Building a Digital E-textile Infrastructure

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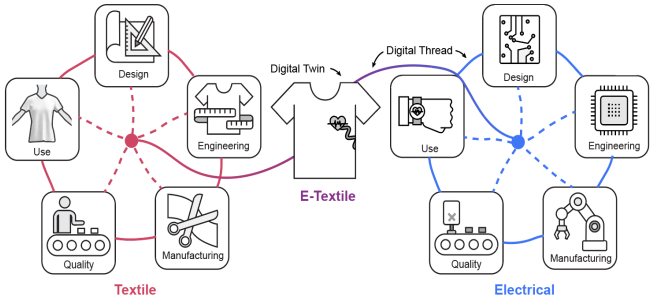
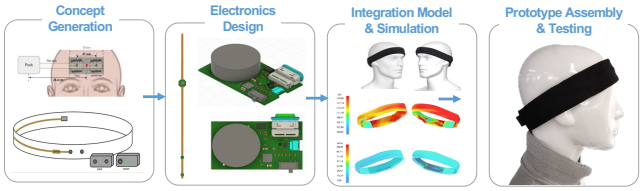
ABSTRACT

Scalability - E-textile design must be supported by a validated digital framework to create scalable and robust systems. This includes digital tools and methodologies as well as a supporting infrastructure for data integration and sharing between multidisciplinary teams.
Challenge - No such digital framework exists. Current e-textile design relies on the iteration of physical prototypes to achieve a system that meets stakeholder requirements. This time-intensive process results in systems that are not designed with scalable manufacturing in mind and have inconsistent and unreliable performance.
This Work - This effort determines the scope for a cohesive digital framework by identifying a process flow for e-textile system design using best practices in both the electrical and textile industries. The proposed design flow and framework was informed by customer discovery with academic and industry stakeholders using or developing CAD-CAM tools for textile, electrical, and mechanical systems. Gaps in the tools and supporting infrastructure are identified, and a roadmap for moving forward is established.



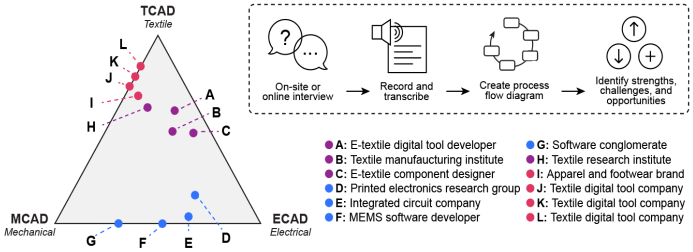
E-textile digital framework. Framework includes the tools, methodologies, and supporting infrastructure to enable the digital design and manufacturing of e-textiles.



AFFOA Example – Physiological Status Monitoring (PSM) Headband; Various digital tools are used at each stage of the design and manufacturing process.

CUSTOMER DISCOVERY

Semi-structured interviews were performed with 30 stakeholders from 12 institutes that use or develop CAD/CAM tools for textile, electrical, and/or mechanical systems



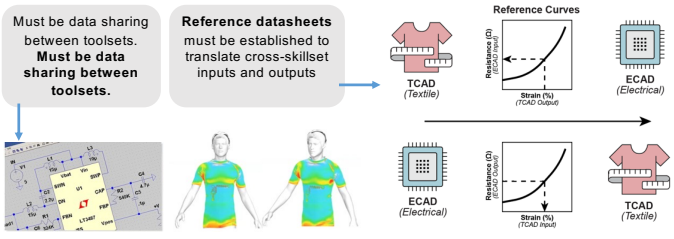
ECAD + MCAD + "TCAD"

Circuit & Garment Simulation Compatibility

Needs:

Must be data sharing between toolsets. **Must be data sharing between toolsets.**

Reference datasheets must be established to translate cross-skillset inputs and outputs

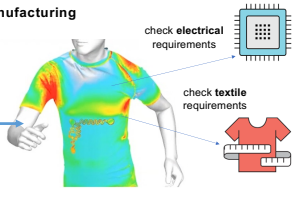


***E-Textile components** need to be **accessible** within SPICE simulator **libraries** such as LTSpice. Similar interfacing with garment simulations such as CLO3D.*

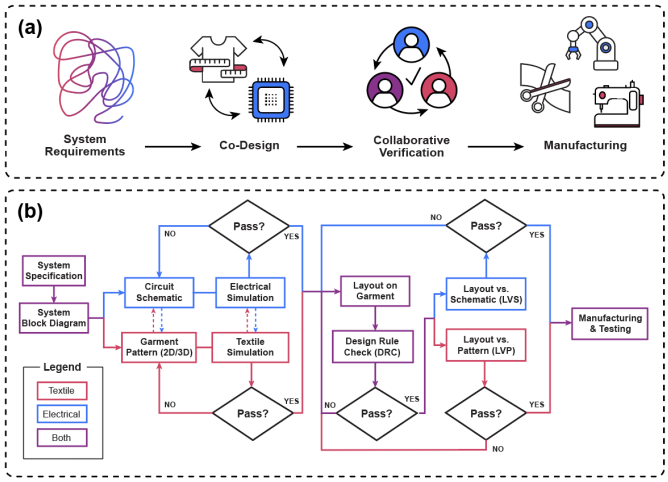
Design for Manufacturing

Need:

Layout vs Schematic (LVS), Layout vs. *Pattern (LVP)*
Design Rule Check ensures manufacturability, LVS tests functionality. It ensure the resulting design (layout) meets the original intention (schematic).
Likely requires **prototype.**



PROPOSED E-TEXTILE DESIGN FLOW

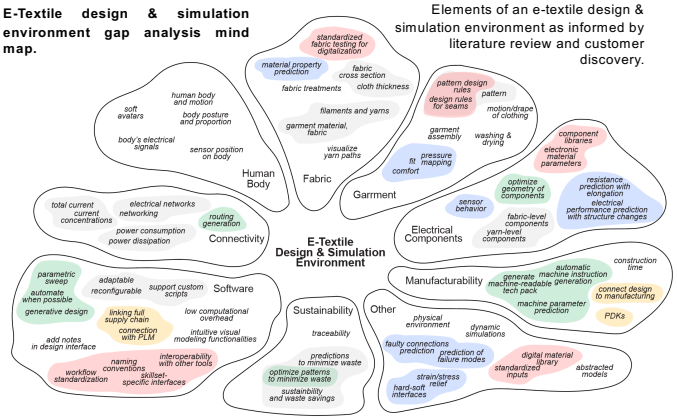


Collaborative e-textile design process. (a) High-level design process and **(b)** detailed proposed process flow diagram (PFD) outlining the individual and collaborative steps in the design process.

GAP ANALYSIS & ROADMAP

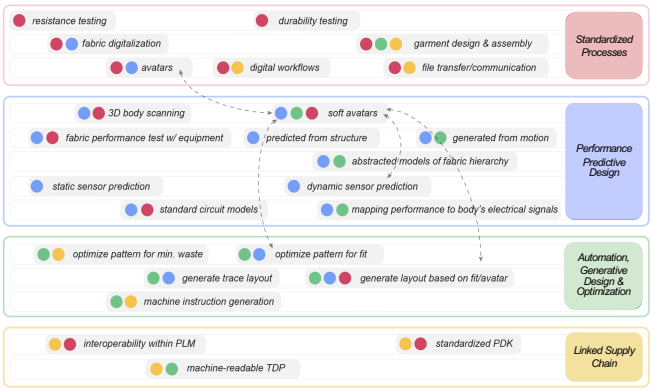
E-Textile design & simulation environment gap analysis mind map.

Elements of an e-textile design & simulation environment as informed by literature review and customer discovery.



Four Categorized Gaps Identified

Standardized Processes	*Performance Predictive Design*	*Automation, Generative Design & Optimization*	*Linking Supply Chain*
(standardization in terms of inputs, outputs, general workflow, etc.)	(predicting e-textile system performance. Both textile and electrical character-istics)	(the software automatically presenting a solution given certain inputs such as objectives and constraints)	(linking from design through to manufacturing. Digital thread)



KEY TAKEAWAYS

Current e-textile design is highly **manual** and **unreliable**.
- *Relying on the iteration of physical prototypes.*

Tools must **define the constraints of manufacturing**.
- *Allow designers to be creative within a set of manufacturable constraints.*

Supporting infrastructure must be established.
- *Including material libraries, design rules, and device simulation models*

Two distinct design flows must be defined:
- *System & component, priority is system.*

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For more information, please contact Dr. Jesse S. Jur, jjur@affoa.org