ADVANCED TEXTILES MANUFACTURING INDUSTRY
Learning unit 5
Lesson 3

Ecodesign for smart textiles

Innovative smart textiles & entrepreneurship

A project:
Co-funded by the European Union
2021-1-RO01-KA220-HED-000027527

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Year

2023

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HACKTEX project was co-funded by the European Union through the grant 2021-1-RO01-KA220-HED-000027527.

Content

Introduction

In the previous lesson (LU5.2) the lifecycle of smart textile products and their main environmental impacts have been discussed. Circular economy, which helps avoiding waste accumulation, requires a design approach in which all stages of the life-cycle of the product are considered.

In this lesson, you will learn about ecodesign and the strategies that can be applied for achieved more sustainable smart textiles. However, these ecodesign strategies are not a common rule applicable in all cases. Their applicability and effectiveness will depend on the product type, function, performance and use, as well as on the technologies, materials and manufacturing processes required for its production.

In order to evaluate the effectiveness of these strategies, it is necessary to perform quantitative evaluations of their impacts and possible reductions. In this context, Life Cycle Assessment (LCA) is the most commonly used tool to characterise the environmental impacts of products, processes and services. You will find a short inside on the LCA methodology at the end of this lesson.

1. Ecodesign concept

Generally speaking, the lifecycle of product can be simplified to 5 phases (Figure 1):

- the **design** phase, related to the selection of the raw materials, among others;
- the **manufacturing** phase referring to all transformation processes needed to obtain the product from the raw materials;
- the **distribution** phase, which involves the packaging and transportation;
- the **use** phase that can include maintenance such as cleaning or repairing, if needed and available;
- and the **end-of-life** (EOL) phase, related to the management of the waste, regardless which is the final disposal.

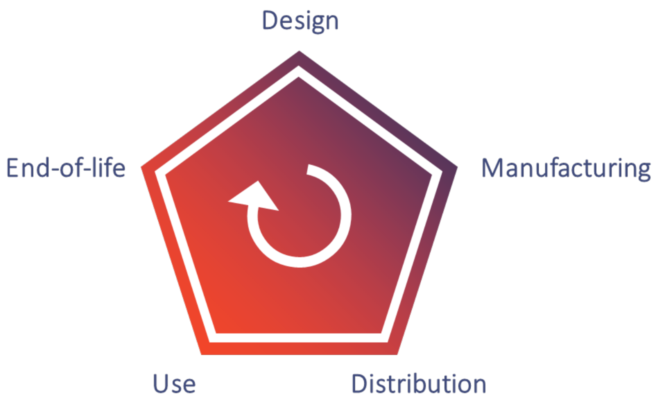

Figure 1. Key phases of the product life cycle.

Relevant impacts on the environment —such as materials consumption, energy resources use, release of hazardous substances or waste generation, among others— are mainly associated to the manufacturing, distribution, use and EOL management phases of the product lifecycle. However, the European Commission's Joint Research Centre states that:

> *"It is estimated that over 80% of all product-related environmental impacts are determined during the design phase of a product."* (JRC, n.d.)

Therefore, **the design phase has a key role to minimise the aforementioned impacts**.

The process used on the design phase of a product —including smart textiles— typically consists on several stages:

- problem definition stage, to identify the need(s) that the product is intended to solve by gathering information, understanding the context and defining the requirements;
- ideation stage, to research and collect ideas for the design by elaborating a state of the art, finding references and similar products in the market, gathering inspiration from other solutions, brainstorming, sketching and creating mood boards;
- conceptualisation stage, to develop a range of ideas based on the insights collected on previous stage by exploring different possibilities, selecting the most promising ideas, and creating functional prototypes to test and refine the concept;

- design development stage, point at which the solution of the selected concept is defined by creating a detailed plan, producing prototypes, testing them to identify problems or opportunities for improvement, and refined —through several iterations— until reaching a final design that covers the requirements defined in the first stage;
- validation stage, in which the final prototype is tested for approval;
- production planning stage, to create a detailed production plan of the final solution by crating detailed production drawings or specifications sheets, selecting materials and suppliers, etc.

Along these stages, multiple decisions are taken to ensure the final product design balances **user needs and desires** with **technical feasibility**, **manufacturing costs**, and **market demand**, although the consideration of these four points does not guarantee that the resulting product will be optimized to reduce its environmental impacts during its service life. In recent years, the growing awareness of the urgent need to address climate change and environmental degradation has focused more attention to the practice of incorporating the environmental considerations into the design process, named *ecodesign*.

Ecodesign is the process of designing products —or also services and systems— with environmental sustainability in mind. It involves considering the entire lifecycle, from raw material extraction and production to use, disposal, and potential reuse or recycling. In this sense, the goal of ecodesign is to minimize the environmental impact of products and services while still meeting customer needs and maintaining profitability (Figure 2). In other words, the European Environmental Agency defines the term ecodesign —or eco-design— as:

> *"The integration of environmental aspects into the product development process, by balancing ecological and economic requirements. Eco-design considers environmental aspects at all stages of the product development process, striving for products which make the lowest possible environmental impact throughout the product life cycle."* (EEA, n.d.)

Figure 2. Ecodesign goal.

This scheme has been designed using resources from Flaticon.com

The European Union (EU) has been at the forefront of promoting ecodesign principles and policies, encouraging the development of more sustainable products, in line with its commitment to the United Nations Sustainable Development Goals (SDGs) and its objective of transitioning towards a more circular economy for reaching more sustainable production and consumption models. Due to their nature, smart textiles are considered textile products, despite those involving electronics —also known as e-textiles— may be closer to the category for electronic products than to the one for textiles.

In any case, the clear current position of the EU towards sustainable production clearly encourages the smart textile producers to develop their products under ecodesign approaches, as ecodesign is considered an important tool for achieving the environmental and climate goals, and has demonstrated its commitment to promoting it through policy and regulatory measures.

Want to learn more about this topic?

In the book "*Ecodesign: A Life Cycle Approach for a Sustainable Future*" (Koopmans & Van Doorsselaer, 2021) you will find a comprehensive guide on designing products that are environmentally sustainable throughout their life cycle, covering concepts, strategies and case studies.

In the document "*Unit 09 Textile: Ecodesign approaches in textile products*" (Ghezzo, 2018)—as part of the learning materials produced in the framework of the EU Project *ECOSIGN* (Ecosign Consortium, 2023a)— you will find a contextualisation about sustainability and ecodesign in the textile sector.

In the paper "Challenges for eco-design of emerging technologies: The case of electronic textiles" (Köhler, 2013a) you will find an analysis about the possibilities of ecodesign focusing specifically on e-textiles.

2. Ecodesign strategies

Ecodesign principles can be applied to a wide range of products and services, from buildings to clothing or electronics, and hence, also to smart textiles. In order to integrate this environmental dimension on the design process, there are a series of strategies that can be applied. These **ecodesign strategies** can be defined as techniques and approaches used to design products that reduce their environmental impact throughout their lifecycle. The ecodesign strategies are often related to mainly one of the product life cycle phases. Some general examples for each of the previously defined phases are first presented in Table 1.

Table 1. Ecodesign strategies (examples organized by product phase)

Phase	Strategy	Description
Design	*Material efficiency*	Reducing the amount of raw material needed in the product (lightweight materials, minimum remnants, no oversizing, etc.).
	Dematerialization	Reducing the amount of material resources used to fulfil the function (e.g. using air cushioning instead of a foam material).
	Minimum material diversity	Reducing the variety of raw materials present in the product (e.g. monomaterial garments) to reduce production steps and facilitate EOL treatment.
	Use of recycled and renewable materials	Using materials that have been recycled or are renewable (e.g. natural fibres such as wool, bamboo, flax or hemp, rPET, etc.).
	Avoid hazardous substances	Not using substances that are hazardous for human/ animal health or the environment.
	Limit finishing application	Minimize the use of finishing products that difficult the recycling/ EOL management of the material.
	Modular designs	Develop modular components that can tailor/upgrade the product according to the user needs, and be replaced when damaged or reused if needed.
	Minimize components	Avoid including parts that do not have an important function or do not increase quality or aesthetic value.
	Reuse of parts	Using recycled parts (e.g. fasteners) or parts coming from the product to be replaced.
Manufacturing	*Reduce production steps*	Developing processes that reduce the steps required (e.g. combining compatible techniques to be performed in a single step such as one-step desizing and scouring).
	Green-production	Using renewable energy or applying energy or water-saving measures in the manufacturing processes.
	Use cleaner production processes	Use technologies free of hazardous outputs that also generate low emissions and waste.
	Re-introduce production waste	Incorporate the industrial pre-consumer waste (e.g. prototypes, tests, remnants, defective products) into the production chain.

Distribution	*Optimize packaging*	Use a maximized product per unit of volume ratio during the transport and storage.
	Green-packaging	Minimise packaging and use environmentally friendly materials (e.g. recycled or renewable materials).
	Minimize transportation distances	Having closer distances between production steps and/or providers and clients to reduce fuel consumption and emissions.
	Keep traceability	Tracing the materials, chemicals, processes and distribution details implied to know the real impact of the product and to better manage it as waste.
Use	*Increase durability*	Using multiple techniques to ensure a good resistance to continued use and/or to expand the service life of the product, reducing the need for its replacement.
	Increase use	Increase of the number of times that a product is used during its life time (e.g. by sharing or servitization) to dilute the impacts.
	Integrate multiple functions	Including multiple functions in a same product avoids the need to produce other products.
	Design for reparation	Facilitate repair and maintenance by easing the accessibility and disassembly of components and the availability their replacements.
	Energy consume efficiency	Designing products with energy-efficient components/ materials (e.g. low consumption lights, fabrics that do not require ironing).
	Water consume efficiency	Designing products that use less water during their use phase (e.g. odour-free smart garments that require less washings).
	Implement energy-harvesting systems	Systems requiring energy sources can be powered with energy-harvesting solutions such as solar cells.
EOL	*Design for disassembly*	Easing the disassembly of the parts (e.g. seams made with "dissolvable" yarns, separable fasteners, etc.) to increase recyclability/ reuse, reducing waste generation.
	Use of recyclable/ biodegradable materials	Using appropriately recyclable or biodegradable materials will help the EOL treatment of the product.
	Design for circularity	Designing products so their waste materials are used as raw materials for new products.

However, some of these ecodesign strategies are more likely to be used in smart textiles due to their own nature. Next, few examples are analysed focusing on their feasibility for the smart textiles field. The examples have been classified in four categories:

- Ecodesign strategies related to raw materials
- Ecodesign strategies related to the production phase
- Ecodesign strategies to extend the service life of smart textiles
- Ecodesign strategies for the end-of-life

2.1. Ecodesign strategies related to raw materials

The materials' selection is the first point of the ecodesign process in which a smart textile product can start minimizing its environmental impact. Using the minimum amount and diversity of materials, while those having the lowest possible impact, can clearly set a difference.

Material efficiency

The raw materials selected for the production of a smart textile must meet the requirements set for the product to be developed. Very often, this implies that the product ends un containing a large variety of non-renewable materials —such as plastics, metals, silicon or other critical minerals that are subject scarcity or controversial geopolitical issues (McLaren, Hardy & Hughes-Riley, 2017)— that are very difficult to be replaced by other more sustainable alternatives. In these cases, the **material efficiency** is the ecodesign strategy of a greater service, since it is based on reducing the amount of raw materials used. This can be achieved by economizing the scarce raw materials application, using lightweight materials, designing products that are more compact, or avoiding excessive decorative layers, among others.

In this regard, the question to ask during the design phase would be:

- *Is the use of the scarce materials optimized?*
  Reaching the best performance with the minimum material amount might require more intensive research and prototyping steps, but the further savings in economic and environmental costs worth it.

Selection of low impact raw materials

However, it in some cases it is possible to find several alternatives for raw materials that can equally fulfil general requirements. For example, when textiles are mere substrates in which other electronic components are attached, or because there is more than one possibility to achieve the conductivity that the product requires, etc. In those cases, the **selection of low impact materials** —such as *recycled or* renewable *materials*, when possible— is a good approach. To that aim, it is necessary to establish ecodesign criteria in the materials' selection process to find those options that minimize the environmental impact, while considering all phases of the product lifecycle in these criteria.

For example, the questions to consider at this point would be:

- *Does this material have a low embodied energy?*
  Materials can present a higher or lower embodied energy, which is a calculation of the amount of energy required for their production, and includes extraction, manufacture and transport. For example, the embodied energy of a carbon fibre is much higher than the embodied energy of a cellulosic fibre, owing to the energy consumption required in the carbon fibre production. Since a lower embodied energy normally implies a lower impact, this can be used as selection criteria among materials with similar performance.
- *Will this material require too much ironing or washing?*
  Ironing and washing are two common textile care actions, but they imply large quantities of energy and water. The selection of certain materials with antibacterial finishing or easy care may reduce/avoid the need of washing and ironing, reducing the

environmental impact of the garment during its use. However, it cannot be forgotten that the application of such finishing products may affect to the environmental impact of other phases such as the raw materials extraction.

Minimum material diversity

As aforementioned, smart textiles often include multiple material types —such as functional or conductive printings and finishing products, combination of conventional and functional fibres in fabrics, etc.— for reaching the desired functionalities on the developed solution. But the use of different materials in the same yarn will highly difficult further separation, limiting a further recycling. Similar problems may arise when a garment contains pieces of different materials than are difficult or impossible to separate. Thus, as a general rule, reducing to a **minimum** the **material diversity** is necessary to also reduce the environmental impact of the product. This strategy reaches its peak whenever it is possible to reach **monomateriality**.

The most convenient question at this point is:

- *Is it possible to solve it using a single material?*
  Using a single material for solving the whole garment —including labels, seams and fasteners— is always preferred. However, due to their own nature, it is very unlikely the design of a smart textile being performed under a monomaterial approach. In these cases, the variety of materials should be kept to the minimum necessary. Less material diversity also means less different processes and transport stages involved in production.

As has been mentioned in this section, multiple factors from other phases —such as their care conditions or further recycling possibilities— must be considered during the materials' selection process. Therefore, the selection of raw materials for smart textiles must contain a wide diversity of criteria covering both performance, aesthetics, environmental, and other technical and manufacturing parameters.

2.2. Ecodesign strategies related to the production phase

It is obvious that the manufacturing processes to be selected for the production of smart textiles are clearly connected to the raw materials to use and to the technologies to implement. However, although the possibilities are somehow limited due to the performance requirements that these kind of products, it is possible to reach a solution through different approaches. For example, to implement electrical connections in a smart garment, it is possible to use a printing alternative by means of conductive pastes, or to embroider conductive yarns, or even implement them in the own fabric structure for a better integration.

All these possibilities have their advantages and disadvantages, and depending on multiple factors —such as the type of product, the target towards the product is directed, its usability or the production scale, among others— the optimal solution can differ. However, there are few key points to consider from the ecodesign point of view regarding the production phase that involve **minimisation of production waste**, **reduction of production steps**, and **use of green/cleaner production processes**, which are related to questions such as:

- *Is the manufacturing process avoiding/minimising the production remnants and/or reintroducing them into the manufacturing process again?*
  For example, integral knitting avoids remnants in a larger extend than and optimized cutting plan for woven fabrics, and can lead to more adaptable garments, but the production is, in general, slower and costlier. The key is finding a good balance between the economic, social and environmental part in order to reach a good sustainability.
- *Is the manufacturing process leading to a product with a good durability?*
  The printing of conductive pastes can be more easily tuned than introducing a conductive yarn in a flat knitting, but the printing might require a further lamination to ensure a good durability of the overall product, this increasing the amount of processing steps required and threatening other phases such as the EOL phase.
- *Is the raw materials/energy/water of the manufacturing process optimized for a minimum resource use?*
  Currently, the advances of the fourth industrial revolution in the development of textile machinery, clearly align with the ecodesign principles. The connected manufacturing and the digital conversion of machines helps to make the most efficient use of resources as a strategy to reduce production costs and maximize benefit margins.

2.3. Ecodesign strategies to extend the service life of smart textiles

Smart textiles are, typically, complex solutions that use expensive raw materials to achieve the desired interaction between the product and the environment at different levels. Both the economic and environmental costs of producing such a product are high, so they largely differ from disposable products. Moreover, due to their complexity, the possibilities to recycle them in further EOL management are lower. Thus, the most interesting approach is to extent their service life, reaching a more sustainable production and avoiding waste accumulation.

Issues of physical durability specific to e-textiles include washability, durability of interconnects and inks, and lifetimes of components. Depending on the nature of the device, the fibres may wear-out well before the electronics. Conversely, the rapid development of microelectronics might lead to electronics becoming out-dated before the garment wears out, whereas also the garment's aesthetics may lead to a perceived obsolescence. The lifetime of an e-textile is dictated by the shortest lifetime of any individual component, unless repair or replacement is possible.

Therefore, for reaching the objective of extending the service life of smart textiles, it is necessary to ensure an appropriate durability of the smart textile by conceptualising it under modularity and design for reparation approaches, but also to ensure an intensive and controlled use of the product though its servitization, for instance.

Modularity

On the one hand, in a user-centred design, the smart textiles are conceptualised to meet the needs of users- However, the needs of users may differ highly. On the other hand, in all textile products there can be identified certain weak parts that tend to wear or break faster due to the own use of the product. In both situations, **modularity** can help to achieve a more adaptable solution. The development of designs that consider the solution as a system of modules (modular components) rather than a whole integrated solution ("black box") can make them easier to customise and upgrade, but also to maintain and repair.

The customisation and possibilities of upgrading tends to generate a greater attachment between the owner and the product, reducing the perceived obsolescence. Moreover, the upgrading, maintenance and reparation features of the smart textile products extend their lifespan, this reducing waste and environmental impact.

Design for reparation

Design for reparation, also known as repairable design, is a design strategy that aims to make products easier to repair and maintain over their lifetime. It involves designing products with the understanding that they will need to be repaired or maintained at some point, and ensuring that these tasks can be carried out easily, quickly, and at a low cost. Design for reparation can involve a range of strategies, such as using standardized components that can be easily replaced, designing products with accessible and visible fasteners, providing repair instructions and guides, and using durable and easily repairable materials.

Design for reparation has gained attention in recent years as a response to the throwaway culture and planned obsolescence that is often associated with modern consumer products. It aligns with the principles of circular economy, which emphasizes the importance of keeping products and materials in use for as long as possible. Moreover, by making it easier to repair, these products can also save consumers money by avoiding the need to replace products that could be repaired.

Servitization

Servitization is a business strategy rather than ecodesign strategy. Nonetheless, in servitization the company focuses on providing services and not or not only traditional products. In this case, the company creates value for its customers not by just selling them a product but by offering a range of services around it such as maintenance, repair, upgrades, etc. Given that the smart textile becomes the channel for providing the service, the company is the first interested to ensure its durability, good maintenance and, depending on the business model, its rotation, meaning that the product is more intensively used with an extended service life.

This approach becomes of a great interest for products related to health monitoring, for instance, that instead of being sold could be rented to hospitals and/or patients for their punctual use. In fact, the kind of services that can be provided through servitization of smart textiles are multiple, such as maintenance and repair to ensure that the smart garments continue to function properly, data analysis, or subscription-based services such as renting of smart garments.

2.4. Ecodesign strategies for the end-of-life

There are multiple strategies that are related to the end-of-life of textile products. On the one hand, there are ambitious strategies for closed-loop systems in which the whole product is designed for its recovery and reintroduction of such a waste in the production chain as raw material, providing a closed circularity. On the other hand, there are more simple options such as the use of biodegradable —or even compostable— raw materials, which can clearly define an interesting strategy to be evaluated for disposable textile products. However, as mentioned before, smart textiles often imply the need of multiple components for reaching the expected performance, as well as the use of high value-added technologies that require an important investment in material and energy resources. This reduces the possibilities, since smart textile garments/products often need to ensure a good durability to make a better economic and environmental amortisation of the investment done in these resources. Due to this, the most interesting strategy for smart materials related to their EOL is, probably, the design for disassembly strategy.

Design for disassembly

Design for disassembly is a design strategy that aims to make products that, at the end of their useful life, their parts can be easy to dismantle. Its goal is to minimize waste and environmental impact by making it easier to recover and reuse valuable resources from products, promoting the separation of the parts or components in order to ease their reuse, recycling or, if no other alternative available, their most appropriate waste management route. This approach can also lead to cost savings for manufacturers, as it can reduce the need for new raw materials and make it easier to comply with regulations and standards related to product end-of-life management.

To that purpose, when designing for disassembly multiple options can be considered such as: avoid adhesives; sew with special yarns that can be degraded/broken down under certain conditions; use fastening elements that are easier to remove like buttons, or that require no disassembly such as laces made of the same textile material; minimise/avoid unnecessary trimmings; or use welded joints in thermoplastic fabrics that can be further recycled by thermal means, among others.

In the case of smart textiles, very often the durability requirements for garments and products include being washable, implying the need for encapsulation of certain components that later difficults this disassembly. In those cases, it is needed to assess the whole life cycle of the product to select which is the best strategy in economic and environmental terms, since to ensure the disassembly may shorten the product’s life up to an unbalanced point.

Want to learn more about this topic?

In the PhD thesis *“Anticipatory Eco-Design Strategies for Smart Textiles Perspectives on environmental risk prevention in the development of an emerging technology Risks and Opportunities of RFID Applications View project Rebound effects and ICT View project*” (Köhler, 2013b), you will find a comprehensive analysis about different risk aspects and ecodesign prevention strategies related to smart textiles.

In the paper “*Review of the end-of-life solutions in electronics-based smart textiles*” (Veske & Ilen, 2021), you will find a review about the research and development conducted on EOL solutions for e-textiles.

3. Tools for assessing the sustainability of smart textiles

As aforementioned, the ecodesign approach involves including the environmental dimension to the design phase. Therefore, the aim of using ecodesign strategies during the development of a smart textile product is to reduce or minimize its environmental impact. However, the evaluation of these environmental impacts is not easy. What may seem a great solution to reduce an environmental impact (include a solar sell to power a wearable, for instance) can imply an increase of the environmental impact in other categories (scarcity and high embodied energy of raw materials used for the production of such a solar cell). Here lies the need to have tools for an objective evaluation of said impacts, tools that allow quantifying the impact in multiple categories and comparing various alternatives to decide which is the best option or if it is worth applying an ecodesign strategy or not. The most widely used tool to perform such analysis is the Life Cycle Assessment (LCA).

3.1. Life Cycle Assessment (LCA)

LCA is a methodology used to evaluate the environmental impacts of a product, service, or process **throughout its entire life cycle**, from raw material extraction and production to use and disposal. LCA takes into account the environmental impact of all stages of a product's life cycle, including energy use, resource consumption, waste generation, and emissions to air, water, and soil.

The LCA process typically involves four main steps:

(1) Goal and Scope Definition: Establishing the goal and scope of the study, including the product system boundaries, functional unit, and the environmental impact categories to be assessed.

(2) Inventory Analysis: Gathering data on the inputs, outputs, and emissions associated with each stage of the product life cycle, using tools such as material flow analysis, energy accounting, and emission inventories.

(3) Impact Assessment: Evaluating the potential environmental impacts associated with the inputs, outputs, and emissions identified in the inventory analysis, using established impact categories such as climate change, resource depletion, and human health impacts.

(4) Interpretation: Interpreting the results of the inventory analysis and impact assessment to identify areas of potential improvement and inform decision-making, such as product design or process optimization.

Through these steps, LCA can reach a **comprehensive** evaluation of the environmental impacts of the analysed product or process, taking into account its entire life cycle. Moreover, this evaluation is **holistic**, considering multiple environmental impact categories. Thanks to this, LCA can **identify potential improvement opportunities** in terms of the environmental performance of a product or process —such as reducing energy or resource consumption, reducing emissions or waste, or improving product design—. In addition, it can also **support decision-making** by providing a quantitative basis for comparing the environmental performance of different products or processes and identifying trade-offs between different environmental impact categories.

However, it is worth noticing that LCA can be a **complex process** that requires specialized expertise and knowledge in environmental science, statistics, and modelling. **Data collection is** the most **time- and resource-consuming** step of LCA, since it requires a significant amount of data, but it is a key step for performing good LCAs, since the more accurate the data, the better and more reliable the LCA. Due to this, LCAs are often **limited in scope**, being cradle-to-gate approaches —which do not consider use and EOL management— easier to develop that the cradle-to-grave ones —that consider the entire life cycle including the aforementioned phases— and focusing on the environmental impacts, whereas social or economic impacts are not taken into account despite their importance in sustainability. Other drawbacks of LCA are the **difficulty to compare results** across different studies —given that the methods and standards vary—, and that there is a certain **risk of misinterpretation or inappropriate use** of the achieved results, which can lead to incorrect conclusions or misguided decision-making.

Nonetheless, despite the limitations of LCA, the overall balance points that it is as a valuable tool for evaluating the environmental performance of products and processes with the aim of identifying opportunities for improvement, and that its transparency can help build trust and credibility with stakeholders, such as customers, regulators, and investors. A proof of this is the great credit that researchers and producers put into the development of such assessments in the multiple fields that LCA can be applied. In the smart textiles context, it is possible to find in the literature few studies conducted to evaluate the environmental impacts of smart textiles using LCA (examples presented in Table 2).

Table 2. Studies containing LCA of smart textiles

Topic	*Year*	*Reference*
LCA of a wearable smart textile device for ambulant medical therapy	*2015*	*Van der Velden, Kuusk, & Köhler, 2015*
LCA of textile-based large-area sensor system	*2012*	*Köhler et al., 2012*

The results of LCA studies on smart textiles suggest that the environmental impact of these products is highly dependent on the product and function itself, related to the specific technology and materials used, as well as the production and use patterns —the environmental impact of a smart textile can be concentrated in one or more phases of its lifecycle—. However, LCA studies can provide valuable insights into the environmental performance of smart textiles and inform the development of more sustainable products and processes.

Want to learn more about this topic?

In the document "*Unit 4: Life Cycle Assessment and Costs*" (Fernández, 2018) —as part of the learning materials produced in the framework of the EU Project ECOSIGN (Ecosign Consortium, 2023b)— you will find a more detailed explanation about LCA methodology.

The papers mentioned in Table 2 are studies containing LCA of solutions based on smart textiles.

Summary

In this lesson you have reviewed: (1) the concept of ecodesign and its relevance towards the development of sustainable smart textiles; (2) the overall ecodesign strategies that can be applied in the five main phases of the products life cycle —the design phase, the manufacturing phase, the distribution phase, the use phase and the end-of-life phase—, focussing on some of the strategies that can be more suitable for smart textiles, owing their nature; and (3) the Life Cycle Assessment (LCA) methodology as a tool to quantify and characterise the environmental impacts of smart textiles.

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Partnership

Project coordinator
TUIASI - Universitatea Tehnica Gheorghe Asachi din Iasi
www.tuiasi.ro

AEI Tèxtils - Agrupació d'Empreses Innovadores Tèxtils
www.textils.cat

CIAPE – Centro pre l'Apprendimento Permanente
www.ciape.it

CRE.THI.DEV - Creative Thinking Development
www.crethidev.gr

TITERA - Technically Innovative Technologies
www.titera.tech

UB – Högskolan i Boras
www.hb.se

UNIWA - Panepistimio Dytikis Attikis
www.uniwa.gr

UPC - Universitat Politècnica de Catalunya
www.upc.edu

HACKTEX project was co-funded by the European Union through the grant 2021-1-RO01-KA220-HED-000027527.

HACKTEX | Innovative smart textiles & entrepreneurship

ERASMUS +

KA2 – Cooperation for innovation and the exchange of good practice
KA220-HED - Cooperation partnerships in higher education
Grant Agreement: 2021-1-RO01-KA220-HED-000027527

Project duration: 01/02/2022 – 31/07/2024

Co-funded by the European Union

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