

## Modular Platform Approach for Developing and Upscaling Technologies for Spinning Biobased and Recycled Raw Materials

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### Abstract

As the textile industry increasingly prioritises sustainability, the demand for biobased and recycled raw materials has surged. However, developing and upscaling the technologies required to process these materials present unique challenges, including variability in material properties, environmental impact, and scalability. A modular platform approach offers an effective solution by enabling flexible, efficient, and scalable development of spinning technologies tailored to the diverse range of biobased and recycled materials.

A modular platform approach entails creating a flexible system of interchangeable modules, each designed for a specific function within the spinning process. These modules can be independently developed, tested, and optimised before being combined in various configurations. This contrasts with traditional methods, where spinning technologies are often monolithic and require significant redesign when adapting to new materials. The advantages of a modular platform approach include:

- a) **Flexibility:** Tailors spinning processes to the specific properties of biobased and recycled materials, handling variations in their properties.
- b) **Customisation:** Crucial to adapt to variations depending on the source and processing methods of biobased and recycled materials.
- c) **Scalability:** Enables easy scaling by adding or replicating modules as needed, without requiring complete system overhauls.
- d) **Rapid Innovation and Development:** Accelerates innovation by allowing individual modules to be developed and tested independently, reducing time and cost.
- e) **Cost-Effectiveness:** Reduces research and development costs by focusing on specific modules rather than entire systems, lowering barriers to entry for smaller companies or start-ups.
- f) **Sustainability:** Promotes sustainability by integrating energy-efficient and low-impact modules, supporting a circular economy model where modules can be upgraded, replaced, or recycled independently.

The modular platform approach offers significant benefits but also poses challenges. Coordinating modules requires advanced data integration and communication systems, complicating IT infrastructure design. However, innovations such as the Internet of Things (IoT) and artificial intelligence can reduce this complexity. Future modular systems are expected to integrate smart technologies for real-time monitoring and optimisation, improving the efficiency of spinning biobased and recycled materials. This approach is transformative, enabling efficient technology development and upscaling for sustainable textiles. By adopting modularity, manufacturers can respond to increasing demand while remaining flexible, cost-effective, and innovative.