypothetical locations were considered. In particular, the wool yarn and the tissue (made with cashmere and wool) are assumed to be produced in Prato,

(Tuscany) that represents one of the biggest Italian textile district and one of the most important textile industries worldwide[225].

### *4.2.2 Inventory analysis*

Data related to the garment knitted production are organised by following six different phases:

1) *Raw material production* – in this phase, the production of all the raw material adopted into the manufacturing processes are considered, except for the tissue paper used for packaging and the paper used for printing the garment sample, that are included into the phase 3 because of the lack of data related to the raw material production. In particular, this phase includes the agricultural practices related to the production of cashmere and wool, as well as the production of steel, cotton, polyethylene (PE), respectively used for the manufacturing of buttons, wire and labels, as well as the production of polypropylene (PP) and cardboard adopted for the packaging.
2) *Transport T1* – in this phase, the transport of the raw materials from the production centres to the manufactory plants is included.
3) *Material manufacturing* – in this phase, the processes related to the final production of the tissue (made with cashmere and wool), buttons, wire, paper for printing for printing garment sample, labels and packaging materials are accounted.
4) *Transport T2* – this phase includes the transport of final products from the manufacturing plants to the San Lorenzo Group company.
5) *Garment production* – in this phase, all the production processes that are carried out in the San Lorenzo Group company are considered. In particular,

[225]Regione Toscana. (2017). http://www.regione.toscana.it/-/distretto-tessile-abbigliamento-di-prato

this phase refers to the following sub-processes: cutting, stitching, ironing, and packaging.

6) *Transport T3* – this phase refers to the transport of the waste materials (cardboard, plastics, paper) from the San Lorenzo Group to the recycling plant.

The data collection related of garment's order (495 pieces) was carried out from August 2016 to October 2016. Data sources of the analysis include foreground data, in which primary data were collected through specific questionnaires (see the attachment) and direct interviews and background data, in which secondary data were obtained from the international literature and databases. In particular, the foreground data refers to the local process considered in the system boundaries and include, the amount, in terms of weight, of tissue, buttons, wire, paper, labels and packaging materials, as well as the amount of electricity and water consumed during the garment production (phase 3) in the San Lorenzo Group company and the transport distances. Instead, the background data refers to the global and national processes selected in the system boundaries, and include all the process related to raw material production, material manufacturing and transport activities. The inventory data and data sources are reported in Table 1.

**Table 1.** Inventory data and data sources related to the flow unit of 495 items of clothing produced by the San Lorenzo Group.

| Phase | Sub-processes | Unit | Amount | Data sources | Database process |
|---|---|---|---|---|---|
| Raw material production | Greasy wool | Kg | 321 | Primary data, Cardoso, 2013[226] | N.A. |
| | Greasy cashmere | Kg | 214 | Primary data, Cardoso, 2013 | N.A. |
| | Steel | Kg | 9.5 | Primary data; Ecoinvent[227] | Steel, low-alloyed, at plant/RER U |
| | Cotton | Kg | 0.3 | Primary data; Ecoinvent | Cotton fibres, at farm/US U |
| | PE | Kg | 0.7 | Primary data; Ecoinvent | Fleece, polyethylene, at plant/RER U |
| | PP | Kg | 49.5 | Primary data; Ecoinvent | Polypropylene, granulate, at plant/RER U |
| | Cardboard | Kg | 10 | Primary data; Ecoinvent | Corrugated board, mixed fibre, single wall, at plant/RER U |
| Transport T1 | Greasy Wool | kgkm | 6840 | Primary data; Ecoinvent | Transport, lorry 3.5-7.5t, EURO5/RER U |
| | Greasy cashmere | kgkm | 684,000 | Primary data; Ecoinvent | Transport, lorry 3.5-7.5t, EURO5/RER U |
| | | kgkm | 5,930,280 | Primary data; Ecoinvent | Transport, transoceanic freight ship/OCE U |
| | | kgkm | 57,000 | Primary data; Ecoinvent | Transport, lorry 3.5-7.5t, EURO5/RER U |
| | Steel | kgkm | 190 | Primary data; Ecoinvent | Transport, lorry 3.5-7.5t, EURO5/RER U |
| | Cotton | kgkm | 6.9 | Primary data; Ecoinvent | Transport, van <3.5t/RER U |
| | PE | kgkm | 14 | Primary data; Ecoinvent | Transport, van <3.5t/RER U |
| | PP | kgkm | 990 | Primary data; Ecoinvent | Transport, van <3.5t/RER U |
| | Cardboard | kgkm | 200 | Primary data; Ecoinvent | Transport, van <3.5t/RER U |
| Material manufacturing | Wool yarn | Kg | 321 | Primary data, Cardoso, 2013 | N.A. |
| | Cashmere yarn | Kg | 214 | Primary data, Cardoso, 2013 | N.A. |
| | Tissue | Kg | 535 | Primary data; Ecoinvent | Textile refinement, cotton/GLO U |
| | Buttons | Kg | 9.5 | Primary data; Ecoinvent | Steel product manufacturing, average metal working/RER U |
| | Cotton wire | Kg | 0.3 | Primary data; Ecoinvent | Textile refinement, cotton/GLO U |
| | Paper | Kg | 1.2 | Primary data; Ecoinvent | Paper, woodfree, uncoated, at integrated mill/RER U |
| | PE Labels | Kg | 0.7 | Primary data; Ecoinvent | Fleece production, polyethylene terephthalate/RER U |
| | PP bags | Kg | 49.5 | Primary data; Ecoinvent | Extrusion, plastic film/RER U |
| | Tissue paper | Kg | 0.7 | Primary data; Ecoinvent | Kraft paper, bleached, at plant/RER U |
| | Cardboard boxes | Kg | 10 | Primary data; Ecoinvent | Packaging, corrugated board, mixed fibre, single wall, at plant/RER U |

*(continue)*

[226]Cardoso, A. A. M. (2013). Life Cycle Assessment of Two Textile Products Wool and Cotton.
[227]Ecoinven Centre. (2007). Ecoinvent Data v2.0 Final Reports Ecoinvent; Swiss Centre for Life Cycle Inventories: Dübendorf, Switzerland.

**Table 1.**Inventory data and data sources related to the flow unit of 495 items of clothing produced by the San Lorenzo Group (continue).

| | | | | | |
|---|---|---|---|---|---|
| Transport T2 | Tissue | kgkm | 1,470,600 | Primary data; Ecoinvent[228] | Transport, lorry 3.5-7.5t, EURO5/RER U |
| | | kgkm | 3705 | Primary data; Ecoinvent | Transport, barge/RER U |
| | Buttons | kgkm | 20,330 | Primary data; Ecoinvent | Transport, lorry 3.5-7.5t, EURO5/RER U |
| | | kgkm | 61.7 | Primary data; Ecoinvent | Transport, barge/RER U |
| | Cotton wire | kgkm | 1,207.4 | Primary data; Ecoinvent | Transport, van <3.5t/RER U |
| | | kgkm | 2.2 | Primary data; Ecoinvent | Transport, barge/RER U |
| | Paper | kgkm | 3,154.3 | Primary data; Ecoinvent | Transport, lorry 3.5-7.5t, EURO5/RER U |
| | | kgkm | 7.7 | Primary data; Ecoinvent | Transport, barge/RER U |
| | PE Labels | kgkm | 1,498 | Primary data; Ecoinvent | Transport, lorry 3.5-7.5t, EURO5/RER U |
| | | kgkm | 4.5 | Primary data; Ecoinvent | Transport, barge/RER U |
| | PP bags | kgkm | 105,930 | Primary data; Ecoinvent | Transport, van <3.5t/RER U |
| | | kgkm | 321.7 | Primary data; Ecoinvent | Transport, barge/RER U |
| | Tissue paper | kgkm | 1,498 | Primary data; Ecoinvent | Transport, van <3.5t/RER U |
| | | kgkm | 4.5 | Primary data; Ecoinvent | Transport, barge/RER U |
| | Cardboard boxes | kgkm | 21,400 | Primary data; Ecoinvent | Transport, van <3.5t/RER U |
| | | kgkm | 65 | Primary data; Ecoinvent | Transport, barge/RER U |
| Garment production | Cutting | kWh | 129.7 | Primary data; Ecoinvent | Electricity, low voltage, at grid/IT U |
| | Stitching | kWh | 398,233 | Primary data; Ecoinvent | Electricity, low voltage, at grid/IT U |
| | Ironing | kWh | 674.4 | Primary data; Ecoinvent | Electricity, low voltage, at grid/IT U |
| | | $m^3$ | 7.2 | Primary data; Ecoinvent | Water, decarbonised, at plant/RER U |
| | Packaging | kWh | 168 | Primary data; Ecoinvent | Electricity, low voltage, at grid/IT U |
| | Waste | kg | 38.9 | Primary data | N.A. |
| Transport T3 | Waste to recycling | kgkm | 38,426.8 | Primary data; Ecoinvent | Transport, lorry 3.5-7.5t, EURO5/RER U |
| | | kgkm | 412 | Primary data; Ecoinvent | Transport, barge/RER U. |

[228]Ecoinven Centre. (2007). Ecoinvent Data v2.0 Final Reports Ecoinvent; Swiss Centre for Life Cycle Inventories: Dübendorf, Switzerland.

### *4.2.3 Impact assessment*

The software SimaPro 8[229] was used to perform the analysis. The impact assessment was carried out by means of ReCiPe Midpoint (H) V1.09 method[230] in order to obtain a higher level of detail that allows to develop a detailed picture of the environmental performance of the investigated system, by analysing eighteen different impact categories: climate change, ozone depletion, terrestrial acidification, freshwater eutrophication, marine eutrophication, human toxicity, photochemical oxidant formation, particulate matter formation, terrestrial ecotoxicity, freshwater ecotoxicity, marine ecotoxicity, ionising radiation,agricultural land occupation, urban land occupation, natural land transformation, water depletion, metal depletion and fossil depletion.

## 4.3 Results and discussion

The results in terms of contribution to the environmental impacts of one garment knitted in a soft blend of wool and cashmere are reported in Figure 3. A general overview of the results highlights that the highest potential environmental impacts are related to the transport phases, in particular the transport of the raw material (T1) and of the manufactured material (T2), and to the garment production phase in all the impact categories except for the agricultural land occupation in which higher impacts are due to the material manufacturing phase. Instead, the lowest impacts are connected to the waste transport (transport T3 phase), which contributes for less of 0.9% in all the investigated impact categories, followed by the material manufacturing and the raw material production phases.

[229]PRè Consultant. (2010). Simapro 8; PRè Consultant: Amersfoort, The Netherlands.
[230]Goedkoop, M., Heijungs, R., Huijbregts, M., De Schryver, A., Struijs, J., & Van Zelm, R. (2009). ReCiPe 2008. *A life cycle impact assessment method which comprises harmonised category indicators at the midpoint and the endpoint level*, *1*.

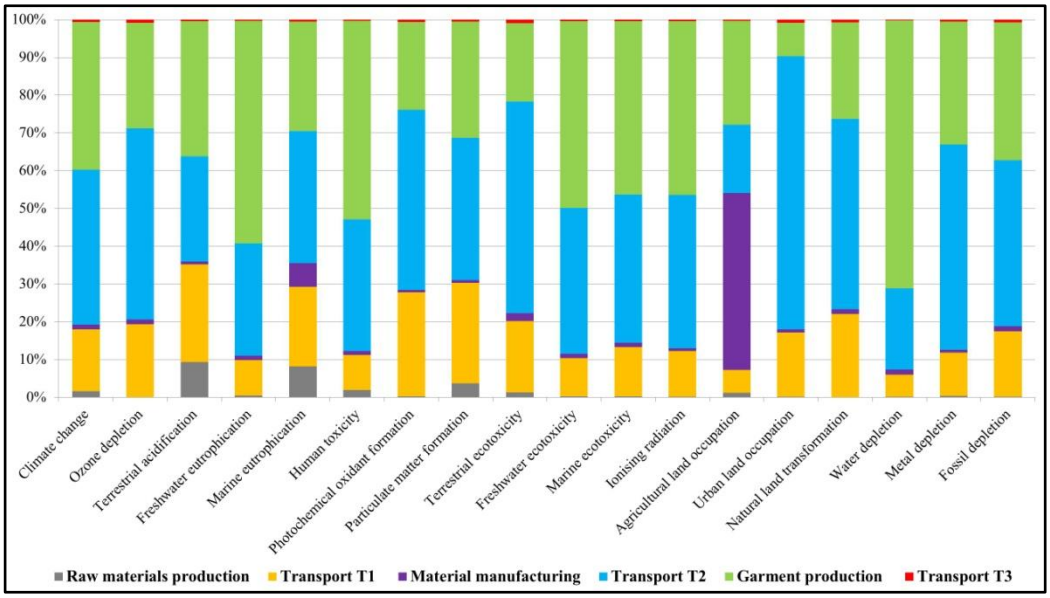


**Figure 3.** Contribution analysis related to the functional unit of one garment knitted in a soft blend of wool and cashmere.

A depth analysis underscores that the contribution of the manufactured materials' transport (T2) ranges from 18.1% in agricultural land occupation to 72.4% in agricultural land occupation, and it is mainly due to the tissue made with wool and cashmere for which the production and refinement are assumed to be carried out in Prato (Tuscany). Instead, the contribution of the raw material transport (T1) ranges from 5.9% in water depletion to 27.6% in photochemical oxidant formation. The higher impacts related to this phase are caused by the transport of the greasy cashmere from Mongolia to Italy through a transoceanic freight ship. Furthermore, the highest environmental impacts caused by the material manufacturing phase in the agricultural land occupation impact category are mainly associated to the production of the paper used for printing the garment sample. It is important to underscore that the data related to the transport activities as well as the manufacturing processes were obtained from international databases and were founded on some assumptions. In particular, regarding the higher impacts of the paper production process, the Ecoinvent

database and the related process, "*Paper, wood free, uncoated, at integrated mill/RER U*", were adopted because of the lack of information on the characteristics of the paper used for printing the garment sample, by the San Lorenzo Group company. The selected Ecoinvent's process includes the production of paper by using wood processed into a chemical pulp, as well as the production of Scandinavian industrial wood, that, in the specific context of this analysis, is the main responsible for the higher impacts of the material manufacturing phase in the agricultural land occupation impact category. This underscores that the results are strongly related to the assumptions and choices made to carry out the analysis.

Regarding the garment production, that represents the phase carried out into the investigated company and for which primary data were obtained, the results shows that the contribution to the environmental impacts ranges from 70.9% in water depletion to 8.8% in urban land occupation. The activities conducted into the San Lorenzo Group company for obtaining the garment knitted require a high amount of electricity, given the fact that great part of these processes are carried out by means of mechanised machineries. In this context, the higher impacts connected to this phase are due to the electricity consumption, which account for more than 99% in all the impact categories, and in particular to the stitching that is the most important activity performed by the company. Instead, the water consumption during the ironing sub-process causes the lowest impacts, contributing for less than 0.0004%.

Lastly, the raw material production phase shows higher environmental impacts in terrestrial acidification, marine eutrophication and particulate matter formation, in which it respectively contributes for 9.3%, 8.2% and 3.7%. The main impacts associated with this phase are due to the agricultural practices carried out to

produce the wool and cashmere, for which the production process was assumed to be the same and secondary data were obtained from the international literature. In particular, the highest impacts related to this sub-process are caused by the direct emission from the enteric fermentation and fertilisers use.

Table 2 shows the characterisation results in terms of potential impacts related to the investigated garment knitted.

A depth analysis of the characterisation results related to the climate change impact category highlights that the total impacts of one garment knitted in a soft blend of wool and cashmere are about 1,416.14 kg $CO_2$ equivalent (eq). As for the others impact categories, the manufactured material transport (T2), the garment production and the raw material transport phases are responsible for the highest impacts showing climate change values respectively of 581.91 kg $CO_2$ eq, 553.4 kg $CO_2$ eq and 231.21kg $CO_2$ eq per functional unit. The results also

**Table 2.** Characterisation results related to the functional unit of one garment knitted in a soft blend of wool and cashmere.

| Impact categories | Unit | Total | Raw material production | Transport T1 | Material manufacturing | Transport T2 | Garment production | Transport T3 |
|---|---|---|---|---|---|---|---|---|
| Climate change | kg $CO_2$ eq | 1,416.14 | 23.43 | 231.21 | 17.55 | 581.91 | 553.40 | 8.63 |
| Ozone depletion | kg CFC-11 eq | 0.00017 | 1.37E-07 | 3.35E-05 | 2.03E-06 | 8.76E-05 | 4.85E-05 | 1.35E-06 |
| Terrestrial acidification | kg $SO_2$ eq | 6.90 | 0.64 | 1.79 | 0.050 | 1.93 | 2.47 | 0.026 |
| Freshwater eutrophication | kg P eq | 0.27 | 1.39E-03 | 0.025 | 3.05E-03 | 8.02E-02 | 0.16 | 7.29E-04 |
| Marine eutrophication | kg N eq | 0.30 | 0.024 | 0.062 | 0.019 | 0.10 | 0.086 | 1.33E-03 |
| Human toxicity | kg 1.4-DB eq | 291.01 | 5.81 | 26.86 | 2.97 | 101.39 | 153.05 | 0.94 |
| Photochemical oxidant formation | kg NMVOC | 6.29 | 0.016 | 1.73 | 0.036 | 3.00 | 1.46 | 0.039 |
| Particulate matter formation | kg PM10 eq | 2.34 | 0.088 | 0.62 | 0.016 | 0.88 | 0.72 | 0.011 |
| Terrestrial ecotoxicity | kg 1.4-DB eq | 0.12 | 1.53E-03 | 0.022 | 2.37E-03 | 0.066 | 0.024 | 1.03E-03 |
| Freshwater ecotoxicity | kg 1.4-DB eq | 6.33 | 0.017 | 0.64 | 0.073 | 2.44 | 3.13 | 0.023 |
| Marine ecotoxicity | kg 1.4-DB eq | 7.18 | 0.018 | 0.94 | 0.082 | 2.82 | 3.29 | 0.029 |
| Ionising radiation | kBq U235 eq | 218.63 | 0.43 | 26.47 | 1.54 | 88.74 | 100.52 | 0.93 |
| Agricultural land occupation | $m^2a$ | 12.99 | 0.16 | 0.79 | 6.09 | 2.35 | 3.58 | 0.031 |
| Urban land occupation | $m^2a$ | 16.65 | 0.029 | 2.83 | 0.13 | 12.05 | 1.47 | 0.13 |
| Natural land transformation | $m^2$ | 0.41 | 3.69E-04 | 0.091 | 5.26E-03 | 0.21 | 0.11 | 3.15E-03 |
| Water depletion | $m^3$ | 5,162.77 | 6.57 | 302.53 | 73.08 | 1,109.32 | 3,659.78 | 11.49 |
| Metal depletion | kg Fe eq | 66.82 | 0.252 | 7.68 | 0.496 | 36.32 | 21.73 | 0.35 |
| Fossil depletion | kg oil eq | 452.18 | 0.573 | 78.55 | 5.89 | 198.70 | 165.47 | 2.99 |

highlight that the consumption of electricity in the stitching sub-process (garment production phase) account for about 552.1 kg $CO_2$ eq per functional unit, corresponding to almost the 40% of the total climate change impact related to the life cycle of the garment knitted. This confirms that the highest environmental impacts are associated with the "local boundaries" of the investigated company and it underscores the needing for more sustainable solution, that may improve the company's environmental performance.

## 4.4 Conclusions

The aim of this study was to assess the potential environmental impacts of one garment knitted in a soft blend of wool and cashmere made by the Sicilian textile company San Lorenzo Group, through the application of the LCA tool. The analysis was performed in order to obtain a first evaluation of the environmental performance of the product. The study allowed to broaden the S-LCA study carried out into the paper II, in order to associate the environmental and social performances.

The main results underscored that the highest environmental impacts in all the investigated impact categories are connected to the transport activities and to the garment production at the company level. Considering, for example, the climate change impact category, the analysis shows that one garment knitted in a soft blend of wool and cashmere accounts for 1,416.14 kg $CO_2$ eq. In particular, the main climate change impacts are related to the transport of the greasy cashmere and to the electricity consumption during the stitching sub-process which accounts for almost the 40% of the total impacts.

The results obtained from this paper can help the San Lorenzo Group company to identify the environmental hot-spots related to the production of the

investigated garment considering a life cycle perspective, and to have a general evaluation of the environmental impacts that are directly related to the company activities.

Although the analysis allowed to achieve a first preliminary assessment of the environmental impacts, some considerations have to be pointed out. First of all, the results may be characterised by some uncertainties because of the assumption made for carrying out the analysis. Indeed, the lack of information and primary data regarding the raw materials, the manufacturing processes and the localisation of the manufacturing plants may bring to overestimate or underestimate the environmental impacts of the investigated garment when a life cycle perspective is considered. In this context, further analysis should deeply investigate these processes in order to reduce the results' uncertainties. Secondly, the scope of the analysis of broadening the S-LCA study previously performed has been partially achieved. Indeed, the LCA here performed showed the "possibility of not doing" a total-parallel analysis with the S-LCA. This is, in particular, due to different data and information related to the production of cashmere, used in the S-LCA carried out into the paper II and in the LCA here presented. In fact, the evaluation of the social impacts related to the agricultural practices (which allow to obtain the main input adopted in the garment production) was carried out by considering the production of cashmere in Mongolia, while, because of the lack of primary and secondary data, the assessment of the environmental impacts was performed by assuming the production of wool and cashmere as the same, and by considering the data from Cardoso (2013) related to the wool produced in New Zealand. In this context, the results of the social and environmental performance specifically related to the to the agricultural activities (global processes) cannot be evaluated in parallel

because they refer to two different production systems. This highlights that the social and environmental results related to a product or company, obtained through the combination of the LCA and S-LCA methods, sometimes may not be evaluated together, in particular, when specific assumptions are considered and important data are missing.

# Conclusions

The emerging attention on the life cycle sustainability issues become more and more strong in the last years, but the assessment of the social dimension is still in its infancy.

In this context, the aim of this PhD thesis was to carry out an overview in the S-LCA field with the purpose of understanding if it is a valuable tool to support business decisions by assessing the social impact of the product in order to improve the social conditions of stakeholders.

To achieve this purpose, after an overview of the state-of-the-art, the S-LCA method has been applied to a selected product of a textile factory (the "San Lorenzo Group", located in San Marco d'Alunzio - Messina). Then a LCA has been added for a preliminary environmental assessment of the same if a combined environmental and social assessment is achievable.

The literature overview showed that the UNEP/SETAC-Guidelines for S-LCA are certainly a step towards an agreed procedure on how to implement social aspects. However, limitations in the S-LCA methodology remain. Also the case studies analysed in the literature overview conclude that the S-LCA is valuable and it is intuitive that S-LCA has the potential to help crucially to the eco-efficiency and sustainable realization and consummation of products from a social point of view. But, further developments are needed, such as:

- improvements in the set of qualitative and quantitative indicators, for example in order to face the different perceptions of social effects from country to country, the differences emerging from negative and positive impacts, etc.;
- solutions to contextualize at local level the impacts;
- improvements in the availability of data and their quality;

- solutions for the still limited social awareness at company level, that constitutes a barrier in obtaining primary data.

Concerning the S-LCA implementation in the textile sector, the study shows that the garment has an important social and economic value at local level, because it is handmade and it is produced in an Italian region with a high unemployment rate where this company represents the main employment source.The firm has embarked on a path of local social responsibility and strong relationship with its employees and the territory and this is well reflected in the assessment of the organization's behavior through the life cycle of the product using the SAM method. Unfortunately, due to a lack of primary data referred to the other supply chain organizations, it was impossible to implement the SAM of the whole life cycle product system.

Concerning the national and global level risk analysis using the SHBD method assessment, even if the analysis has been applied on whole life cycle product system, a strong limitation occurs in databases and indicators availability, especially at a small business level.

The San Lorenzo Group perceived positively the results obtained with the S-LCA, and has decided to match the social results with its environmental certifications in order to improve its visibility and commitment to the local community. This highlights that the firm is favourable in integrating the S-LCA results into the company decision-making process and in finding solutions to balance social results with environmental results, but it can't be ignored that the company is not able to check their suppliers for lack of means and power and this strongly limits the significance and reliability of the results.

Finally, the social assessment has been broadened by including an environmental assessment that was performed through the application of the LCA method.

Analysing the results from the two assessment methods, it is clear that where primary data were collected balanced conclusions could be drawn, on the contrary further attention has to be paid to improve data quality related to upstream processes in order to better assess the social and environmental dimensions of the investigated system.

More in details the study showed that at company level (the San Lorenzo Group were primary data were collected), the highest environmental impacts are connected to the electricity consumption during the stitching sub-process. By combining the two implementations, the company has a relevant source of inputs useful to improve its environmental and social performances.

But collecting primary data from the whole supply chain remain the main obstacle to carry out a complete life cycle assessment. Indeed, the results obtained could present some limitations which are related, in particular, to the different assumptions made to carry out the analysis due to the lack of primary data of some processes. Indeed, transport is the main hot-spot highlighted in the LCA analysis, but the social impact of the transport phases have not been considered yet in the upstream risk assessment; on the other side, the main social risks are associated to the production of cashmere in Mongolia, but the lack of LCA inventory data specifically related to Mongolian production, forced me to apply different assumptions, limiting the possibility to make a comparison between S-LCA results and LCA ones.

Thus, it can be stated that S-LCA is a valuable tool to support business decisions, assessing the social impact of the product in order to improve the social conditions of stakeholders; it can support decision-makers in prioritizing resources and investing them where there are more chances of positive impacts and less risk of negative ones. But the access to primary and/or good quality

local, national and global data is essential to draw credible conclusions. The access to this data is consequence of the availability of good quality databases, but also of the presence of highly integrated and cooperating supply chains.

The case study here investigated highlighted that this is not the case of the textile sector in which manufacturing firms (generally SMEs) have a limited power to control the decisions along the supply chain, generally controlled by multinationals or the big fashion companies that still demonstrate a limited social awareness and impede the access to social primary data.

Concerning the LCA implementation presented in paper III, the analysis underscored that, at least in the specific context of the textile sector, it may be difficult to make the same assumptions for both the environmental and social analyses. These limits again depend by the limited access to primary data and availability of specific databases. Consequently, it would not be possible to obtain comparable results that could be useful for decision-makers. Indeed, combining the two dimensions requires not only using the same system boundaries, allocation procedures, and functional units, but also the same data quality, as well as the main assumptions determining the characteristics of the products.

The path towards an integrated life cycle assessment of sustainability (obviously including also LCC, together with LCA and S-LCA - the so-called Life Cycle Sustainability Assessment) is still very long. A separate discussion (not in the scope of this thesis) would be on how to integrate results that use different metrics to measure different impacts.

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# Appendix A

# Questionnaries

## Workers' Questionnaire

- Sesso ○ F ○ M
- Età _____
- Da quanti anni lavora in azienda _____
- Nazionalità _____

1) Quanti giorni lavora a settimana?
- o Meno di 4
- o 5
- o 6
- o Più di 6

2) Quante ore lavora mediamente al giorno?
- o Meno di 8
- o 8
- o Più di 8

3) Quante ore lavorative svolge a settimana?
- o Meno di 40
- o 40
- o Più di 40

4) Indicare i periodi dell'anno in cui la produzione risulta più intensa:

○ GENNAIO ○ FEBBRAIO
○ MARZO ○ APRILE
○ MAGGIO ○ GIUGNO
○ LUGLIO ○ AGOSTO
○ SETTEMBRE ○ OTTOBRE
○ NOVEMBRE ○ DICEMBRE

5) Quanti giorni ha di riposo in una settimana?
- o 1
- o 2
- o Più di 2

6) Quante ore di straordinario svolge mediamente?
- o Meno di 2
- o 2
- o Più di 2

7) Esistono pause durante l'orario lavorativo?
- o Si
- o No

8) Se si, quanto durano e con quale frequenza?

_____

9) Quanto dura la pausa pranzo?
- o Meno di 30
- o Un'ora
- o Più di un'ora

10) Dove viene consumato il pranzo?
- o Nella mensa aziendale
- o A casa
- o In azienda, ma non in mensa

11) Esistono lavoratori minorenni nell'azienda in cui lavora?

- SI
- No

**Subcategoria: salute e sicurezza**

1) Nello svolgimento della sua mansione, utilizza attrezzi o strumenti pericolosi?
- SI
- NO

2) Reputa l'attività lavorativa da lei svolta rischiosa?
- SI
- NO

3) Utilizza un'attrezzatura opportuna per proteggersi da eventuali rischi per la salute?
- SI
- NO

4) Utilizza dei macchinari per svolgere la propria mansione?
- SI
- NO

5) E' presente inquinamento acustico nel proprio luogo di lavoro?
- SI
- NO

6) Svolge mansioni che possono risultare usuranti per la sua salute?
- SI
- NO

7) Se si, quali sono i pericoli che percepisce?

_____

8) È coperto da assistenza sanitaria?
- SI
- NO

9) Ha la possibilità di esporre liberamente eventuali problemi al proprietario?
- Si
- No

10) Se si, quali sono le modalità previste?
- Gruppi di ascolto
- Personalmente alla direzione
- In maniera anonima
- Altro (specificare)_____

11) Vengono svolti corsi di formazioni/aggiornamento in materia di salute e sicurezza?
- Si
- No

12) Lei ha mai partecipato ad un corso di formazioni/aggiornamento in materia di salute e sicurezza?
- Si
- No

13) Se si, in che modalità e frequenza?

_____

14) Vengono adottate misure generali di sicurezza?
- SI

- NO

15) Esistono misure preventive e procedure di emergenza in materia di sostanze chimiche utilizzate?
_____

**Subcategoria: salario equo**

16) Indicare l'attività svolta in azienda
_____

17) Il suo contratto lavorativo a quale tipologia corrisponde?
_____

18) Ogni quanto viene erogato il salario?
_____

19) Il salario percepito permette di soddisfare le esigenze primarie?
_____

**Subcategoria: diritti di associazione e contrattazione collettiva**

20) E' associato al sindacato?
- Si
- No

21) Se si, a quale sindacato è associato?
_____

**Subcategoria: pari opportunità/discriminazione**

22) C'è una politica di pari opportunità all'interno dell'azienda?
- Si
- No

23) Ci sono stati casi di discriminazione negli ultimi 5 anni?
- Si
- No

24) Ci sono donne che lavorano in azienda?
- Si
- No

25) Ci sono stranieri che lavorano in azienda?
- Si
- No

26) Avverte qualche forma di discriminazione?
- Si
- No

27) Se si, che forma di discriminazione avverte?
- Sessuale
- Razziale
- Religiosa
- Altro (specificare)_____

**Subcategoria: lavoro forzato**

28) Lei lavora oltre l'orario di lavoro previsto dalla legge?
- Si
- No

29) Il suo contratto di lavoro prevede: salario, retribuzioni, altro/benefici?
- o Si
- o No
- o Se altro (specificare)_____

30) Le è chiaro il contratto che ha firmato in ogni sua parte?
- o Si
- o No

31) In quanto lavoratore, è libero di dimettersi in qualsiasi momento?
- o Si
- o No

**Subcategoria: benefici e sicurezza sociale**

12) Ha un contratto di lavoro?
- o Si
- o No

13) Se si, che tipologia di contratto di lavoro?
- o Contratto a tempo indeterminato:
- o Contratto a tempo determinato
- o Contratto internale
- o Stage
- o Apprendistato
- o Voucher
- o Altro (specificare)_____

14) Tra quanto tempo andrà in pensione?
- o Meno di 10 anni
- o Fra i 10/20 anni
- o Fra più di 20 anni

15) L'azienda offre dei servizi aggiuntivi per migliorare il suo benessere sociale?
- o Si
- o No

16) Se si, quali servizi ha usufruito negli ultimi 5 anni?
- o Mensa aziendale
- o Trasporto tramite pulmino aziendale
- o Asilo nido
- o Altro (specificare)_____

17) L'azienda le ha garantito uno o più dei seguenti benefici sociali?
- o Pensionamento ○si ○ no
- o Sussidio per disabilita/ malattia/infortunio ○si ○ no
- o Sussidio per familiari a carico ○si ○ no
- o Maternità o paternità retribuita ○si ○ no
- o Educazione e formazione ○si ○ no
- o Vacanze ○si ○ no
- o Diritto allo studio ○si ○ no
- o Altro ( quattordicesima). ○si ○ no

## Company Questionnaire

1. Quanti dipendenti lavorano in azienda?
   _____

2. Di questi, quanti sono:
   - Uomini _____
   - Donne _____
   - Italiani _____
   - Stranieri _____
   - Lavoratori interni _____
   - Lavoratori a domicilio _____

3. Sono previste ore di lavoro straordinario?
   - Si
   - No

4. Qual é la percentuale dei lavoratori (di cui al punto 1) che svolge e riceve gli straordinari?
   _____

5. Quante sono le ore di straordinario svolte a settimana dai lavoratori indicati al punto 1?
   _____

6. Quante sono le ore di straordinario svolte all'anno dai lavoratori indicati al punto 1?
   _____

7. Quante sono le ore lavorative svolte mediamente a settimana dai lavoratori indicati al punto 1?
   _____

8. Indicare i periodi dell'anno in cui la produzione risulta più intensa:
   - ○ GENNAIO
   - ○ FEBBRAIO
   - ○ MARZO
   - ○ APRILE
   - ○ MAGGIO
   - ○ GIUGNO
   - ○ LUGLIO
   - ○ AGOSTO
   - ○ SETTEMBRE
   - ○ OTTOBRE
   - ○ NOVEMBRE
   - ○ DICEMBRE

9. L'azienda promuove verso i suoi fornitori (o verso le aziende della catena del valore) il rispetto delle ore di lavoro previste dalla legge?
   - Si
   - No

10. Se si, come lo promuove?
    _____

**Subcategoria: lavoro minorile**

11. In azienda, esistono lavoratori minorenni (al di sotto dei 16 anni)?
    - Si
    - No

12. Esistono lavoratori minorenni (tra i 16-18 anni) nell'azienda in cui lavora?
    - Si
    - No

13. Se si, che tipo di contratto/accordo viene stipulato
    - Contratto di apprendistato
    - Progetto comunale "Bottega dei mestieri"
    - Stage/ tirocinio
    - Altro _____(indicare)

14. Quanti di questi lavoratori (16/18 anni) frequentano la scuola dell'obbligo?
_____

15. Quanti di questi lavoratori (16/18 anni) svolgono ore di straordinario?
_____

16. L'azienda promuove verso i suoi fornitori (o verso le aziende della catena del valore) azioni per prevenire e/o ridurre il lavoro minorile?
- Si
- No

17. Se si, in che modo lo promuove?
_____

**Subcategoria: salute e sicurezza**

18. L'attività lavorativa svolta in azienda si può reputare rischiosa?
- SI
- NO

19. In azienda vengono utilizzati attrezzi o strumenti pericolosi?
- Si
- No

20. Se si, quanti dei lavoratori, di cui al punto 1, utilizzano strumenti pericolosi?
- Uomini _____
- Donne _____
- Italiani _____
- Stranieri _____
- Lavoratori interni _____
- Lavoratori esterni _____

21. In azienda si utilizzano attrezzature opportune per proteggersi da eventuali rischi per la salute?
- SI
- No

22. Se si, quanti dei lavoratori, di cui al punto 1, utilizzano tali attrezzature?
- Uomini _____
- Donne _____
- Italiani _____
- Stranieri _____
- Lavoratori interni _____
- Lavoratori esterni _____

23. In azienda vengono utilizzate sostanze chimiche (ad es. smacchiatori)?
- Si
- No

24. Se si, quanti dei lavoratori, di cui al punto 1, utilizzano sostanze chimiche?
- Uomini _____
- Donne _____
- Italiani _____
- Stranieri _____
- Lavoratori interni _____
- Lavoratori esterni _____

25. In azienda è presente inquinamento acustico?

- SI
- NO

26. Se si, quanti dei lavoratori, di cui al punto 1, sono soggetti ad inquinamento acustico?
- Uomini _____
- Donne _____
- Italiani _____
- Stranieri _____
- Lavoratori interni _____
- Lavoratori esterni _____

27. In azienda vengono svolte attività che possono risultare usuranti per la salute?
- SI
- NO

28. Se si, quanti dei lavoratori, di cui al punto 1, svolgono attività che possono risultare usuranti per la salute?
- Uomini _____
- Donne _____
- Italiani _____
- Stranieri _____
- Lavoratori interni _____
- Lavoratori esterni _____

29. In azienda c'è la presenza di misure preventive e procedure di emergenza in materia di incidenti e/o infortuni, tramite Intervento Pronto Soccorso e Comunicazione all'Inail?
- Si
- No

30. Se si, quali misure vengono applicate?
_____

31. L'azienda garantisce una copertura da assistenza sanitaria?
- SI
- NO

32. Se si, quanti dei lavoratori, di cui al punto 1, sono coperti da assistenza sanitaria?
- Uomini _____
- Donne _____
- Italiani _____
- Stranieri _____
- Lavoratori interni _____
- Lavoratori esterni _____

33. I lavoratori hanno la possibilità di esporre liberamente eventuali problemi al proprietario?
- SI
- NO

34. Se si, che modalità i lavoratori possono utilizzare per esporre liberamente eventuali problemi?
- Gruppi di ascolto
- Personalmente alla direzione
- In maniera anonima
- Altro _____ (indicare)

35. Vengono svolti programmi e piani di formazione/aggiornamento in materia di salute e sicurezza?
- SI
- NO

36. Se si, in che modalità e frequenza?
_____

37. Esistono  misure generali di sicurezza che vengono adottate in azienda?
- Si
- No

38. Se si, quali sono le misure generali di sicurezza che vengono adottate in azienda?
- Standardizzate
- In conformità alla legge _____ (specificare quale)
- Altro _____(inidcare)

39. Si sono  verificati incidenti negli ultimi 5 anni?
- Si
- No

40. Se si, quanti di questi incidenti dipendono:
- dallo svolgimento di attività pericolose _____
- dall'utilizzo di sostanze chimiche _____
- dall'inquinamento acustico _____
- altro _____

41. L'azienda promuove verso i suoi fornitori (o verso le aziende della catena del valore) il rispetto dei diritti di salute e sicurezza dei lavoratori previsti dalla legge?
- Si
- No

42. Se si, come lo promuove?
_____

**Subcategoria: salario equo**

43. I dipendenti con salari orai più bassi, sono in grado di soddisfare le loro esigenze primarie?
- Si
- No

44. Se si, in che misura lo monitora?
_____

45. Qual è il valore dello stipendio più basso relativamente ai dirigenti?
_____

46. Qual è il valore dello stipendio più basso relativamente al settore amministrativo?
_____

47. Qual è il valore dello stipendio più basso relativo al settore della produzione (operaio)?
_____

48. Qual è il valore dello stipendio più basso relativo al settore della produzione (capo reparto)?
_____

49. Esiste una differenza tra lo stipendio percepito da un dipendente donna rispetto al dipendente uomo?
- Si
- No

50. Esiste una differenza tra lo stipendio percepito da un dipendente italiano rispetto al dipendente straniero?
- Si
- No

51. Esiste una differenza tra lo stipendio percepito da un dipendente interno rispetto al dipendente a domicilio?
- Si
- No

52. C’è la prova del pagamento delle retribuzioni al lavoratore?
- Si
- No

53. Quali quanti sono i tipi di contratti di lavoro emessi dall’azienda, in riferimento ai lavoratori indicati al punto 1?
- Contratto a tempo indeterminato:
  - Lavoratore uomini _____
  - Lavoratore donna _____
  - Lavoratore italiano _____
  - Lavoratore straniero _____
  - Lavoratore interno _____
  - Lavoratore a domicilio _____

- Contratto a tempo determinato
  - Lavoratore uomini _____
  - Lavoratore donna _____
  - Lavoratore italiano _____
  - Lavoratore straniero _____
  - Lavoratore interno _____
  - Lavoratore a domicilio _____

- Contratto internale
  - Lavoratore uomini _____
  - Lavoratore donna _____
  - Lavoratore italiano _____
  - Lavoratore straniero _____
  - Lavoratore interno _____
  - Lavoratore a domicilio _____

- Stage
  - Lavoratore uomini _____
  - Lavoratore donna _____
  - Lavoratore italiano _____
  - Lavoratore straniero _____
  - Lavoratore interno _____
  - Lavoratore a domicilio _____

- Apprendistato
  - Lavoratore uomini _____
  - Lavoratore donna _____
  - Lavoratore italiano _____
  - Lavoratore straniero _____
  - Lavoratore interno _____
  - Lavoratore a domicilio _____

- Voucher
  - Lavoratore uomini _____
  - Lavoratore donna _____
  - Lavoratore italiano _____
  - Lavoratore straniero _____
  - Lavoratore interno _____
  - Lavoratore a domicilio _____

54. Ogni quanto tempo viene erogato lo stipendio?
_____

55. L’azienda promuove verso i suoi fornitori (o verso le aziende della catena del valore) di erogare salari equi nei confronti dei propri lavoratori?
- Si
- No

56. Se si, in che misura lo promuove?
_____

**Subcategoria: diritti di associazione e contrattazione collettiva**

57. In azienda, in riferimento ai lavoratori indicati al punto 1, risultano iscritti al sindacato?
- Si
- No

58. Se si, quanti dipendenti, di cui al punto 1, risultano associati al sindacato?
- Lavoratore uomini _____
- Lavoratore donna _____
- Lavoratore italiano _____
- Lavoratore straniero _____
- Lavoratore interno _____
- Lavoratore a domicilio _____

**Subcategoria: lavoro forzato**

59. Cosa prevede il contratto di lavoro: salari, oneri sociali, altro/benefici?
_____(specificare)

60. L’azienda aiuta tutti i dipendenti a comprendere il significato di ogni parte del contratto firmato?
- Si
- No

61. Se si, in che modo li aiuta?
_____

62. L’azienda verifica che i dipendenti non lavorino oltre l’orario di lavoro previsto dalla legge?
- Si
- No

63. Se si, in che modo lo verifica?
_____

64. L’azienda da la possibilità al dipendente di dimettersi in qualsiasi momento, nei termiti previsti per legge?
- Si
- No

65. L’azienda trattiene documenti personali del lavoratore?
- Si
- No

66. L’azienda promuove verso i suoi partner aziendali politiche che proibiscano il lavoro forzato?
- Si
- No

67. Se si, in che modo lo promuove?
_____

**Subcategoria: pari opportunità/discriminazione**

68. C’è una politica di pari opportunità all’interno dell’azienda?
- Si

- No

69. Ci sono stati casi di discriminazione negli ultimi 5 anni?
- Si
- No

70. Ci sono donne che lavorano in azienda?
- Si
- No

71. Ci sono stranieri che lavorano in azienda?
- Si
- No

72. Se si, l'azienda promuove corsi di alfabetizzazione e/o integrazione?
- Si
- No

73. Se si, quali sono stati i corsi di alfabetizzazione e/o integrazione che l'azienda ha attuato negli ultimi 5 anni?
_____

74. L'azienda promuove verso i suoi fornitori (o verso le aziende della catena del valore) il rispetto delle pari opportunità o nel ridurre le discriminazioni?
- Si
- No

75. Se si, in che modo li promuove?
_____

**Subcategoria: benefici e sicurezza sociale**

76. L'azienda offre dei servizi aggiuntivi ai propri dipendenti, di cui al punto 1, per migliorare il loro benessere sociale?
- Si
- No

77. Se si, quali sono i servizi che ha fornito negli ultimi 5 anni?
- Mensa aziendale
- Trasporto tramite pulmino aziendale
- Asilo nido
- Altro _____(specificare)

78. Se si, questi servizi vengono forniti a tutti i dipendenti?
- Lavoratore uomini : ○si ○ no
- Lavoratore donna ○si ○ no
- Lavoratore italiano ○si ○ no
- Lavoratore straniero ○si ○ no
- Lavoratore interno ○si ○ no
- Lavoratore a domicilio ○si ○ no

79. L'azienda di garantisce i seguenti benefici sociali?
- Pensionamento ○si ○ no
- Sussidio per disabilita/ malattia/infortunio ○si ○ no
- Sussidio per familiari a carico ○si ○ no
- Maternità o paternità retribuita ○si ○ no
- Educazione e formazione ○si ○ no
- Vacanze ○si ○ no
- Diritto allo studio ○si ○ no
- Altro ( quattordicesima). ○si ○ no

80. Se si, questi benefici vengono forniti a tutti i dipendenti?
- Lavoratore uomini : ○si ○ no
- Lavoratore donna ○si ○ no
- Lavoratore italiano ○si ○ no
- Lavoratore straniero ○si ○ no
- Lavoratore interno ○si ○ no
- Lavoratore a domicilio ○si ○ no

**Subcategoria: impegno verso la comunità locale**

81. Esiste una politica e/o prassi dell'azienda a favore della comunità locale?
- Si
- No

82. Se si, che tipo di politica e/o prassi attua?

_____

83. L'azienda supporta le iniziative della comunità locale?
- Si
- No

84. Se si, come li supporta?

_____

85. L'azienda contribuisce allo sviluppo dell'economia locale?
- Si
- No

86. Se si, come contribuisce?

_____

87. Vengono realizzati incontri tra l'azienda e gli abitanti della comunità locale?
- Si
- No

88. L'azienda finanzia/supporta/promuove eventi culturali, artistici o che siano espressione del patrimonio culturale locale?
- SI
- NO

89. Se si, in che modo finanzia/supporta/promuove?

_____

# Local Community Questionnaire

**Subcategoria: impegno verso la comunità locale**

1) Azienda attua una politica a favore della comunità locale?
- Si
- No

2) Se si, che tipo di politica e/o prassi attua l'azienda?
_____

3) Le iniziative della comunità locale vengono supportate dall'azienda?
- Si
- No

4) Se si, come vengono supportate?
_____

5) L'azienda contribuisce allo sviluppo dell'economia locale?
- Si
- No

6) Se si, come contribuisce?
_____

7) Vengono realizzati incontri tra l'azienda e gli abitanti della comunità locale?
- Si
- No

8) L'azienda finanzia/supporta/promuove eventi culturali, artistici o che siano espressione del patrimonio culturale locale?
- SI
- NO

9) Se si, in che modo finanzia/supporta/promuove?
_____

AZIENDA _____

| | **Magazzino: acquisizione materi prime** |
|---|---|
| ***1.*** **Numero totaleCAPI richiesti nell'ordine preso in riferimento** | _____*(dettagliare tipologia, costo e numero)* |
| ***2.*** **Materi prime necessarie quantità, costo e provenienza** | Quantità di tessuto utilizzata e tipologia<br>Cotone ☐____% Velluto ☐____%<br>Lana ☐____% Altro ☐____%<br>Seta ☐____%<br>Costo del/i tessuto/i utilizzati _____ €<br>Consumo di gasolio per il trasporto delle materie prime ____*(dettagliare se $m^3$ o litri)*<br>Specificare il peso di ogni confezione ____*(kg)*<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista il/i tessuto/i _____<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto/i<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro ____*(specificare)*<br>- Specificare l'imballaggio del/i tessuto/i ____*(tipologia materiale es. bidoni PVC, ecc.)*<br>- Specificare il peso dell'imballaggio del/i tessuto/i ____*(kg)*<br>- Specificare il costo dell'imballaggio del/i tessuto/i _____ €<br><br>Quantità di Bottoni utilizzata e tipologia ____<br>- Costo dei bottoni utilizzati _____ €<br>Consumo di gasolio per il trasporto di bottoni relative ai capi di riferimento____*(dettagliare se $m^3$ o litri)*<br>Specificare il peso di ogni confezione ____*(kg)*<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista dei bottoni _____<br>- Specificare il tipo di automezzo utilizzato per il trasporto dei bottoni<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro ____*(specificare)*<br>- Specificare l'imballaggio dei bottoni ____*(tipologia materiale es. bidoni PVC, ecc.)*<br>- Specificare il peso dell'imballaggio dei bottoni ____*(kg)*<br>- Specificare il costo dell'imballaggio delle bottoni _____ €<br><br>Quantità di ZIP utilizzate e tipologia ____<br>Costo delle zip utilizzate _____ €<br>Consumo di gasolio per il trasporto delle zip relative ai capi di riferimento____*(dettagliare se $m^3$ o litri)*<br>Specificare il peso di ogni confezione ____*(kg)* |

| | |
|---|---|
| | Specificare il comune di residenza dell'azienda produttrice da cui si acquistano le zip _____<br>- Specificare il tipo di automezzo utilizzato per il trasporto delle zip<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro _____*(specificare)*<br>- Specificare l'imballaggio delle zip _____*(tipologia materiale es. bidoni PVC, ecc.)*<br>- Specificare il peso dell'imballaggio delle zip _____*(kg)*<br>- Specificare il costo dell'imballaggio delle grucce _____ €<br><br>Quantità di Grucce utilizzata e tipologia _____<br>Costo delle grucce utilizzate _____€<br>Consumo di gasolio per il trasporto delle grucce relative ai capi di riferimento_____*(dettagliare se $m^3$ o litri)*<br>Specificare il peso di ogni confezione _____*(kg)*<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquistano le grucce_____<br>- Specificare il tipo di automezzo utilizzato per il trasporto delle grucce<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro _____*(specificare)*<br>- Specificare l'imballaggio delle grucce _____*(tipologia materiale es. bidoni PVC, ecc.)*<br>- Specificare il peso dell'imballaggio delle grucce _____*(kg)*<br>- Specificare il costo dell'imballaggio delle grucce _____ € |
| ***3.*** **Personale** | N° e mansione dipendenti che si occupano dello scarico/stoccaggio _____<br>N° ore impiegate per l'ordine _____<br>Mezzo di trasporto utilizzato da tale personale Mezzo proprio ☐<br>Mezzo pubblico/urbano ☐<br>Mezzo aziendale ☐<br>Mezzo privato ☐<br><br>Tempo impiegato per l'arrivo in azienda _____<br>Stipendio dei dipendenti _____€<br><br>Note _____ *(specificare)* |
| | PVC _____*(kg) (specificare se riciclato* ☐ o non riciclato ☐)<br>PE _____*(kg)(specificare se riciclato* ☐ o non riciclato ☐) |

| | |
|---|---|
| ***4.*** **Tipologia, provenienza costo e quantità imballo** *(specificare sempre la quantità dell'ordine preso in riferimento)* | PP _____*(kg) (specificare se riciclato* ☐ o non riciclato ☐)<br>Altro _____*(specificare tipo plastica)* _____*(kg)*<br><br>Specificare il peso di ogni confezione _____*(kg)*<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista il prodotto_____<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro _____*(specificare)*<br>- Specificare l'imballaggio del prodotto _____*(tipologia materiale es. cartone ondulato doppio, sacchi di PP, ecc.)*<br>- Specificare il peso dell'imballaggio del prodotto _____(kg.)<br>- Specificare il costo dell'imballaggio del prodotto _____€<br><br>PVC _____*(kg) (specificare se riciclato* ☐ o non riciclato ☐)<br>PE _____*(kg)(specificare se riciclato* ☐ o non riciclato ☐)<br>PP _____*(kg) (specificare se riciclato* ☐ o non riciclato ☐)<br>Altro _____*(specificare tipo plastica)* _____*(kg)*<br><br>Specificare il peso di ogni confezione _____*(kg)*<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista il prodotto_____<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro _____*(specificare)*<br>- Specificare l'imballaggio del prodotto _____*(tipologia materiale es. cartone ondulato doppio, sacchi di PP, ecc.)*<br>- Specificare il peso dell'imballaggio del prodotto _____(kg.)<br>- Specificare il costo dell'imballaggio del prodotto _____€<br><br>PVC (kg) (specificare se riciclato ☐ o non riciclato ☐)<br>PE (kg) (specificare se riciclato ☐ o non riciclato ☐)<br>PP (kg) (specificare se riciclato ☐ o non riciclato ☐)<br>LDPE (kg) (specificare se riciclato ☐ o non riciclato ☐)<br>Altro (specificare tipo plastica) (kg)<br><br>Specificare il peso di ogni confezione (kg)<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista il prodotto<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro (specificare)<br>- Specificare l'imballaggio del prodotto (tipologia materiale es. cartone ondulato doppio, sacchi di PP, ecc.)<br>- Specificare il peso dell'imballaggio del prodotto (kg.) |

| | |
|---|---|
| | - Specificare il costo dell'imballaggio del prodotto _____€ |
| ***5.*** **Scarti e rifiuti** *(specificare sempre la quantità dell'ordine preso in riferimento)* | Rifiuti da imballaggi (specificati sopra) - Specificare tipologia imballo (tipologia materiale)<br>Specificare il peso (kg.)<br>- Specificare la tipologia di trattamento che il rifiuto subirà a destinazione<br>- Specificare il comune di residenza della destinazione<br>- Specificare il costo per lo smaltimento _____€<br>- Specificare il tipo di automezzo utilizzato per il trasporto del rifiuto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro (specificare)<br>N.B. se il trasporto avviene con altro materiale, specificare quale<br><br>Altri scarti e rifiuti (diversi dagli imballaggi specificati sopra) - Specificare tipologia scarto (tipologia materiale)<br>- Specificare il peso (kg.)<br>- Specificare la tipologia di trattamento che il rifiuto subirà a destinazione<br>- Specificare il comune di residenza della destinazione<br>- Specificare il costo per lo smaltimento _____€<br>-Specificare il tipo di automezzo utilizzato per il trasporto del rifiuto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro (specificare)<br>N.B. se il trasporto avviene con altro materiale, specificare quale |

**Se lo desiderate potete porre in evidenza ogni altro aspetto che, a vostro giudizio, non è stato trattato nelle domande precedenti:**_____

Nome azienda: _____ Nome di chi ha compilato il questionario: _____ Contatto e-mail o telefonico: _____

*UNIVERSITA' DEGLI STUDI DI MESSINA – DIPARTIMENTO DI ECONOMIA (Referente ricerca Prof.ssa Roberta Salomone - tel. 090.771548 - e-mail roberta.salomone@unime.it)*

***QUESTIONARIO - RACCOLTA DATI PROGETTAZIONE AZIENDA _____***

| | **FASE 2 CAD** |
|---|---|
| **Numero totale CAPI richiesti nell'ordine preso in riferimento** | _____*(dettagliare tipologia e numero)* |
| **1. Consumo materiali** *(specificare sempre la quantità dell'ordine preso in riferimento)* | Carta bianca _____*(kg) (specificare se riciclata* ☐ o vergine ☐)<br>Carta kraft _____*(kg)(specificare se riciclato* ☐ o vergine ☐)<br>Altro _____*(specificare tipo plastica)* _____*(kg)*<br><br>Specificare il peso di ogni confezione _____*(kg)*<br>- Specificare il costo _____€<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista il prodotto _____<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro _____*(specificare)*<br>- Specificare l'imballaggio del prodotto _____*(tipologia materiale es. cartone ondulato doppio, sacchi di PP, ecc.)*<br>- Specificare il peso dell'imballaggio del prodotto _____*(kg.)*<br>- Specificare il costo dell'imballaggio _____€<br><br>_____*(dettagliare tipo materiale* - ammontare annuo) _____*(dettagliare se kg, litri, ecc.)*<br>Specificare il costo del materiale _____€<br>Specificare il peso di ogni confezione _____*(kg)*<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista il prodotto _____<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro _____*(specificare)*<br>- Specificare l'imballaggio del prodotto _____*(tipologia materiale es. cartone ondulato doppio, sacchi di PP, ecc.)*<br>- Specificare il peso dell'imballaggio del prodotto _____*(kg.)*<br>- Specificare il costo dell'imballaggio _____€<br><br>Altro _____*(specificare)* |
| **2. Strumenti e personale utilizzato** | Meccanizzata☐tipologia macchinari (1) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (2) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (3) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (4) ☐ _____ n° di ore utilizzato ☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (5) ☐ _____ n° di ore utilizzato ☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (6) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____ |

| | |
|---|---|
| | Manuale ☐<br>N° e mansione dipendenti che si occupano della progettazione CAD_____<br>N° ore impiegate per l'ordine _____<br>Mezzo di trasporto utilizzato da tale personale Mezzo proprio ☐<br>Mezzo pubblico/urbano ☐<br>Mezzo aziendale ☐<br>Mezzo privato ☐<br><br>Tempo impiegato per l'arrivo in azienda _____<br>Stipendio dei dipendenti _____€<br><br>**Note** _____***(specificare)*** |
| **3. Consumo energia** | Consumo di energia elettrica relativa al processo (ammontare annuo) _____*(dettagliare se J o kwh)*<br>Consumo di energia elettricaper altri scopi _____*(specificare quale attività)* _____*(specificare quantità annua e dettagliare se J o kwh)*<br>Note _____*(specificare)* |
| **4. Scarti e rifiuti** *(specificare sempre la quantità dell'ordine preso in riferimento)* | Rifiuti da imballaggi (specificati sopra) - Specificare tipologia imballo (tipologia materiale)<br>Specificare il peso (kg.)<br>- Specificare la tipologia di trattamento che il rifiuto subirà a destinazione<br>- Specificare il comune di residenza della destinazione<br>- Specificare il costo per lo smaltimento _____€<br>- Specificare il tipo di automezzo utilizzato per il trasporto del rifiuto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro (specificare)<br>N.B. se il trasporto avviene con altro materiale, specificare quale<br><br>Altri scarti e rifiuti (diversi dagli imballaggi specificati sopra) - Specificare tipologia scarto (tipologia materiale)<br>- Specificare il peso (kg.)<br>- Specificare la tipologia di trattamento che il rifiuto subirà a destinazione<br>- Specificare il comune di residenza della destinazione<br>- Specificare il costo per lo smaltimento _____€<br>-Specificare il tipo di automezzo utilizzato per il trasporto del rifiuto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro (specificare)<br>N.B. se il trasporto avviene con altro materiale, specificare quale |

**Se lo desiderate potete porre in evidenza ogni altro aspetto che, a vostro giudizio, non è stato trattato nelle domande precedenti:**_____

Nome azienda: _____ Nome di chi ha compilato il questionario: _____ Contatto e-mail o telefonico: _____

*UNIVERSITA' DEGLI STUDI DI MESSINA – DIPARTIMENTO DI ECONOMIA (Referente ricerca Prof.ssa Roberta Salomone - tel. 090.771548 - e-mail roberta.salomone@unime.it)*

***QUESTIONARIO - RACCOLTA DATI TAGLIO AZIENDA _____***

| | **FASE 3 TAGLIO** |
|---|---|
| **Numero totale CAPI richiesti nell'ordine preso in riferimento** | _____*(dettagliare tipologia, costo e numero)* |
| **1. Consumo materiali** *(specificare sempre la quantità dell'ordine preso in riferimento)* | _____*(dettagliare tipo materiale )* _____*(dettagliare se kg, litri, ecc.)*<br>Specificare il peso di ogni confezione _____*(kg)*<br>Specificare il costo del materiale utilizzato _____€<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista il prodotto_____<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro _____*(specificare)*<br>- Specificare l'imballaggio del prodotto _____*(tipologia materiale es. cartone ondulato doppio, sacchi di PP, ecc.)*<br>- Specificare il peso dell'imballaggio del prodotto _____*(kg.)*<br>- Specificare il costo dell'imballaggio del prodotto _____€<br>Altro _____(specificare) |
| **2. Strumenti e personale utilizzato** | Meccanizzata☐tipologia macchinari (1) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (2) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (3) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (4) ☐ _____ n° di ore utilizzato ☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (5) ☐ _____ n° di ore utilizzato ☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (6) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (7) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (8) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (9) ☐ _____ n° di ore utilizzato ☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (10) ☐ _____ n° di ore utilizzato ☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br><br>Manuale ☐<br>N° e mansione dipendenti che si occupano del taglio_____<br>N° ore impiegate per l'ordine _____<br>Mezzo di trasporto utilizzato da tale personale Mezzo proprio ☐<br>Mezzo pubblico/urbano ☐<br>Mezzo aziendale ☐<br>Mezzo privato ☐<br><br>Tempo impiegato per l'arrivo in azienda _____<br>Stipendio dei dipendenti _____€ |

| | |
|---|---|
| | **Note** _____*(specificare)* |
| **3. Consumo energia** | Consumo di energia elettrica relativa al processo (ammontare annuo) _____*(dettagliare se J o kwh)*<br>Consumo di energia elettricaper altri scopi _____*(specificare quale attività)* _____*(specificare quantità annua e dettagliare se J o kwh)*<br>Note _____*(specificare)* |
| **4. Scarti e rifiuti** *(specificare sempre la quantità dell'ordine preso in riferimento)* | Rifiuti da imballaggi (specificati sopra) - Specificare tipologia imballo (tipologia materiale)<br>Specificare il peso (kg.)<br>- Specificare la tipologia di trattamento che il rifiuto subirà a destinazione<br>- Specificare il comune di residenza della destinazione<br>- Specificare il costo per lo smaltimento _____€<br>- Specificare il tipo di automezzo utilizzato per il trasporto del rifiuto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro (specificare)<br>N.B. se il trasporto avviene con altro materiale, specificare quale<br><br>Altri scarti e rifiuti (diversi dagli imballaggi specificati sopra) - Specificare tipologia scarto (tipologia materiale)<br>- Specificare il peso (kg.)<br>- Specificare la tipologia di trattamento che il rifiuto subirà a destinazione<br>- Specificare il comune di residenza della destinazione<br>- Specificare il costo per lo smaltimento _____€<br>-Specificare il tipo di automezzo utilizzato per il trasporto del rifiuto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro (specificare)<br>N.B. se il trasporto avviene con altro materiale, specificare quale |

**Se lo desiderate potete porre in evidenza ogni altro aspetto che, a vostro giudizio, non è stato trattato nelle domande precedenti:**_____

Nome azienda: _____ Nome di chi ha compilato il questionario: _____ Contatto e-mail o telefonico: _____

| | **FASE 4 APERTURA** |
|---|---|
| **Numero totale CAPI richiesti nell'ordine preso in riferimento** | _____*(dettagliare tipologia, costo e numero)* |
| **1. Consumo materiali** *(specificare sempre la quantità dell'ordine preso in riferimento)* | _____*(dettagliare tipo materiale*) _____*(dettagliare se kg, litri, ecc.)*<br>Specificare il peso di ogni confezione _____*(kg)*<br>Specificare il costo del materiale utilizzato _____€<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista il prodotto_____<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro _____*(specificare)*<br>- Specificare l'imballaggio del prodotto _____*(tipologia materiale es. cartone ondulato doppio, sacchi di PP, ecc.)*<br>- Specificare il peso dell'imballaggio del prodotto _____*(kg.)*<br>- Specificare il costo dell'imballaggio del prodotto _____€<br>Altro _____(specificare) |
| **2. Strumenti e personale utilizzato** | Meccanizzata☐tipologia macchinari (1) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (2) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (3) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (4) ☐ _____ n° di ore utilizzato ☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (5) ☐ _____ n° di ore utilizzato ☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (6) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (7) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (8) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (9) ☐ _____ n° di ore utilizzato ☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (10) ☐ _____ n° di ore utilizzato ☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br><br>Manuale ☐<br>N° e mansione dipendenti che si occupano dell'apertura_____<br>N° ore impiegate per l'ordine _____<br>Mezzo di trasporto utilizzato da tale personale Mezzo proprio ☐<br>Mezzo pubblico/urbano ☐<br>Mezzo aziendale ☐<br>Mezzo privato ☐<br><br>Tempo impiegato per l'arrivo in azienda _____<br>Stipendio dei dipendenti _____€<br><br>**Note** _____***(specificare)*** |

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| **3. Consumo energia** | Consumo di energia elettrica relativa al processo _____*(dettagliare se J o kwh)*<br>Consumo di energia elettricaper altri scopi _____*(specificare quale attività)* _____*(specificare quantità annua e dettagliare se J o kwh)*<br>Note _____*(specificare)* |
| **4. Scarti e rifiuti** *(specificare sempre la quantità dell'ordine preso in riferimento)* | Rifiuti da imballaggi (specificati sopra) - Specificare tipologia imballo (tipologia materiale)<br>Specificare il peso (kg.)<br>- Specificare la tipologia di trattamento che il rifiuto subirà a destinazione<br>- Specificare il comune di residenza della destinazione<br>- Specificare il costo per lo smaltimento _____€<br>- Specificare il tipo di automezzo utilizzato per il trasporto del rifiuto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro (specificare)<br>N.B. se il trasporto avviene con altro materiale, specificare quale<br><br>Altri scarti e rifiuti (diversi dagli imballaggi specificati sopra) - Specificare tipologia scarto (tipologia materiale)<br>- Specificare il peso (kg.)<br>- Specificare la tipologia di trattamento che il rifiuto subirà a destinazione<br>- Specificare il comune di residenza della destinazione<br>- Specificare il costo per lo smaltimento _____€<br>-Specificare il tipo di automezzo utilizzato per il trasporto del rifiuto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro (specificare)<br>N.B. se il trasporto avviene con altro materiale, specificare quale |

**Se lo desiderate potete porre in evidenza ogni altro aspetto che, a vostro giudizio, non è stato trattato nelle domande precedenti:**_____

Nome azienda: _____ Nome di chi ha compilato il questionario: _____ Contatto e-mail o telefonico: _____

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***QUESTIONARIO - RACCOLTA DATI CONFEZIONE AZIENDA _____***

| | **FASE 4 CONFEZIONE** |
|---|---|
| **Numero totale CAPI richiesti nell'ordine preso in riferimento** | _____*(dettagliare tipologia e numero)* |
| **1. Consumo materiali** *(specificare sempre la quantità dell'ordine preso in riferimento)* | _____*(dettagliare tipo materiale* - ammontare annuo) _____*(dettagliare se kg, litri, ecc.)*<br>Specificare il peso di ogni confezione _____*(kg)*<br>Specificare il costo del materiale utilizzato _____€<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista il prodotto_____<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro _____*(specificare)*<br>- Specificare l'imballaggio del prodotto _____*(tipologia materiale es. cartone ondulato doppio, sacchi di PP, ecc.)*<br>- Specificare il peso dell'imballaggio del prodotto _____*(kg.)*<br>- Specificare il costo dell'imballaggio del prodotto _____€<br>Altro _____(specificare)<br><br>_____*(dettagliare tipo materiale*) _____*(dettagliare se kg, litri, ecc.)*<br>Specificare il peso di ogni confezione _____*(kg)*<br>Specificare il costo del materiale utilizzato _____€<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista il prodotto_____<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro _____*(specificare)*<br>- Specificare l'imballaggio del prodotto _____*(tipologia materiale es. cartone ondulato doppio, sacchi di PP, ecc.)*<br>- Specificare il peso dell'imballaggio del prodotto _____*(kg.)*<br>- Specificare il costo dell'imballaggio del prodotto _____€<br>Altro _____(specificare)<br><br>_____*(dettagliare tipo materiale*) _____*(dettagliare se kg, litri, ecc.)*<br>Specificare il peso di ogni confezione _____*(kg)*<br>Specificare il costo del materiale utilizzato _____€<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista il prodotto_____<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐ |

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| | Altro _____*(specificare)*<br>- Specificare l'imballaggio del prodotto _____*(tipologia materiale es. cartone ondulato doppio, sacchi di PP, ecc.)*<br>- Specificare il peso dell'imballaggio del prodotto _____*(kg.)*<br>- Specificare il costo dell'imballaggio del prodotto _____€<br>Altro _____(specificare) |
| **2. Strumenti e personale utilizzato** | Meccanizzata☐tipologia macchinari (1) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (2) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (3) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (4) ☐ _____ n° di ore utilizzato ☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (5) ☐ _____ n° di ore utilizzato ☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (6) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (7) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (8) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (9) ☐ _____ n° di ore utilizzato ☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (10) ☐ _____ n° di ore utilizzato ☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br><br>Manuale ☐<br>N° e mansione dipendenti che si occupano del confezionamento_____<br>N° ore impiegate per l'ordine _____<br>Mezzo di trasporto utilizzato da tale personale Mezzo proprio ☐<br>Mezzo pubblico/urbano ☐<br>Mezzo aziendale ☐<br>Mezzo privato ☐<br><br>Tempo impiegato per l'arrivo in azienda _____<br>Stipendio dei dipendenti _____€<br><br>**Note** _____***(specificare)*** |
| **3. Consumo energia** | Consumo di energia elettrica relativa al processo (ammontare annuo) _____*(dettagliare se J o kwh)*<br>Consumo di energia elettricaper altri scopi _____*(specificare quale attività)* _____*(specificare quantità annua e dettagliare se J o kwh)*<br>Note _____*(specificare)* |
| **4. Scarti e rifiuti** *(specificare sempre la quantità dell'ordine preso in riferimento)* | Rifiuti da imballaggi (specificati sopra) - Specificare tipologia imballo (tipologia materiale)<br>Specificare il peso (kg.)<br>- Specificare la tipologia di trattamento che il rifiuto subirà a destinazione<br>- Specificare il comune di residenza della destinazione<br>- Specificare il costo per lo smaltimento _____€<br>- Specificare il tipo di automezzo utilizzato per il trasporto del rifiuto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro (specificare)<br>N.B. se il trasporto avviene con altro materiale, specificare quale |

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| | Altri scarti e rifiuti (diversi dagli imballaggi specificati sopra) - Specificare tipologia scarto (tipologia materiale)<br>- Specificare il peso (kg.)<br>- Specificare la tipologia di trattamento che il rifiuto subirà a destinazione<br>- Specificare il comune di residenza della destinazione<br>- Specificare il costo per lo smaltimento _____€<br>-Specificare il tipo di automezzo utilizzato per il trasporto del rifiuto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro (specificare)<br>N.B. se il trasporto avviene con altro materiale, specificare quale |

**Se lo desiderate potete porre in evidenza ogni altro aspetto che, a vostro giudizio, non è stato trattato nelle domande precedenti:**_____

Nome azienda: _____ Nome di chi ha compilato il questionario: _____ Contatto e-mail o telefonico: _____

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***QUESTIONARIO - RACCOLTA DATI FASE CONTROLLO AZIENDA _____***

| | **FASE 6 CONTROLLO** |
|---|---|
| **Numero totale CAPI richiesti nell'ordine preso in riferimento** | _____*(dettagliare tipologia, costo e numero)* |
| **1. Consumo materiali** *(specificare sempre la quantità dell'ordine preso in riferimento)* | _____*(dettagliare tipo materiale* - ammontare annuo) _____*(dettagliare se kg, litri, ecc.)*<br>Specificare il peso di ogni confezione _____*(kg)*<br>Specificare il costo del materiale utilizzato _____€<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista il prodotto_____<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro _____*(specificare)*<br>- Specificare l'imballaggio del prodotto _____*(tipologia materiale es. cartone ondulato doppio, sacchi di PP, ecc.)*<br>- Specificare il peso dell'imballaggio del prodotto _____*(kg.)*<br>- Specificare il costo dell'imballaggio del prodotto _____€<br>Altro _____(specificare) |
| **2. Strumenti e personale utilizzato** | Meccanizzata☐tipologia macchinari (1) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (2) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (3) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (4) ☐ _____ n° di ore utilizzato ☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (5) ☐ _____ n° di ore utilizzato ☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (6) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (7) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (8) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (9) ☐ _____ n° di ore utilizzato ☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (10) ☐ _____ n° di ore utilizzato ☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br><br>Manuale ☐<br>N° e mansione dipendenti che si occupano del controllo_____<br>N° ore impiegate per l'ordine _____<br>Mezzo di trasporto utilizzato da tale personale Mezzo proprio ☐<br>Mezzo pubblico/urbano ☐<br>Mezzo aziendale ☐<br>Mezzo privato ☐<br><br>Tempo impiegato per l'arrivo in azienda _____<br>Stipendio dei dipendenti _____€ |

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| | **Note** _____*(specificare)* |
| **3. Consumo energia** | Consumo di energia elettrica relativa al processo _____*(dettagliare se J o kwh)*<br>Consumo di energia elettricaper altri scopi _____*(specificare quale attività)* _____*(specificare quantità annua e dettagliare se J o kwh)*<br>Note _____*(specificare)* |
| **5. Scarti e rifiuti** *(specificare sempre la quantità dell'ordine preso in riferimento)* | Rifiuti da imballaggi (specificati sopra) - Specificare tipologia imballo (tipologia materiale)<br>Specificare il peso (kg.)<br>- Specificare la tipologia di trattamento che il rifiuto subirà a destinazione<br>- Specificare il comune di residenza della destinazione<br>- Specificare il costo per lo smaltimento _____€<br>- Specificare il tipo di automezzo utilizzato per il trasporto del rifiuto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro (specificare)<br>N.B. se il trasporto avviene con altro materiale, specificare quale<br><br>Altri scarti e rifiuti (diversi dagli imballaggi specificati sopra) - Specificare tipologia scarto (tipologia materiale)<br>- Specificare il peso (kg.)<br>- Specificare la tipologia di trattamento che il rifiuto subirà a destinazione<br>- Specificare il comune di residenza della destinazione<br>- Specificare il costo per lo smaltimento _____€<br>-Specificare il tipo di automezzo utilizzato per il trasporto del rifiuto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro (specificare)<br>N.B. se il trasporto avviene con altro materiale, specificare quale |

**Se lo desiderate potete porre in evidenza ogni altro aspetto che, a vostro giudizio, non è stato trattato nelle domande precedenti:**_____

Nome azienda: _____ Nome di chi ha compilato il questionario: _____ Contatto e-mail o telefonico: _____

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***QUESTIONARIO - RACCOLTA DATI SETTORE STIRO AZIENDA _____***

| | **FASE 8 STIRO** |
|---|---|
| **Numero totale CAPI richiesti nell'ordine preso in riferimento** | _____*(dettagliare tipologia, costo e numero)* |
| **1. Consumo materiali** *(specificare sempre la quantità dell'ordine preso in riferimento)* | _____*(dettagliare tipo materiale* - ammontare annuo) _____*(dettagliare se kg, litri, ecc.)*<br>Specificare il peso di ogni confezione _____*(kg)*<br>Specificare il costo del materiale utilizzato _____€<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista il prodotto_____<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro _____*(specificare)*<br>- Specificare l'imballaggio del prodotto _____*(tipologia materiale es. cartone ondulato doppio, sacchi di PP, ecc.)*<br>- Specificare il peso dell'imballaggio del prodotto _____*(kg.)*<br>- Specificare il costo dell'imballaggio del prodotto _____€<br>Altro _____(specificare)<br><br>_____*(dettagliare tipo materiale* - ammontare annuo) _____*(dettagliare se kg, litri, ecc.)*<br>Specificare il peso di ogni confezione _____*(kg)*<br>Specificare il costo del materiale utilizzato _____€<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista il prodotto_____<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro _____*(specificare)*<br>- Specificare l'imballaggio del prodotto _____*(tipologia materiale es. cartone ondulato doppio, sacchi di PP, ecc.)*<br>- Specificare il peso dell'imballaggio del prodotto _____*(kg.)*<br>- Specificare il costo dell'imballaggio del prodotto _____€<br>Altro _____(specificare) |
| **2. Strumenti e personale utilizzato** | Meccanizzata☐tipologia macchinari (1) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (2) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (3) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (4) ☐ _____ n° di ore utilizzato ☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (5) ☐ _____ n° di ore utilizzato ☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (6) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (7) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (8) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____ |

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| | Manuale ☐<br>N° e mansione dipendenti che si occupano della stiratura_____<br>N° ore impiegate per l'ordine _____<br>Mezzo di trasporto utilizzato da tale personale Mezzo proprio ☐<br>Mezzo pubblico/urbano ☐<br>Mezzo aziendale ☐<br>Mezzo privato ☐<br><br>Tempo impiegato per l'arrivo in azienda _____<br>Stipendio dei dipendenti _____€<br><br>**Note** _____***(specificare)*** |
| **3. Consumo energia** | Consumo di energia elettrica relativa al processo (ammontare annuo) _____*(dettagliare se J o kwh)*<br>Consumo di energia elettricaper altri scopi _____*(specificare quale attività)* _____*(specificare quantità annua e dettagliare se J o kwh)*<br>Note _____*(specificare)* |
| **4. Scarti e rifiuti** *(specificare sempre la quantità dell'ordine preso in riferimento)* | Rifiuti da imballaggi (specificati sopra) - Specificare tipologia imballo (tipologia materiale)<br>Specificare il peso (kg.)<br>- Specificare la tipologia di trattamento che il rifiuto subirà a destinazione<br>- Specificare il comune di residenza della destinazione<br>- Specificare il costo per lo smaltimento _____€<br>- Specificare il tipo di automezzo utilizzato per il trasporto del rifiuto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro (specificare)<br>N.B. se il trasporto avviene con altro materiale, specificare quale<br><br>Altri scarti e rifiuti (diversi dagli imballaggi specificati sopra) - Specificare tipologia scarto (tipologia materiale)<br>- Specificare il peso (kg.)<br>- Specificare la tipologia di trattamento che il rifiuto subirà a destinazione<br>- Specificare il comune di residenza della destinazione<br>- Specificare il costo per lo smaltimento _____€<br>-Specificare il tipo di automezzo utilizzato per il trasporto del rifiuto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro (specificare)<br>N.B. se il trasporto avviene con altro materiale, specificare quale |

**Se lo desiderate potete porre in evidenza ogni altro aspetto che, a vostro giudizio, non è stato trattato nelle domande precedenti:**_____

Nome azienda: _____ Nome di chi ha compilato il questionario: _____ Contatto e-mail o telefonico: _____

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***QUESTIONARIO - RACCOLTA DATI FASEQUALITA' AZIENDA _____***

| | **FASE 9 QUALITA'** |
|---|---|
| **Numero totale CAPI richiesti nell'ordine preso in riferimento** | _____*(dettagliare tipologia, costo e numero)* |
| **1. Consumo materiali** *(specificare sempre la quantità dell'ordine preso in riferimento)* | _____*(dettagliare tipo materiale* - ammontare annuo) _____*(dettagliare se kg, litri, ecc.)*<br>Specificare il peso di ogni confezione _____*(kg)*<br>Specificare il costo del materiale utilizzato _____€<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista il prodotto_____<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro _____*(specificare)*<br>- Specificare l'imballaggio del prodotto _____*(tipologia materiale es. cartone ondulato doppio, sacchi di PP, ecc.)*<br>- Specificare il peso dell'imballaggio del prodotto _____*(kg.)*<br>- Specificare il costo dell'imballaggio del prodotto _____€<br>Altro _____(specificare) |
| **2. Personale** | N° e mansione dipendenti che si occupano dellaverifica qualità_____<br>N° ore impiegate per l'ordine _____<br>Mezzo di trasporto utilizzato da tale personale Mezzo proprio ☐<br>Mezzo pubblico/urbano ☐<br>Mezzo aziendale ☐<br>Mezzo privato ☐<br>Tempo impiegato per l'arrivo in azienda _____<br>Stipendio dei dipendenti _____€<br>Note _____ *(specificare)* |
| **3. Consumo energia** | Consumo di energia elettrica relativa al processo (ammontare annuo) _____*(dettagliare se J o kwh)*<br>Consumo di energia elettricaper altri scopi _____*(specificare quale attività)* _____*(specificare quantità annua e dettagliare se J o kwh)*<br>Note _____*(specificare)* |
| **4. Scarti e rifiuti** *(specificare sempre la quantità dell'ordine preso in riferimento)* | Rifiuti da imballaggi (specificati sopra) - Specificare tipologia imballo (tipologia materiale)<br>Specificare il peso (kg.)<br>- Specificare la tipologia di trattamento che il rifiuto subirà a destinazione<br>- Specificare il comune di residenza della destinazione<br>- Specificare il costo per lo smaltimento _____€<br>- Specificare il tipo di automezzo utilizzato per il trasporto del rifiuto<br>Furgone ☐<br>Camion da 10 t ☐ |

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| | Camion da 16 t ☐<br>Altro (specificare)<br>N.B. se il trasporto avviene con altro materiale, specificare quale<br><br>Altri scarti e rifiuti (diversi dagli imballaggi specificati sopra) - Specificare tipologia scarto (tipologia materiale)<br>- Specificare il peso (kg.)<br>- Specificare la tipologia di trattamento che il rifiuto subirà a destinazione<br>- Specificare il comune di residenza della destinazione<br>- Specificare il costo per lo smaltimento _____€<br>-Specificare il tipo di automezzo utilizzato per il trasporto del rifiuto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro (specificare)<br>N.B. se il trasporto avviene con altro materiale, specificare quale |

**Se lo desiderate potete porre in evidenza ogni altro aspetto che, a vostro giudizio, non è stato trattato nelle domande precedenti:**_____

Nome azienda: _____ Nome di chi ha compilato il questionario: _____ Contatto e-mail o telefonico: _____

*UNIVERSITA' DEGLI STUDI DI MESSINA – DIPARTIMENTO DI ECONOMIA (Referente ricerca Prof.ssa Roberta Salomone - tel. 090.771548 - e-mail roberta.salomone@unime.it)*

***QUESTIONARIO - RACCOLTA DATI IMBALLAGGIO/ DISTRIBUZIONE AZIENDA _____***

| | | | |
|---|---|---|---|
| **1. Ammontare imballato dei capi dell'ordine preso in riferimento** | _____*(dettagliare se kg o ton)* | **2. Ammontare dell'ordine** | _____*(numero)* |

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| **2. Tipologia, costo e quantità ADESIVI** *(specificare sempre la quantità dell'ordine preso in riferimento)* | PVC _____*(kg) (specificare se riciclato* ☐ o non riciclato ☐)<br>PE _____*(kg)(specificare se riciclato* ☐ o non riciclato ☐)<br>PP _____*(kg) (specificare se riciclato* ☐ o non riciclato ☐)<br>Altro _____*(specificare tipo plastica)* _____*(kg)*<br><br>Specificare il peso di ogni confezione _____*(kg)*<br>Specificare il costo _____€<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista il prodotto_____<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro _____*(specificare)*<br>- Specificare l'imballaggio del prodotto _____*(tipologia materiale es. cartone ondulato doppio, sacchi di PP, ecc.)*<br>- Specificare il peso dell'imballaggio del prodotto _____*(kg.)*<br>Specificare il costo dell'imballaggio _____€ |
| **3. Tipologia, costo e quantità SCATOLE** *(specificare sempre la quantità dell'ordine preso in riferimento)* | PVC _____*(kg) (specificare se riciclato* ☐ o non riciclato ☐)<br>PE _____*(kg)(specificare se riciclato* ☐ o non riciclato ☐)<br>PP _____*(kg) (specificare se riciclato* ☐ o non riciclato ☐)<br>Altro _____*(specificare tipo plastica)* _____*(kg)*<br><br>Specificare il peso di ogni confezione _____*(kg)*<br>Specificare il costo _____€<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista il prodotto_____<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro _____*(specificare)*<br>- Specificare l'imballaggio del prodotto _____*(tipologia materiale es. cartone ondulato doppio, sacchi di PP, ecc.)*<br>- Specificare il peso dell'imballaggio del prodotto _____*(kg.)*<br>- Specificare il costo dell'imballaggio _____€ |
| **4. Tipologia, costo e quantità CARTELLINI** *(specificare sempre la quantità dell'ordine preso in riferimento)* | PVC _____*(kg) (specificare se riciclato* ☐ o non riciclato ☐)<br>PE _____*(kg)(specificare se riciclato* ☐ o non riciclato ☐)<br>PP _____*(kg) (specificare se riciclato* ☐ o non riciclato ☐)<br>Altro _____*(specificare tipo plastica)* _____*(kg)*<br><br>Specificare il peso di ogni confezione _____*(kg)*<br>Specificare il costo _____€ |

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| | Specificare il comune di residenza dell'azienda produttrice da cui si acquista il prodotto_____<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro _____*(specificare)*<br>- Specificare l'imballaggio del prodotto _____*(tipologia materiale es. cartone ondulato doppio, sacchi di PP, ecc.)*<br>- Specificare il peso dell'imballaggio del prodotto _____*(kg.)*<br>- Specificare il costo dell'imballaggio _____€ |
| **5. Tipologia, costo e quantità dei BAULETTI per il trasporto** *(specificare sempre la quantità dell'ordine preso in riferimento)* | PVC _____*(kg) (specificare se riciclato* ☐ o non riciclato ☐)<br>PE _____*(kg)(specificare se riciclato* ☐ o non riciclato ☐)<br>PP _____*(kg) (specificare se riciclato* ☐ o non riciclato ☐)<br>LDPE _____*(kg) (specificare se riciclato* ☐ o non riciclato ☐)<br>Altro _____*(specificare tipo plastica)* _____*(kg)*<br><br>Cartone ondulato doppio _____*(kg) (specificare se riciclato* ☐ o vergine ☐)<br>Cartone ondulato semplice _____*(kg)(specificare se riciclato* ☐ o vergine ☐)<br>Altro _____*(specificare tipo plastica)* _____*(kg)*<br><br>Specificare il peso di ogni confezione _____*(kg)*<br>Specificare il costo _____€<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista il prodotto_____<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro _____*(specificare)*<br>- Specificare l'imballaggio del prodotto _____*(tipologia materiale es. cartone ondulato doppio, sacchi di PP, ecc.)*<br>- Specificare il peso dell'imballaggio del prodotto _____*(kg.)*<br>- Specificare il costo dell'imballaggio _____€ |
| **6. Tipologia, costo, e quantità CARTONE (scatole)** *(specificare sempre la quantità dell'ordine preso in riferimento)* | Cartone ondulato doppio _____*(kg) (specificare se riciclato* ☐ o vergine ☐)<br>Cartone ondulato semplice _____*(kg)(specificare se riciclato* ☐ o vergine ☐)<br>Altro _____*(specificare tipo plastica)* _____*(kg)*<br><br>Specificare il peso di ogni confezione _____*(kg)*<br>Specificare il costo _____€<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista il prodotto_____<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro _____*(specificare)*<br>- Specificare l'imballaggio del prodotto _____*(tipologia materiale es. cartone ondulato doppio, sacchi di PP, ecc.)*<br>- Specificare il peso dell'imballaggio del prodotto _____*(kg.)*<br>- Specificare il costo dell'imballaggio _____€ |
| **7. Tipologia, costo e** | Carta bianca _____*(kg) (specificare se riciclata* ☐ o vergine ☐) |

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| **quantità ETICHETTE**<br>8. *(specificare sempre la quantità annua)* | Carta kraft _____*(kg)(specificare se riciclato* ☐ o vergine ☐)<br>Altro _____*(specificare tipo plastica)* _____*(kg)*<br><br>Specificare il peso di ogni confezione _____*(kg)*<br>Specificare il costo _____€<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista il prodotto_____<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro _____*(specificare)*<br>- Specificare l'imballaggio del prodotto _____*(tipologia materiale es. cartone ondulato doppio, sacchi di PP, ecc.)*<br>- Specificare il peso dell'imballaggio del prodotto _____*(kg.)*<br>- Specificare il costo dell'imballaggio _____€ |
| **9. Tipologia, costo e quantità PALLINI SEGNATAGLIA** *(specificare sempre la quantità dell'ordine preso in riferimento)* | Cartone ondulato doppio _____*(kg) (specificare se riciclato* ☐ o vergine ☐)<br>Cartone ondulato semplice _____*(kg)(specificare se riciclato* ☐ o vergine ☐)<br>Altro _____*(specificare tipo plastica)* _____*(kg)*<br><br>Specificare il peso di ogni confezione _____*(kg)*<br>Specificare il costo _____€<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista il prodotto_____<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro _____*(specificare)*<br>- Specificare l'imballaggio del prodotto _____*(tipologia materiale es. cartone ondulato doppio, sacchi di PP, ecc.)*<br>- Specificare il peso dell'imballaggio del prodotto _____*(kg.)*<br>- Specificare il costo dell'imballaggio _____€ |
| **10. Tipologia, costo e quantità BUSTE** *(specificare sempre la quantità dell'ordine preso in riferimento)* | Cartone ondulato doppio _____*(kg) (specificare se riciclato* ☐ o vergine ☐)<br>Cartone ondulato semplice _____*(kg)(specificare se riciclato* ☐ o vergine ☐)<br>Altro _____*(specificare tipo plastica)* _____*(kg)*<br><br>Specificare il peso di ogni confezione _____*(kg)*<br>Specificare il costo di ogni confezione _____€<br>Specificare il comune di residenza dell'azienda produttrice da cui si acquista il prodotto_____<br>- Specificare il tipo di automezzo utilizzato per il trasporto del prodotto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro _____*(specificare)*<br>- Specificare l'imballaggio del prodotto _____*(tipologia materiale es. cartone ondulato doppio, sacchi di PP, ecc.)*<br>- Specificare il peso dell'imballaggio del prodotto _____*(kg.)*<br>- Specificare il costo dell'imballaggio _____€ |
| *11.* **Consumo energia** *(specificare sempre la quantità annua)* | Consumo di energia elettrica per il processo di imballaggio _____*(dettagliare se J o kwh)*<br>Consumo di altra fonte energetica (specificare quale _____) per il processo di imbottigliamento _____*(dettagliare $m^3$, litri o altro)*<br>Altro _____*(specificare)* |

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| **12. Scarti e rifiuti** *(specificare sempre la quantità dell'ordine preso in riferimento)* | Rifiuti da imballaggi (specificati sopra) - Specificare tipologia imballo (tipologia materiale)<br>Specificare il peso (kg.)<br>- Specificare la tipologia di trattamento che il rifiuto subirà a destinazione<br>- Specificare il costo per lo smaltimento ________€<br>- Specificare il comune di residenza della destinazione<br>- Specificare il tipo di automezzo utilizzato per il trasporto del rifiuto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro (specificare)<br>N.B. se il trasporto avviene con altro materiale, specificare quale |
| | Ripetere per ogni altro eventuale rifiuto da imballaggio |
| | Altri scarti e rifiuti (diversi dagli imballaggi specificati sopra) - Specificare tipologia scarto (tipologia materiale)<br>- Specificare il peso (kg.)<br>- Specificare la tipologia di trattamento che il rifiuto subirà a destinazione<br>- Specificare il costo per lo smaltimento _____€<br>- Specificare il comune di residenza della destinazione<br>- Specificare il tipo di automezzo utilizzato per il trasporto del rifiuto<br>Furgone ☐<br>Camion da 10 t ☐<br>Camion da 16 t ☐<br>Altro (specificare)<br>N.B. se il trasporto avviene con altro materiale, specificare quale |
| | Ripetere per ogni altro eventuale rifiuto |
| **13. Strumenti e personale utilizzato** | Meccanizzata☐tipologia macchinari (1) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (2) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____Kw/h☐ _____<br>tipologia macchinari (3) ☐ _____ n°diore utilizzato☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (4) ☐ _____ n° di ore utilizzato ☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br>tipologia macchinari (5) ☐ _____ n° di ore utilizzato ☐ _____ costo del macchinario ☐ _____ Kw/h☐ _____<br><br>Manuale ☐<br>N° e mansione dipendenti che si occupano dell'imballaggio/distribuzione_____<br>N° ore impiegate per l'ordine _____<br>Mezzo di trasporto utilizzato da tale personale Mezzo proprio ☐<br>Mezzo pubblico/urbano ☐<br>Mezzo aziendale ☐<br>Mezzo privato ☐<br><br>Tempo impiegato per l'arrivo in azienda _____<br>Stipendio dei dipendenti _____€ |

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| | **Note** _____*(specificare)* |
| **14. Distribuzione del prodotto finito** | Specificare la quantità di _____ consegnata in città _____e il numero di viaggi medi annui _____<br>Specificare il tipo di automezzo utilizzato per il trasporto Furgone ☐ Camion da 10 t ☐ Camion da 16 t ☐ Altro _____*(specificare)*<br>Specificare la quantità di _____ consegnata in provincia _____e il numero di viaggi medi annui _____<br>Specificare il tipo di automezzo utilizzato per il trasporto Furgone ☐ Camion da 10 t ☐ Camion da 16 t ☐ Altro _____*(specificare)*<br>Specificare la quantità di _____ consegnata in Sicilia _____e il numero di viaggi medi annui _____<br>Specificare il tipo di automezzo utilizzato per il trasporto Furgone ☐ Camion da 10 t ☐ Camion da 16 t ☐ Altro _____*(specificare)*<br>Specificare la quantità di _____ consegnata in Italia _____, il numero di viaggi medi annui _____con dettaglio percentuale della distribuzione nelle varie regioni _____<br>Specificare il tipo di automezzo utilizzato per il trasporto Furgone ☐ Camion da 10 t ☐ Camion da 16 t ☐ Altro _____*(specificare)*<br>Specificare la quantità di _____consegnata all'estero _____, il numero di viaggi medi annui _____con dettaglio percentuale della distribuzione nei vari Stati _____ Specificare il mezzo utilizzato per il trasporto _____ |

**Se lo desiderate potete porre in evidenza ogni altro aspetto che, a vostro giudizio, non è stato trattato nelle domande precedenti:**_____

Nome azienda: _____ Nome di chi ha compilato il questionario: _____ Contatto e-mail o telefonico: _____

***Grazie per la collaborazione***