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Toward Sustainable Smart Textile

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Towards Sustainable Smart Textiles

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ABSTRACT

Recent years have seen the rapid growth of smart textiles in the global market. Furthermore, with growing concerns about the environmental impact of the fashion industry and injustices in the global supply chain, there is huge scope for the sustainable smart textiles market.

The group report follows the planned process model in Figure 1 and outlines possible scenarios for smart textiles towards sustainability. The analysis of the sustainability crisis and potential solutions will be sequentially presented in four main segments: **smart textile markets, materials, manufacturing techniques and supply chain.**

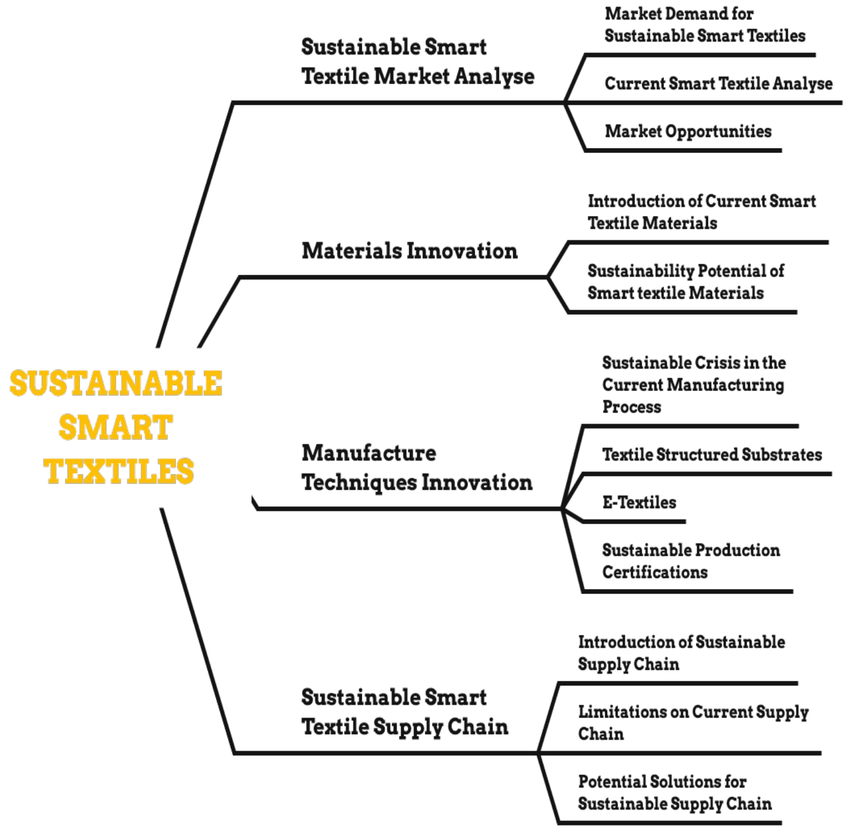

Figure 1. **Process model** of sustainable smart textiles. Created by Author.

HIGHLIGHTS

MARKET ANALYSIS

- Total market value is approximately **£800 to £1.6 billion**.
- Market structure for smart textiles as **Monopolistic Competition.**
- Smart textiles market is dominated by **technology companies**, **not fashion brands**.
- **North America** is the **main market** with a 36% market share.
- **Asia Pacific** is the **second largest** market for smart textiles and has become the **fastest-growing** region due to its **low labour cost advantage**.
- Fashion brands should actively **collaborate** with technology companies.

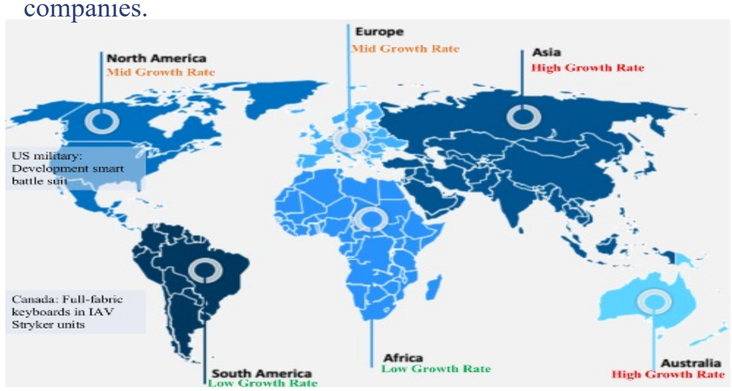

Figure 2. Global Smart fabrics Market **growth rate**. Created by Author.

MATERIAL INNOVATION

- Pioneering definition of sustainability: **Functional** and **intrinsic** sustainability.
- Materials Innovation : **Nanomaterials, Bio-based materials, Biodegradable materials.**

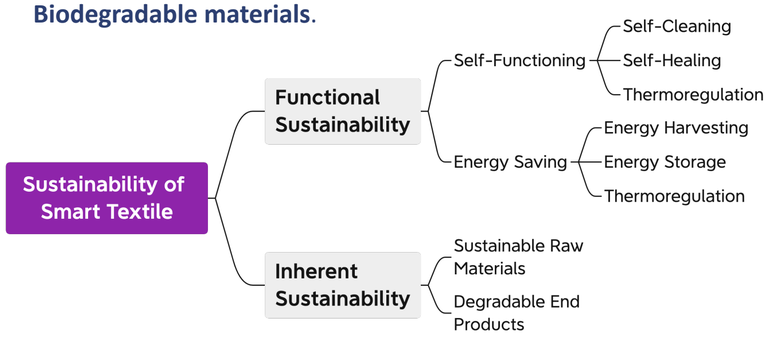

Figure 3. **Pioneering definition** of sustainability of smart textiles. Created by Author.

MANUFACTURING TECHNOLOGY INNOVATION

- Current challenges: **Environmental Pollution** & **Energy Consumption.**
- Advanced manufacturing technologies: **3D Printing**, **Electrospinning**, **Nanocoating**, **Thermal drawing**, etc.
- Developing **sustainable production certification.**

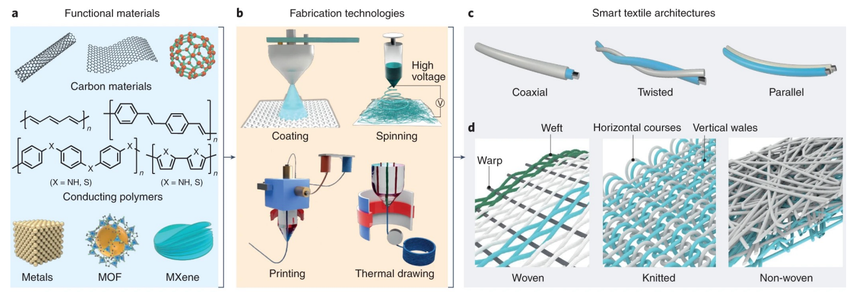

Figure. 4. **Fabrication strategies** of smart textiles. Reproduced from Libanori, A. et al. (2022).

SUPPLY CHAIN

- **Limitations**: Traceability, Environmental Friendliness, Warehouse Logistics management.
- **Potential solutions**: Blockchain Technology & Circular supply chain model.

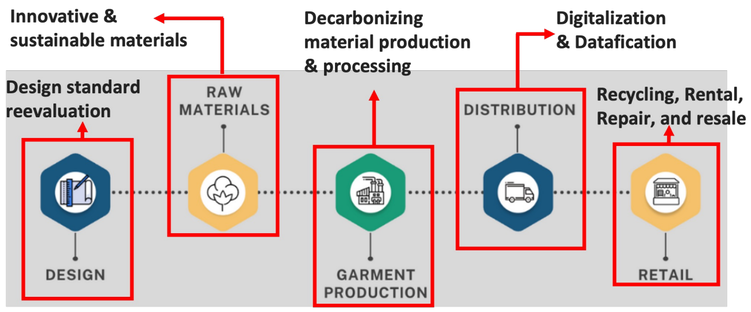

Fig. 5. **Improvement** in future sustainable supply chain. Created by Author.

CONCLUSION

In summary, it is important to lay out the entire lifecycle of smart textiles in advance. The group report features an in-depth and extensive analysis of **four main segments**, by analysing the **potential markets for smart textiles**, researching **innovative materials**, developing **advanced manufacturing technologies** and increasing transparency in **supply chain**.

Towards Sustainable Fashion: Supply Chain Innovation

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INTRODUCTION

The macro topic from group work focuses on the sustainability issues of smart textiles, which enhance their functionality through technology, and have more complex procedures in the supply chain than conventional textiles, leading to more environmental problems. However, the whole fashion industry, which produces 200,000 and 500, 000 tonnes of microplastics from textiles to the marine environment each year, and about 20% of global industrial wastewater pollution, faces the most serious sustainability issues.

FASHION SUPPLY CHAIN CHALLENGES

Current challenges of the fashion supply chain can be included in the following parts. Improving the traceability of the fashion supply chain, including the ability to accurately track products and materials etc., can effectively address existing supply chain challenges and pressure.

Fig. 1. Current challenges in the fashion supply chain, created by the author

MICRO SOLUTIONS

Figure 2 demonstrates several technology opportunities for supply chain across the fashion industry, and Blockchain and AI technology will be used for developing a sustainable and transparent supply chain system.

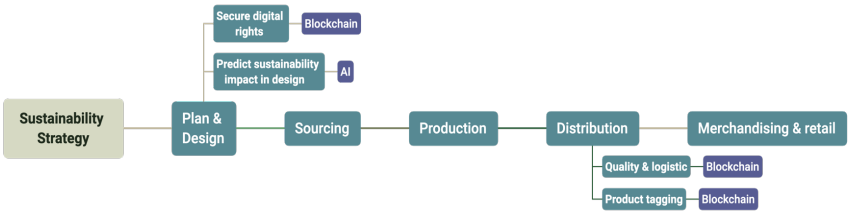

Fig. 2. Technology opportunities in fashion supply chain, created by the author

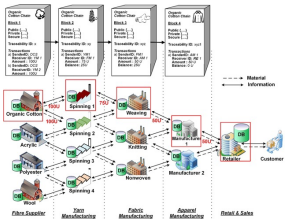

Fig. 3. A complex T&C supply chain network with a marked partner involved in the example scenario. (Agrawal, T.K. et al., 2021)

1) Blockchain: It can enable more transparent and accurate end-to-end tracking in the supply of different supply chain, resulting in greater transparency in the supply chain. Fig 3 provides an example of A complex T&C supply chain network with a marked partner involved in the example scenario. (Agrawal, T.K. et al., 2021)

2) **AI:** Achieving supply chain traceability requires the collection of a large amount of complex data from rces, formats and languages. AI captures data and automatically identifies extracts, classifies and links data from several different sources to improve overall data quality.

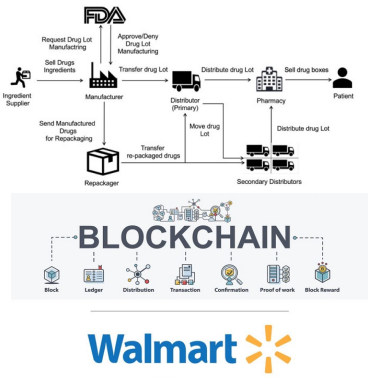

Fig. 4. Examples of blockchain technology used in supply chain

EVIDENCE

- **Alexander McQueen:** MCQ was the first fashion brand to have an entire label traceable on blockchain.
- **Walmart:** Walmart is utilizing Blockchain to add transparency to the food supply ecosystem by digitizing the entire food supply chain process.

REFERENCES

Forbes, 2022. Available at: https://www.forbes.com/sites/forbestechcouncil/2022/03/18/why-fashion-supply-chain-traceability-is-a-tech-challenge-that-begins-with-ai/?sh=34b787355f6d

Towards Sustainable Smart Textiles: Material Innovation

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INTRODUCTION

Smart textiles are a multifaceted concept comprising **functional textiles** and **electronic textiles**. They are capable of sensing and responding to environmental stimuli. However, smart textiles are confronted with heightened sustainability concerns due to their incorporation of **electronic components** and **complex chemical agents** (Fig 1), which sets them apart from traditional textiles.

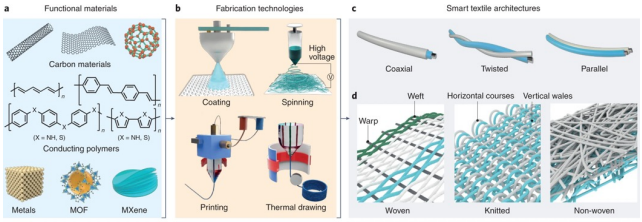

Fig. 1. **Fabrication strategies** of smart textiles. Reproduced from Libanori, A. et al. (2022).[1]

MATERIAL INNOVATION

- Functional Sustainability: **Nanomaterials**
- Inherent Sustainability: **Bio-based/ Biodegradable MATL.**
- Future**: Bio-based electronic devices**

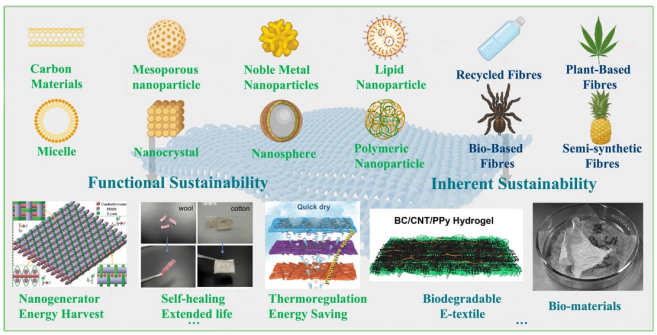

Fig. 4. **Material innovation** of future smart textiles. Created by Author.

Fig. 3. **Analysis** of current smart textile materials. Created by Author.

KEY POINTS

- **Current Challenges**: Environmental & Technical issues
- **Pioneering Definition**: Functional & Inherent sustainability
- **Focused Micro-solution**: Material Innovation

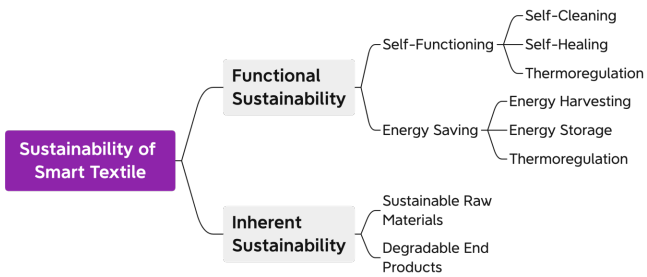

Fig. 2. **Definition** of sustainability in smart textiles. Created by Author.

CONCLUSION

Analogous to fast fashion, smart textiles have the potential to captivate the market, yet concurrently pose significant environmental and ethical dilemmas. Developing **high-performance nanomaterials** as well as **bio-based materials** will lead to sustainability through functionality and recyclability. Furthermore, **indicators** for the evaluation of functional sustainability should be established.

REFERENCE

1. Libanori, A. *et al.* (2022) "Smart textiles for personalized healthcare," *Nature Electronics*, 5(3), pp. 142–156. Available at: https://doi.org/10.1038/s41928-022-00723-z.

Towards Sustainable Smart Textile: 3D print Technology

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Macro report

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1. Smart textile Current issue

As the demand for Smart Wearable Apparel continues to **rise**, Sustainable Smart Textiles have the potential to revolutionise the textile industry, offering new possibilities for customisation, functionality and sustainability.But challenges ahead remain:

- **Complex and unique manufacturing process**
- **Difficult to achieve reliable performance**
- **Waste in production**

2. Solution

In the future, **3D print** technology is expected to contribute to the progression of intelligent wearable devices by enabling the creation of complex and customized designs, reducing waste and incorporating sustainable textiles and production processes.

3. What is 3D print?

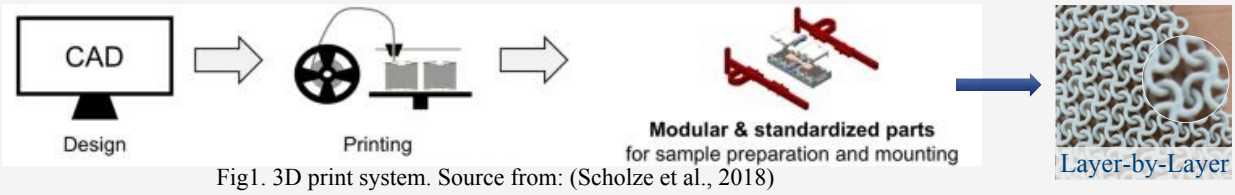


Fig1. 3D print system. Source from: (Scholze et al., 2018)

·Design Flexibility ·Faster Prototyping ·High-standardization ·High throughput

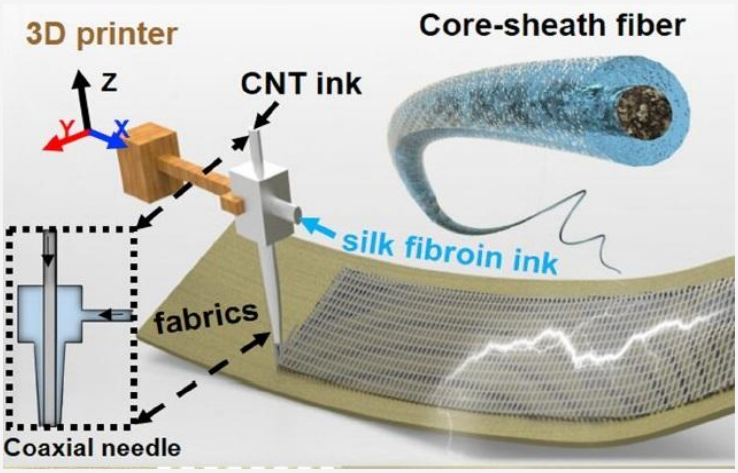
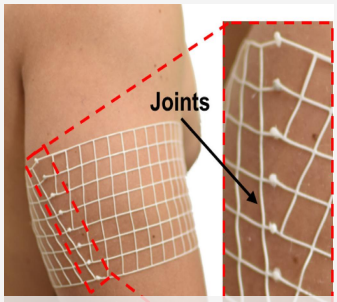


Fig2. 3D print with a coaxial nozzle. Source from: (Zhang et al., 2019)

Customization



Sensor communication

Why?----3D printing enables the creation of **complex** and **custommiazation** designs and incorporates functional elements such as sensors and actuators into textiles.

4. How?—Circular economy 3D Print: Sustainable future

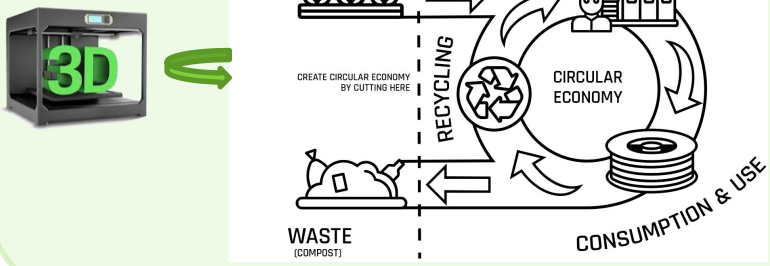


Fig 3. Cirular economy principle. Source from:(3dprintingindustry, 2021).

Reduced Waste: 3D printing is a more sustainable manufacturing technology, generating less waste than traditional manufacturing methods.

Enviromental friendly

- Enables local production
- Reducing the carbon footprint
- Use recycled materials

Overall, 3D printing can impact smart textiles' sustainable development positively or negatively, depending on how they are designed, manufactured and used.

Towards Sustainable Smart Textile: Manufacturing Techniques Innovation

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INTRODUCTION

Manufacturing techniques innovation can achieve smart textiles sustainability by efficient use of resources, energy-saving and pollution reduction, increased lifespan, durability, and customization (Bureau, 2021).

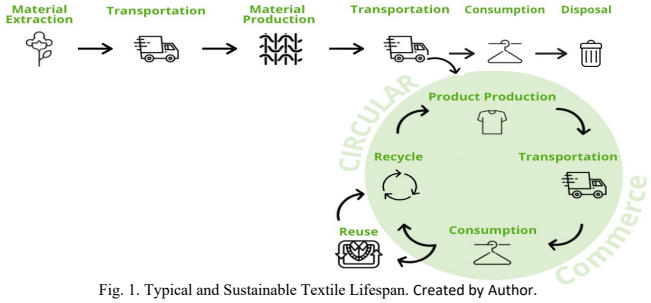

Fig. 1. Typical and Sustainable Textile Lifespan. Created by Author.

TECHNIQUES INNOVATION

Innovations in textile technology can be applied throughout the entire production process, from design to finishing.

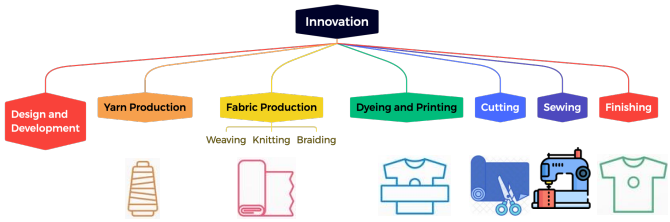

Fig. 2. Possible Techniques Innovation. Created by Author.

Fig. 3. Problems faced and solutions. Created by Author.

HIGHLIGHTS

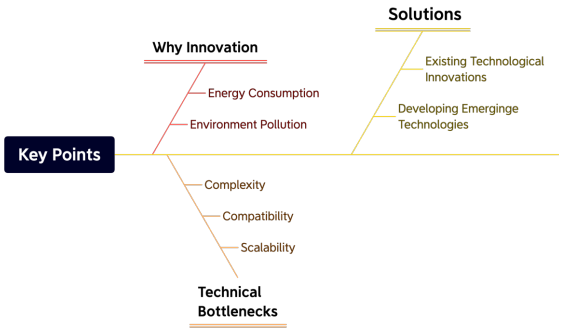

Fig. 4. Key Points. Created by Author.

CONCLUSIONS

Achieving sustainability in production technology is something that is good for both people and the earth. This can be achieved through the **improvement of existing technologies** and the development of **emerging technologies.**

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Bureau, N.S. (2021) *Sustainable fashion: Identifying fast fashion flaws and extending the life cycle of clothing*, *Green Business Bureau*. Available at: https://greenbusinessbureau.com/industries/fashion/sustainable-fashion-identifying-fast-fashion-flaws-and-extending-the-life-cycle-of-clothing/ (Accessed: April 29, 2023).