Life Cycle Assessment on fashion industry: four case studies

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Abstract

The fashion industry is one of the most polluting in the world. It is estimated that the sector is responsible for about 9% of global emissions and contributes 20% of water pollution, as well as producing about 92 thousand tonnes of textile waste (Niinimäki et al., 2020).
The production phase bears a dual responsibility for this pollution, direct and indirect. Direct, because the production processes themselves are responsible for pollution. Indirect, because of indirect pollution (e.g., Scope 3 emissions), but also because of a lack of Life Cycle Design, or Eco-design, as this influences the downstream phases of the product life cycle up to the post-consumer phase, where it is costly or impossible to apply standardized recycling strategies.
This leads to linear and unsustainable business models, contrary to what would be necessary for the abatement of the impact of this sector.

Evidence of such problems and consequent attempts to react can be found in the literature.
Many technologies, models and processes have been developed to improve current business models by acting at different levels of production. The authors focused on this area, conducting a Literature Review on possible best practices for the transition to Sustainable Business Models (SBM), focusing on three key segments of the fashion industry, namely textile, footwear, and leather (De Ponte C., Liscio M.C., Sospiro P., 2023).
From a materials perspective, many technologies have emerged to reduce the impact of polluting production steps such as dyeing in textiles, e.g., (Santal A.R., Rani R., et al., 2022), or chemical adhesives in footwear, e.g., (Ruzafa-Silvestre, C., Carbonell-Blasco, M.P., et al.,, 2021), or cut-waste recovery in the leather, e.g., (Cabrera-Codony A., Ruiz B. et al., 2021).
However, the role of digitisation is indispensable, for the efficient and timely monitoring of production and supply chain processes, enabling targeted actions to improve sustainability performance in all its dimensions (environmental, social and economic), such as Industry 4.0 tools (Fromhold-Eisebith M., Marschall P. et al., 2021).

It is especially monitoring that assumes fundamental importance in the strategic decisions of companies to direct actions aimed at improving sustainability performance. Particularly, a useful tool for this purpose is the Life Cycle Assessment (LCA), starting from product and process design (Vezzoli C., 2017).
LCA addresses the environmental aspects involved throughout the entire life cycle of a product, from raw materials through production and use to end-of-life treatment and disposal (International Organization for Standardization, 2006).
The method proves to be a tool with multiple benefits to the company, both in terms of production eco-efficiency and image, with information that can be used in marketing campaigns, as in the case study conducted by Bevilacqua M., Ciarapica F.E., et al. (2011).
There are several publications in the literature that have considered LCA as a driver to address sustainability in the fashion industries, both at the production level, e.g., (Wiedemann S.G., Biggs L., et al., 2021), (Rossi M., Papetti A., et al., 2021), (Roos S., Zamani B., et al., 2016), and supply chain level, e.g., (Wren B., 2022), (Seuring S., Muller M., 2008), (Moretto A., Macchion L., et al., 2018).

This work is a follow up of a literarture review done in the previous preparatory work (De Ponte C., Liscio M.C., Sospiro P., 2023) and this work aims to investigate the role of LCA in improving sustainability in companies, in general, and in the fashion industry, in particular, following consecutive steps that start from the state of the art in the scientific literature, and then deepen the analysis by administering specific questionnaires to companies to investigate the current state and possible areas for improvement.
The context is the one of Marche Region, Italy, as for the strong presence of fashion producers and firms related to important fashion brands, with almost 6.000 fashion-related firms, 37.000 employees and more than 15% value of the entire regional manufacture, only from the footwear industry (Regione Marche, 2021). This makes fashion a driving sector

for the region, like few in Italy and Europe. Four companies were identified in this context, related to four areas of investigation in the fashion industry, i.e., textiles, footwear, leather, and fashion accessories, and will serve as the basis for four case studies aimed at obtaining an LCA for each of these companies.
To do this, a questionnaire will be drawn up with a twofold purpose: the first is to understand the company's processes and thus identify areas of improvement on which to focus in order to make the business model more sustainable; the second is to acquire the primary data for the LCA, in order to make the analysis as accurate as possible in terms of estimates.
The analysis will be conducted on 6 main areas: Raw materials, intermediate materials, water, energy, transport, waste.
Another area of investigation will be the level of digitisation of companies through a digital maturity assessment tool developed by the Punto Impresa Digitale (PID) of the Chambers of Commerce in Italy.

The expected results of this work will be the following: i) state of the art of using LCA as an enabler for SBMs, ii) sustainability and digitisation assessment of the companies under study, iii) 4 LCA analyses for the companies under study, iv) improvement proposals for companies studied towards adopting SBM and their potential results in terms of reduction of costs, improved sustainability and running different business models.

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