# FINAL REPORT

## Part 1 - Summary Details

**CRDC ID:** CMSE1902

**Project Title:** Scoping study: Identifying opportunities for blending cotton with high tech / novel textile materials

**Project Start Date:** 1/07/2018 **Project Completion Date:** 30/06/2019

**Research Program:** 3 Customers

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## Part 4 – Final Report Executive Summary

*Provide a one-page summary of your research that is not commercial in confidence, and that can be published on the internet. Explain the main outcomes of the research and provide contact details for more information. It is important that the Executive Summary highlights concisely the key outputs from the project and, when they are adopted, what this will mean to the cotton industry.*

Man-made fibres were initially manufactured to imitate natural fibres for textile applications. With progress in polymer science and fibre engineering technology, many new types of specialty man-made fibres have emerged. These offer very strong functional properties, for example, super-high strength, super-high moisture absorbency, super-high elasticity, electrical

conductivity, flame retardance, antimicrobial and smart materials that can respond to changes in environmental conditions.

Cotton/polyester blends have been the largest volume application of cotton in blends, taking advantage of the preferred comfort properties of the cotton, particularly moisture absorbency. Integrating elastane with cotton has become a major trend in the last 20 years or so, resulting in new stretchy cotton/elastane apparels for sportswear, exercise wear/active wear, leisure garments and other close-fitting garments.

This project examined opportunities for cotton to be "up-blended" with newly emerging high value functional fibres. This was achieved by firstly a comprehensive review on emerging functional fibres, their properties and markets. Laws of blending were examined for predicting the diluting effect of functionality by blending cotton with functional fibres. Based on these reviews, a brainstorming session with textile researchers and a range of other considerations, a list of significant opportunities for high value blends of cotton and functional fibres are suggested to CRDC for consideration in planning future research activities.

Use of cotton in functional textiles can be realised primarily through two routes, namely, (1) functional treatment of cotton and (2) blending cotton with specialty functional fibres, although a combination of the two routes can sometimes be beneficial. This scoping study has focused on the blending route.

The study identified a range of emerging opportunities for cotton to blend with high value functional fibres, including opportunities with large volume market potentials, such as

- A wide range of conductive textiles, including antistatic, radiation and electromagnetic field shielding, and electronic or smart textiles for sensors, actuators, power/signal transmission and energy storage textiles. Blending cotton with different ratios of various conductive fibres can tune the final textiles to the required levels of conductivity for these products.
- High durability cotton blends. Typically, cotton fibres and ultra-high strength filaments (e.g., Dyneema and Kevlar) are spun into core yarns, or cotton and ultra-high strength staple fibres are intimately blended and spun into staple yarns. Markets for high durability cotton blends include durable jeans, motorcycle and other sports, industrial workwear, military apparels, etc.
- Heavy gauge winter and trans-seasonal knitwear. Wool and wool-blend knitwear are disappearing as wool supply diminishes. Pure cotton knitwear has low bulk (low warmth)

and low resilience. The opportunity lies in blending cotton with retractable and elastane fibres/filaments to produce high bulk warm knitwear with cotton on the fabric surface to provide comfort.

• Fine gauge cotton-blend warp knitted fabrics. Warp knitting offers higher production rates than weaving, a wide variety of fabric constructions and large working widths. It has the potential to be used as an economical substitute for weaving in light weight fabrics. Very fine count strong yarns can be produced from cotton and man-made filaments by the core-spinning or wrap-spinning methods.

To support growth of a cotton-blended functional textile market, a number of "platform technologies" should be developed or investigated, including:

- Law of Blending for functional textiles. Laws for intimate blends on some properties are used for evaluating functionality compromise due to blending (dilution). There is more work to be done for different functional properties, blended structures and manufacturing methods. Functionality of a blend usually does not follow a simple addition or subtraction of the functionalities of its components. This gives room for optimisation of blends to achieve targeted functional properties within a price bracket

- Cotton-blend structures and manufacturing technology tuned for functional textiles. Currently, cotton blended yarns can be spun into intimate blend singles yarns and core-spun yarns using ring and rotor spinning methods, spun into wrap-spun yarns using hollow spindle wrap-spinning machines, or made into plied yarns on various twisting machines. Cotton yarns and other yarns can be combined into a union fabric during fabric-making. These different manufacturing technologies result in different levels of utilisation of the functional properties in the high-performance fibres in the final products. Improved understanding of the relationships between structure and functionality will help reduce the cost of production of cotton blends and market adoption of functional textiles.
- Functionality characterisation and differentiation. Many functional properties for textiles are adapted from other industries. Testing methods need to be standardised to facilitate product differentiation.

In summary, blending of cotton with functional fibres can lead to a wide range of new opportunities in high value markets for cotton and developments in this area should be supportedbyresearchinanumberoftechnologyareas.