KYMIRA

Manchester Metropolitan University

MANCHESTER FASHION INSTITUTE

Designing Wearable Smart Garments for Sustainable Production

Aaron Zidichouski, *P.Eng.*

E-Textiles Network Webinar
February 20, 2023

KYMIRA

Regenerating Possible

RANKED 4TH IN THE UK FOR FASHION AND TEXTILES

The Guardian University Guide 2018.

A UNIVERSITY WITH A NETWORK OF OVER 270,000 ALUMNI

From Burberry to Vogue, Ralph Lauren to Topshop,
our graduates work at fashion brands across the globe.

ONE OF THE UK'S GREENEST UNIVERSITIES

In 2022/2023, we were listed as the third greenest university by the UK's People and Planet University League for environmental and ethical performance.

A £400 MILLION INVESTMENT

We're committed to creating the best possible learning environment and strive to continually improve our facilities.

Manchester Metropolitan University

MANCHESTER FASHION INSTITUTE

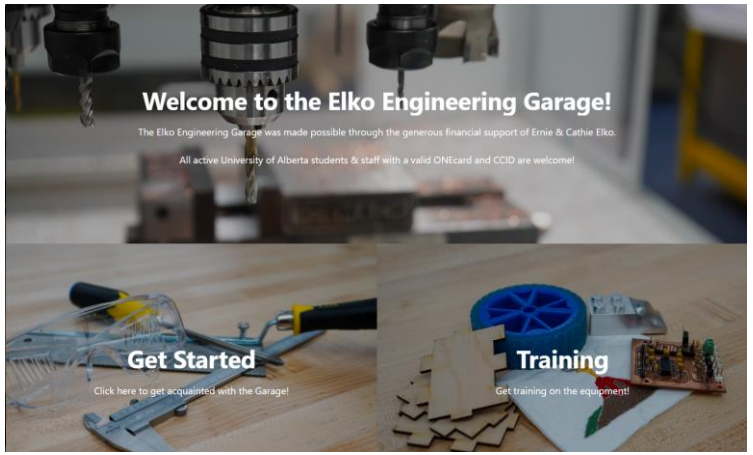
My Background

Education

- BSc Mechanical Engineering, University of Alberta
- Professional Engineer (P.Eng.) designation in Canada

10 yrs Experience

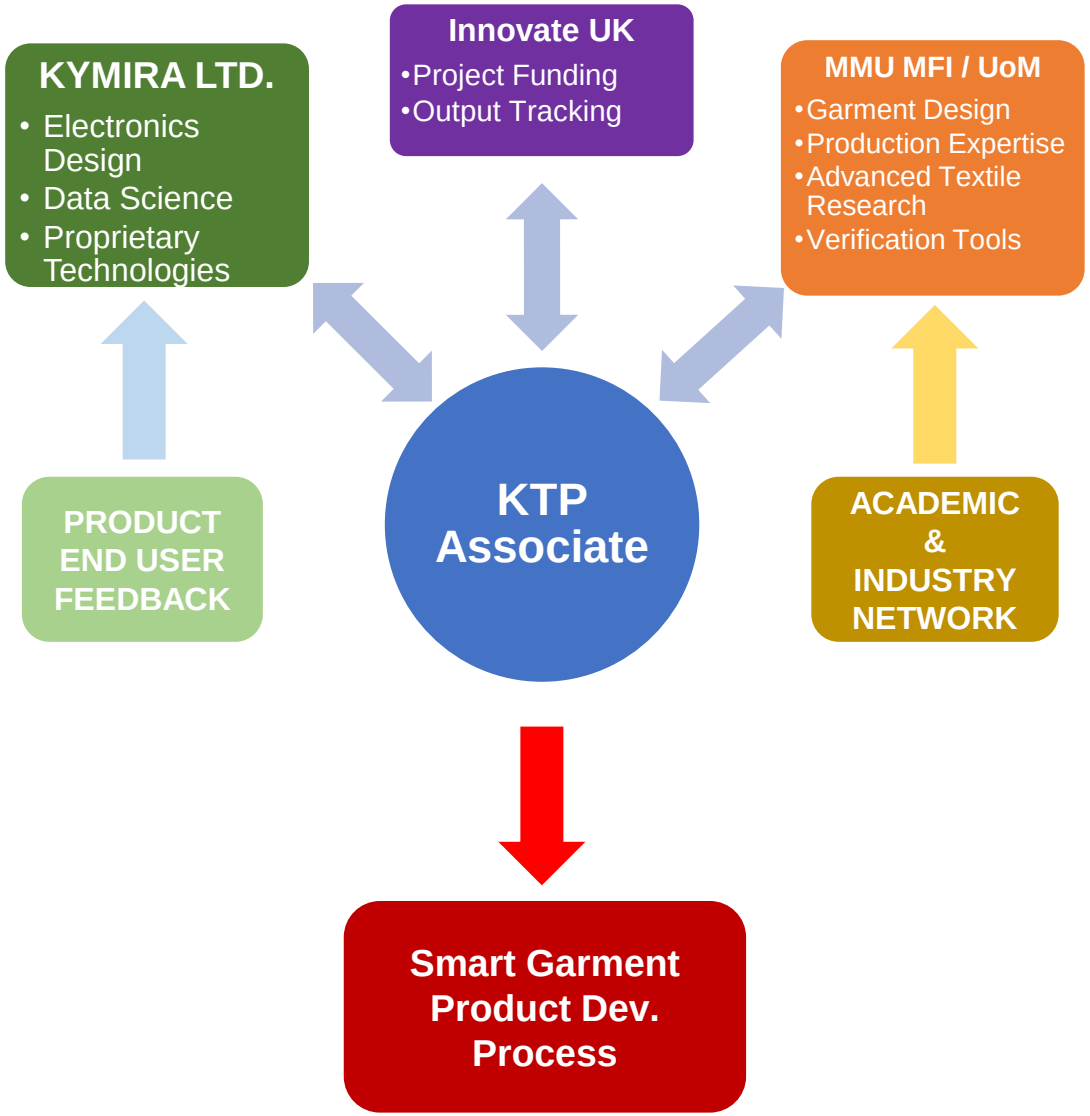
- 2 yrs - Medical Diagnostic Equipment Development
- 5 yrs - Oilfield Heavy Equipment DfM and R&D
- 2.5 yrs - Academic Makerspace Supervisor



Career Focus

- Prototype Development
- Design for Manufacture
- Additive and Subtractive Fabrication
- R&D Testing and Qualification

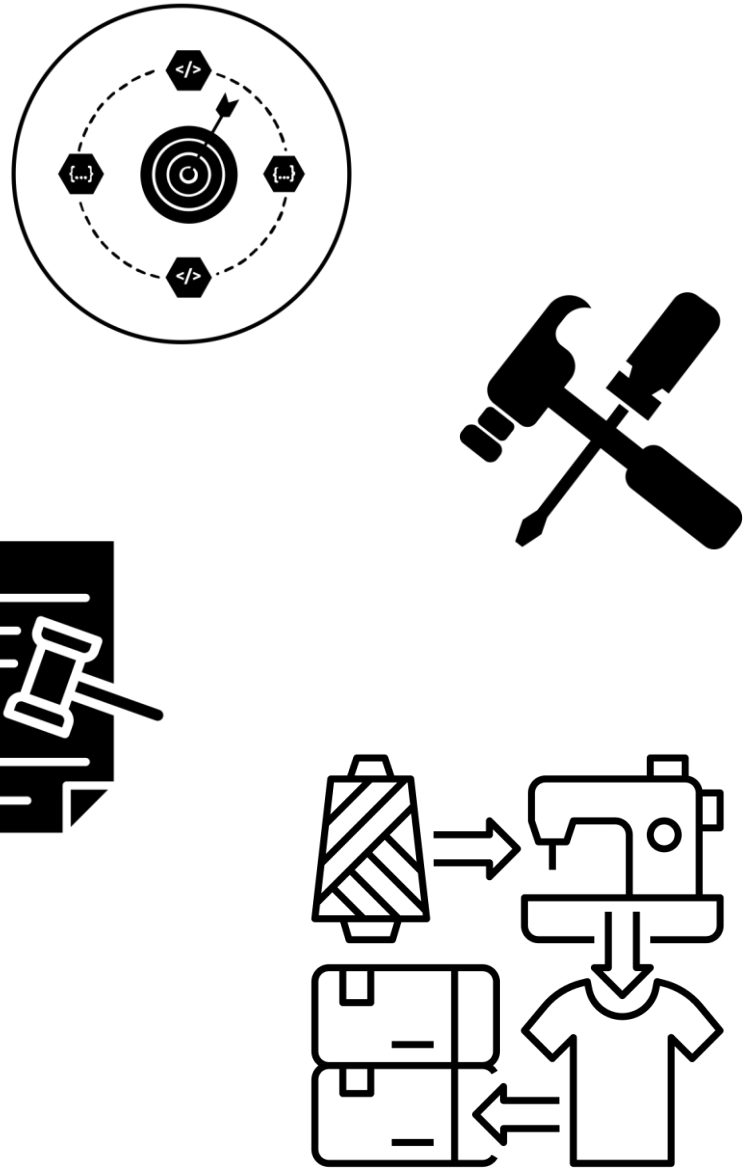
What is a KTP?



- **Innovate UK funded collaboration project, for up to 2 years.**
- **Knowledge transfer between Industry and Academic partners.**
- **This KTP is unique; two academic partners are involved: University of Manchester and Manchester Metropolitan University**

Goals of this KTP

- Framework for smart garment prototyping development.
- Specify the equipment capabilities and staffing for smart garment sampling in the UK.
- Identify e-textile specific considerations based on Textiles 2030 and EPR
- Provide best practices for prototype smart garment design
- Expedite Kymira's prototype to production.



The Noun Project, Khoirin, Shocho, WiStudio, Mas Dihmas

KTP Team

Barbara Shepherd

MA, BA(Hons), PGCert HE, SFHEA,CTextFTI

- **MFI MMU:**
  Reader and Head of Business Engagement
- **KTP Role:**
  Lead Academic and Academic Supervisor

Dr. Phil Kunovski

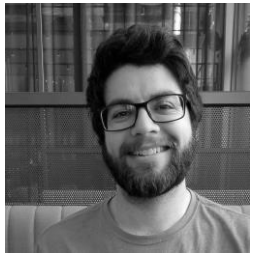
PhD., Electronic Engineering

- **Kymira Ltd:**
  CTO
- **KTP Role:**
  Company Chair and Company Supervisor

Jane Wood

MSc, SFHEA, CTextFTI

- **U of Manchester:**
  Lecturer in Textile & Fashion Technology
- **KTP Role:**
  Academic Support



Aaron Zidichouski

BSc. MecE, P.Eng.

- **MFI MMU:**
  Employee Seconded to Kymira
- **KTP Role:**
  KTP Associate

Smart Garment / Textile Spectrum

Passive Smart

- **Sense Environment**

1. Hydrophobic coatings and materials (DYMA-tex, Neverwet)
2. Compression (seamless knit patterns, and woven warp direction)
3. Passive systems (liquid channels in pilot g-suits)

Vessi Shoes

Smart Garment / Textile Spectrum

Active Smart

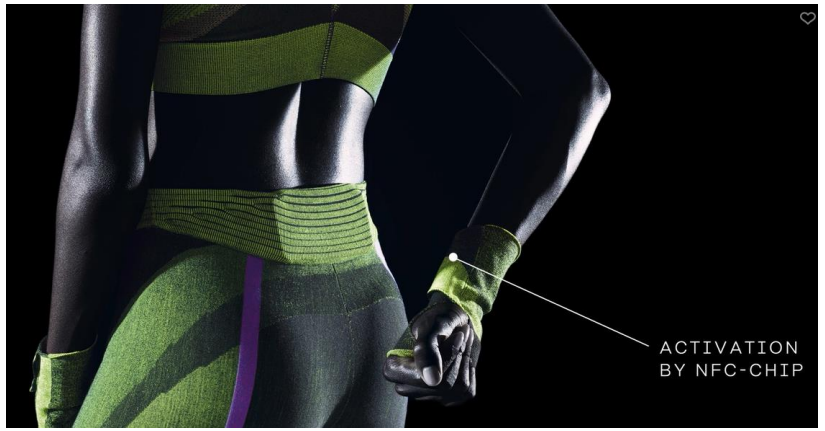
- **Sense and React to Environment**

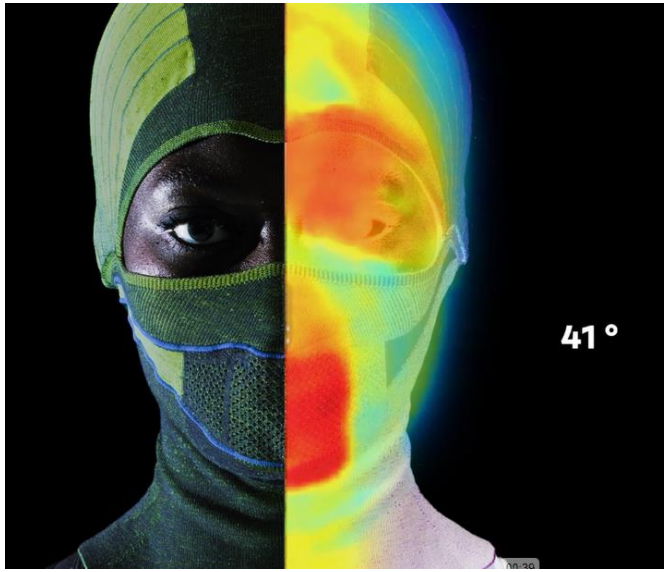
1. SiO_2,TiO_2, Al_2O_3 embedded textile (Kymira, Under Armour Rush)
2. Detachable sensor modules (Under Armour Healthbox)
3. Integrated sensors (Hexoskin, Athos)

Very Smart

- **Sense, React and adapt to Environment**

1. Temperature detection and active regulation
2. Electro and Chemo chromic fabric





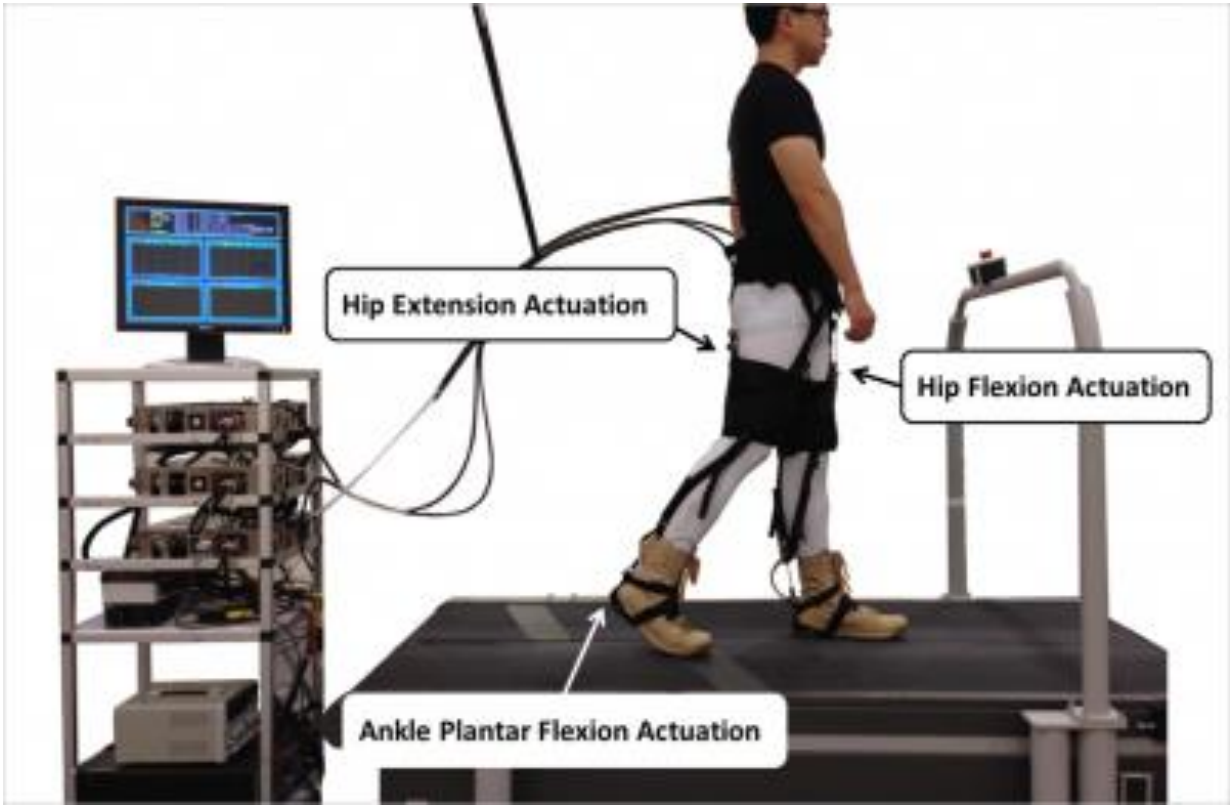
Hexoskin SSAW Studio + Stoll GmbH

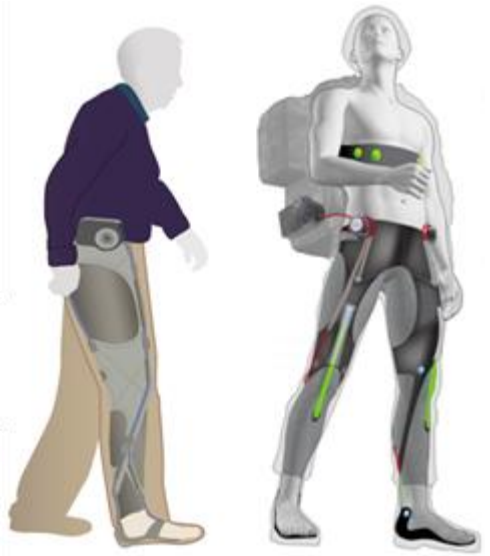
Smart Garment / Textile Spectrum

Intelligent Smart

- **Can be activated to perform complex functions**

1. "4D" self-folding structures (memory metals and filaments)
2. Wearable soft robotic Systems





Harvard Biodesign Lab

Smart Garment / Textile Spectrum

Passive Smart

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Very Smart

- **Sense, React and adapt to Environment**

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2. Electro and Chemo chromic fabric

Powered Electronics Integration

Intelligent Smart

- **Can be activated to perform complex functions**

1. "4D" self-folding structures (memory metals and filaments)
2. Wearable soft robotic Systems

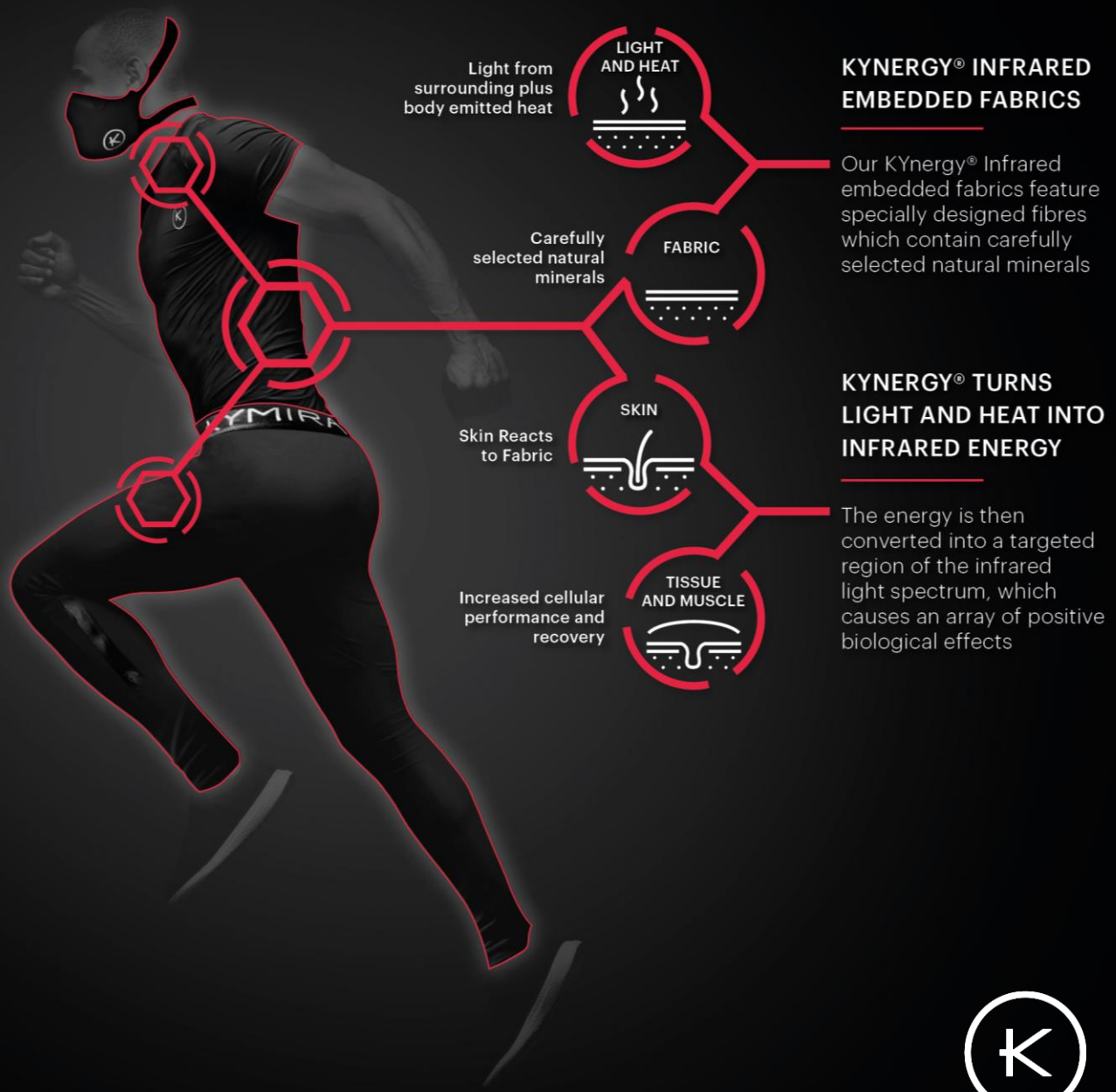
David Tyler, Jane Wood, Tasneem Sabir, Chloe McDonnell, Abu Sadat Muhammad Sayem & Nick Whittaker (2019) Wearable electronic textiles, Textile Progress, 51:4, 299-384.

INFRARED TECHNOLOGY

KYMIRA's Infrared products support individuals and teams to:

- Manage Travel
- Improve Sleep
- Accelerate Recovery
- Reduce Injury
- Enhance Performance

This is supported by clinical, peer reviewed data coming from the world leading sports research institutes, and longitudinal anecdotal evidence.



ACTIVE TECHNOLOGIES

For release in 2023, KYMIRA are developing a range of athlete & patient monitoring smart garments.

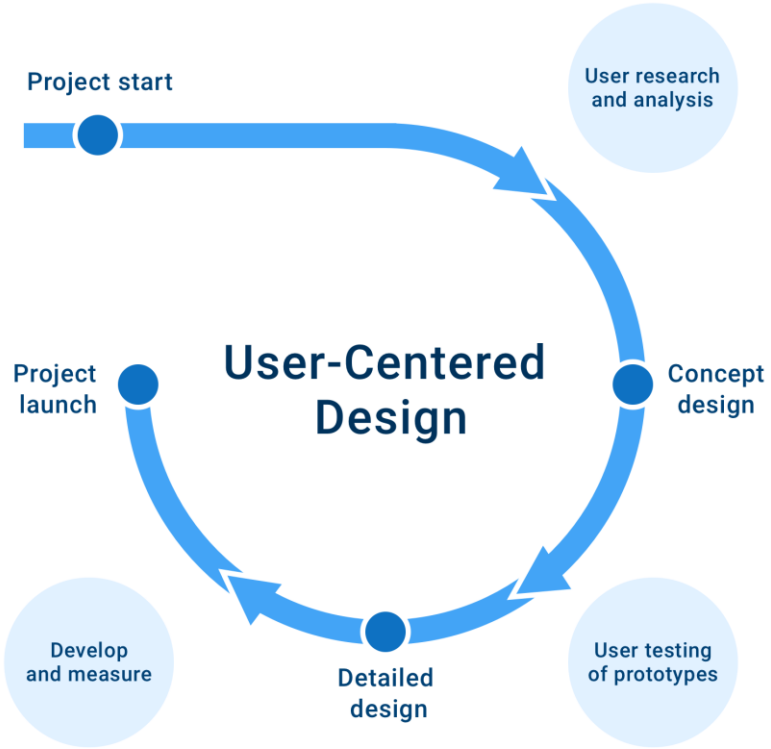
The garments feature medical grade cardiac sensors and biomechanical sensors that deliver MoCap quality data, without the physical constraints of a lab.

- Contextualised data
- Powerful, predictive insights
- Customisable reports and dashboards

Future devices will include additional sensor arrays as these technologies mature.

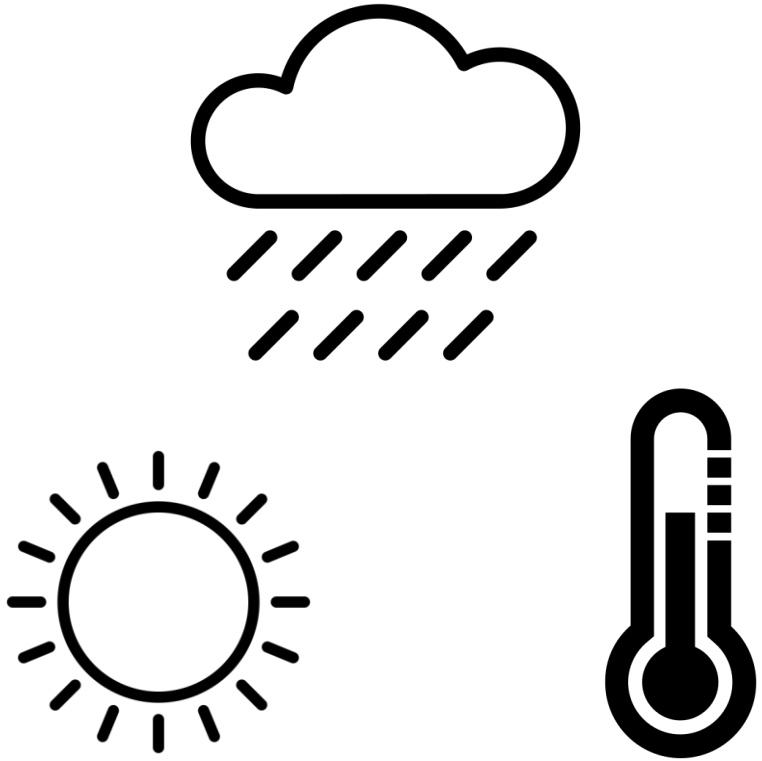
Design of Smart Garments

User-Focused Design



https://marketsplash.com/user-centered-design/

Environmental-Focused Design

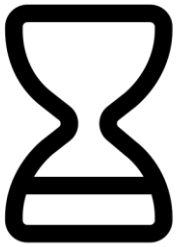


The Noun Project, Yosua Bungar, Evan Shuster

Major Challenges in Smart Garment Development

Time / Cost

- Many Smart Garment systems are at research level
- One-offs
- Custom Parts

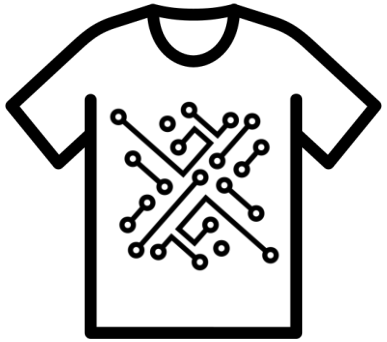


Scaling

- Gap between proof-of-concept prototype and >1000 unit production

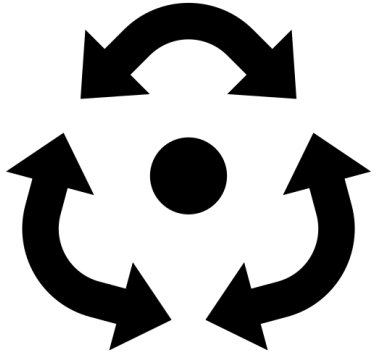
Integration

- Traditional clothing and electronic manufacturing techniques



Regulations

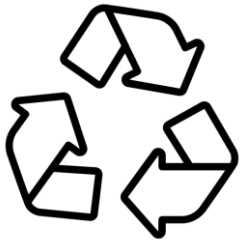
- Impending sustainability regulations for Textiles and Electronics Industries



The Noun Project, LAFS, Luis Prado, Cuputo, asianson.design, Magicon

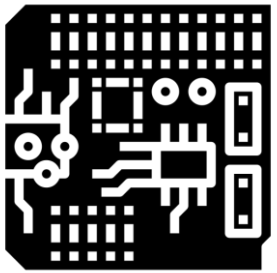
Extended Producer Responsibility (EPR)

EPR policies put producers are on the hook financially.



OR

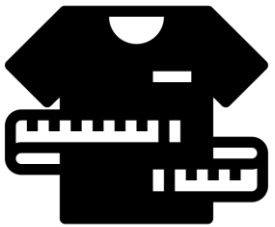
- EPR for Electronic Goods
  - Resources and Waste Strategy for England
  - Waste for Electrical and Electronic Equipment (WEEE)



https://www.gov.uk/government/publications/resources-and-waste-strategy-for-england

https://www.gov.uk/electricalwaste-producer-supplier-responsibilities

- EPR for Textiles (Guide to EPR)
  - Not enacted yet, but following Textiles 2030 voluntary initiatives is future-proofing



https://wrap.org.uk/resources/guide/getting-ready-extended-producer-responsibility

The Noun Project, Bernd Lakenbrink, Mike Zuidgeest, Lagot Design, Template TH

Textiles 2030 Goals

Goals for Textile Industry in UK

- **50% carbon emission reduction**
- **30% water footprint reduction**
- **Targets for % recycled material in new products**

How?

1. Central communications hub and Advisory Group
2. Policy working groups reporting and Reporting tools
3. Workstream groups to create common standards
    i. Design for Circularity
    ii. Circular business model
    iii. Material sourcing
    iv. Citizens

Textiles 2030

https://wrap.org.uk/resources/guide/textiles-2030-roadmap

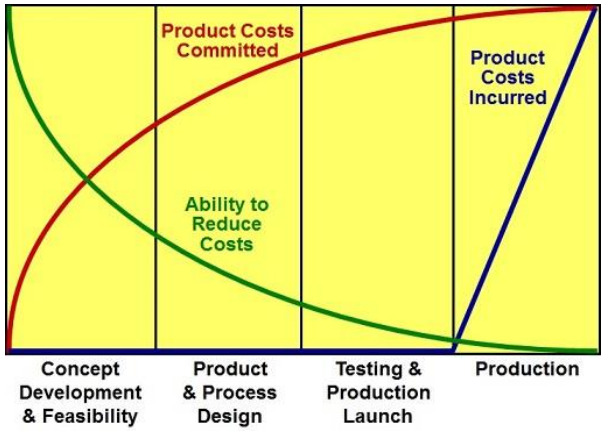
Textiles 2030, EPR and Smart Garments

Why Care?

- Carbon footprint of Global Textiles Industry 10% of global footprint[1]

Intervention

- Can control 80% of the environmental Impact of the product by controlling at the point of production [2]



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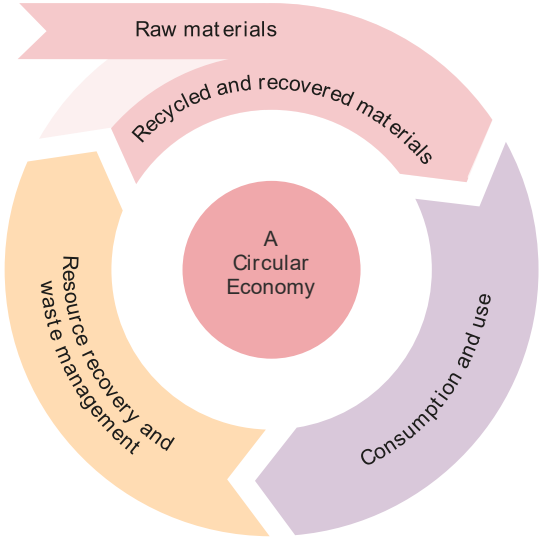
Circular Lifecycles [3]

- Longer-lasting products
- Low environmental impact materials
- Low-waste manufacturing methods
- Design for repair
- Disposal, Reuse, and Recycling Planning



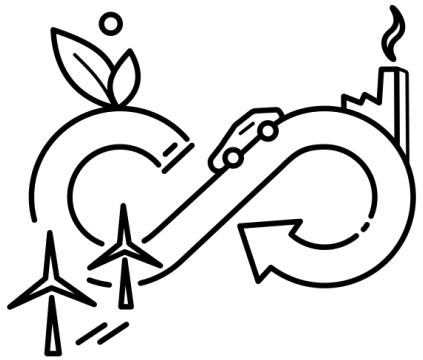
5

1. *A New Textiles Economy – Redesigning Fashion's Future – Ellen MacArthur Foundation 2017*
2. *2.* EU Science Hub 2018, Sustainable Product Policy
3. *Textiles 2030 Roadmap*
4. https://www.npd-solutions.com/dtc.html
5. https://www.gov.uk/government/publications/resources-and-waste-strategy-for-england/resources-and-waste-strategy-at-a-glance

Types of Sustainable Solutions

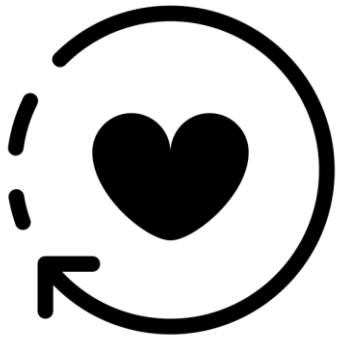
Environmental Sustainability

- Lowering waste
- Energy efficient processes
- Finding efficiencies



Process Sustainability

- Reliable suppliers with sustainable practices
- Buy-in from production partners
- Economically sustainable in long-term

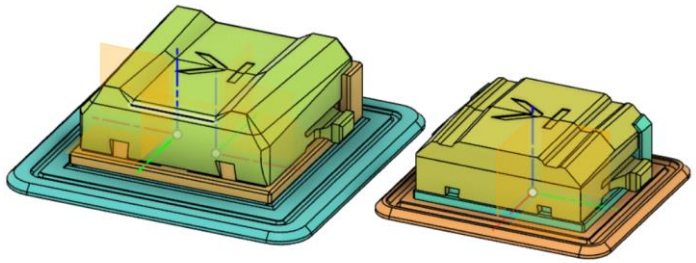


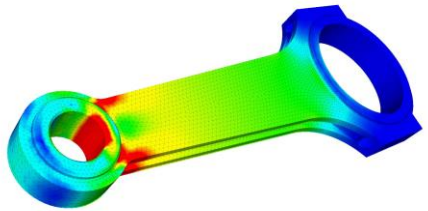
The Noun Project, Olena Panasovska, Maxim Kulikov, Kokota

MFI X KYMIRA Short-Term Sustainability

Prototyping Methods

- Digital prototyping (CLO3D, Optitex, Browzwear, 3D Avatar scanning, CAD, FEA Simulation)



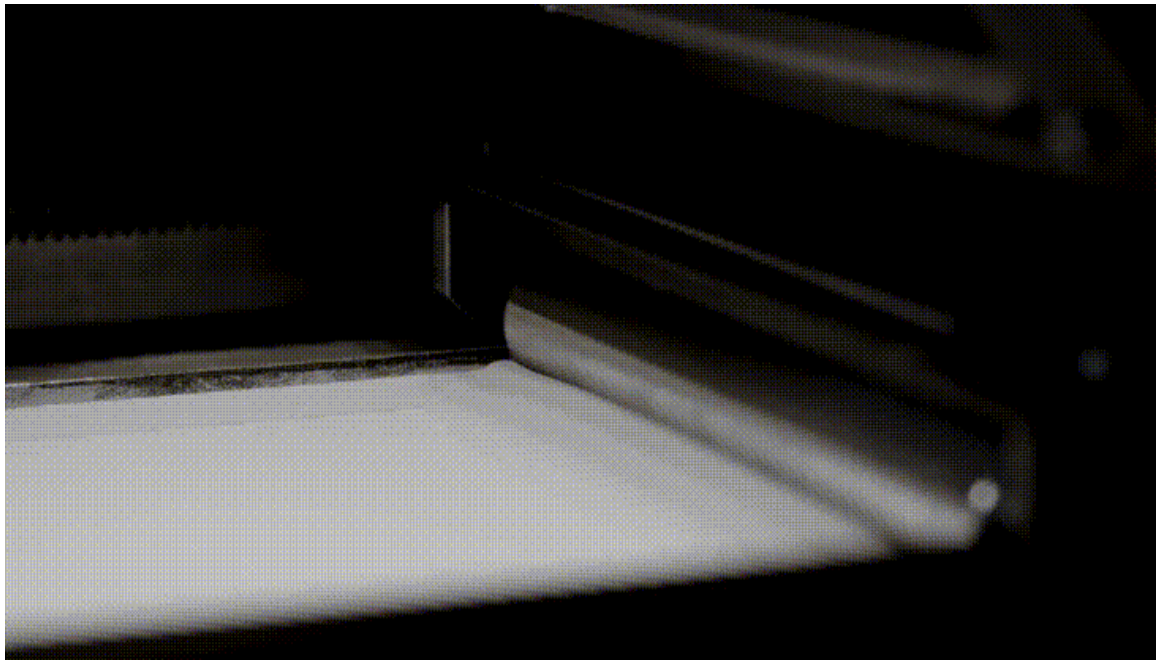


MFI X KYMIRA Short-Term Sustainability

Prototyping Methods

- Additive manufacturing (3D Printing, Knitting)

1



2

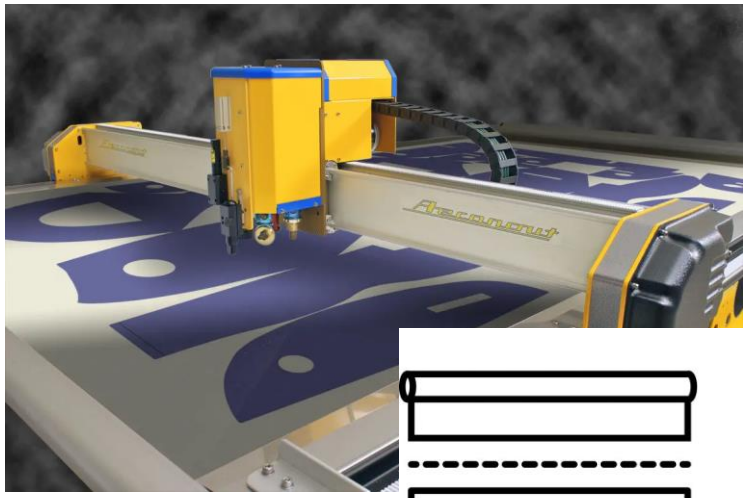
1. Formlabs SL1 SLS Printer, https://docs.saulstudio.ie/fab-lab-handbook/tutorials/3d-printing/sls-printing.html
2. Ministry of Supply Store (Boston) https://www.technologyreview.com/2017/04/06/152728/3-d-knitting-brings-tech-to-your-sweaters-for-a-price/

MFI X KYMIRA Short-Term Sustainability

Prototyping Methods

- Subtractive manufacturing (Machining, Cut-and-sew)

1



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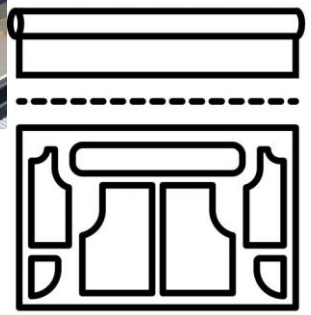
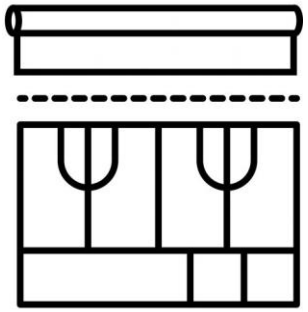


ESTIMATED 15% WASTE
DURING CUTTING PROCESS



ZERO WASTE

1. https://realm.com.my/zero-waste-fashion/
2. https://www.directindustry.com/prod/aeronaut-automation-pty-ltd/product-68184-699285.html

MFI X KYMIRA Short-Term Sustainability

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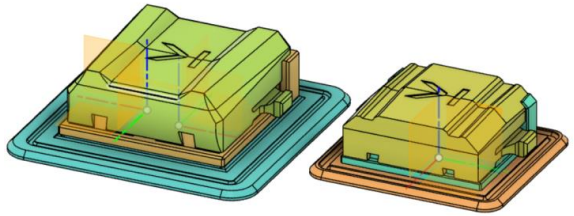
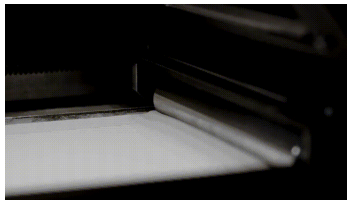


- Additive manufacturing (3D Printing, Knitting)



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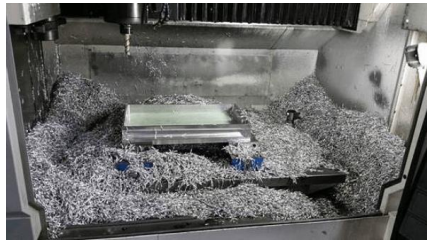
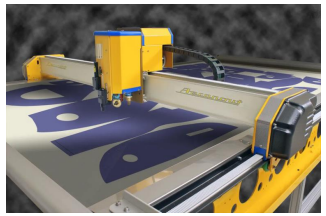
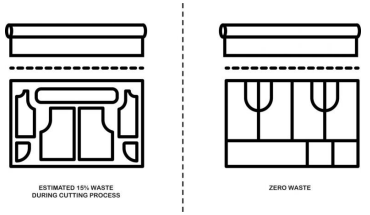






MFI X KYMIRA Short-Term Sustainability

Localizing Prototype and Final Production

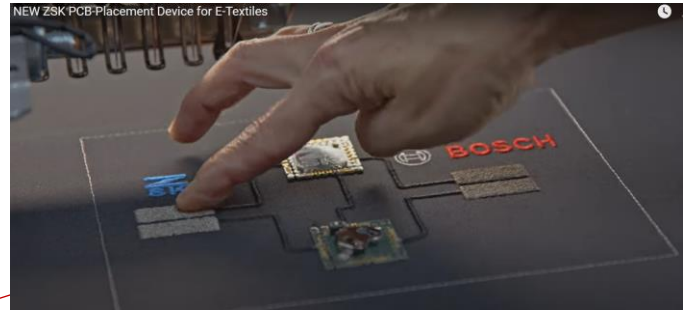
- Faster turnaround
- Less transportation cost / carbon footprint
- Easier oversight on the actual production methods used vs. claimed
- Familiarity with in-country standards
- Finding local, low MOQ partners with professional equipment access

http://bridgestairs.com/en/services/localization-of-production/

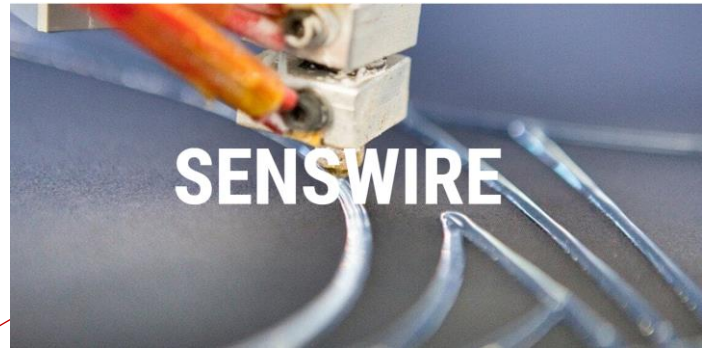
MFI X KYMIRA Medium-Term Sustainability

Design of Electronic Integration

https://learn.sparkfun.com/tutorials/getting-started-with-lilypad/all



https://www.youtube.com/watch?v=loNqQDhm9IQ&t=2s



https://www.ntt-int.com/de/technologies/senswire/

https://born-germany.de/en/home/

Ease of Disassembly

Level of Integration

MFI X KYMIRA Medium-Term Sustainability

https://fractory.com/design-for-x-dfx/

DfMA and DFX

- If design is manufacturing / assembly process focused, more efficiencies and better buy-in from production partners.
- If adaptation is close to current methods, easy to make change.
- If assembly is relatively easy, then people aren't incentivized to find shortcuts
- Trade-offs with user satisfaction (costs, aesthetics, ease of use)

MFI X KYMIRA Long-Term Sustainability

Innovations

- Materials
  - Bio-PET, PLA fibres, bio-nylons
  - Spinnova cellulose-based fibres
  - Kymira using 80% recycled polyester
- Manufacturing Processes
  - Automation
- Development Processes
  - Quick assessment and validation

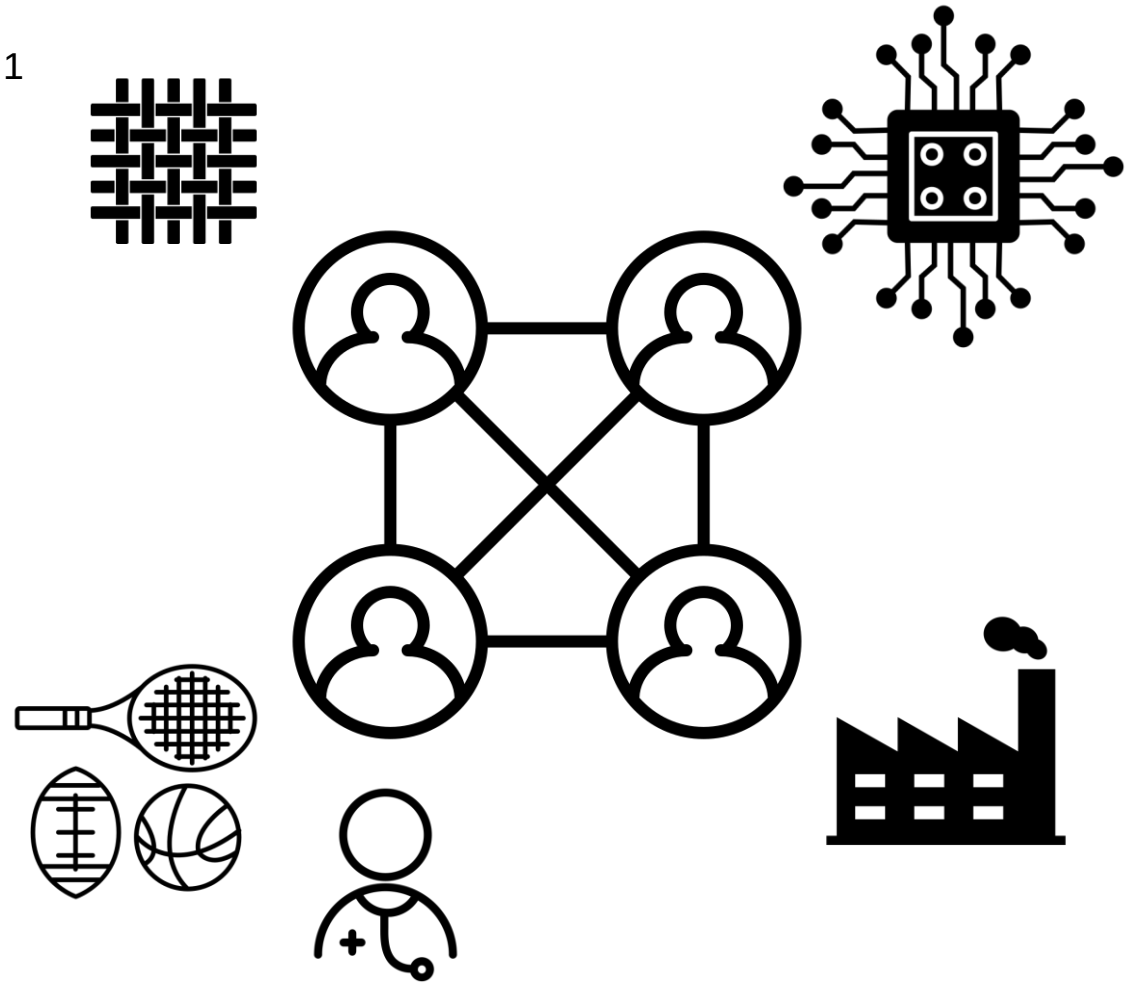
Key Features

100% NATURAL
100% BIODEGRADABLE
0% MICROPLASTICS
0% HARMFUL CHEMICALS
99 % LESS WATER USE
SIGNIFICANTLY SMALLER CO2 EMISSIONS
100% RECYCLABLE

https://spinnova.com/

MFI X KYMIRA Long-Term Sustainability

1



Cross-Disciplinary Design

- Need a co-design approach[2] with
  - Textile Producers
  - Electronics Designers
  - Garment Designers
  - Electronics Manufacturers
  - Application Relevant expert (e.g. sports scientists for athletics, medical scientists for diagnostic wearables)
  - User Consultation
- Develop the tech alongside the garment design.

1. *The Noun Project, Mohamed Mb, Jonathan Wong, Vectors Point, Vighnesh Anvekar, Mira Iconic, Ester Barbato*
2. *Smart Clothes and Wearable Technology, 2nd Ed., Jane McCann, David Bryson, Ch.12*

Thank You

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