

Fashion Meets Function with Smart Fabrics

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Clothes that monitor your health or measure your movements. Fabrics that purify water using nothing but the sun as an energy source. A shirt that can take an electrocardiogram or become cool at extreme temperatures. Textiles are undergoing a radical transformation due to their potential to be embedded with technology, improving people's everyday lives. An instrumental force in the fourth industrial revolution, changes in textiles not only will have a positive economic effect on the industry itself, but on health care and the environment.

E-textiles, also known as smart garments, are fabrics that can be embedded with digital components (including small computers) and electronics. "The textile industry is about to take a giant step from being a supplier of fabrics to becoming a positive force in the development of society," says YPO member **Eric Perlinger**, President of [Filspec Inc.](#) "What seems like fiction today is rapidly becoming reality as advances in fabric-related technology grow exponentially."

Perlinger recently spoke to members of YPO's Apparel Network on the rapid development and manufacturing of smart clothes, a wearable market expected to grow from USD20 million in 2016 to USD138 billion by 2025. "Essentially what happened to the mobile telephone in the last 15 years will happen to textiles in the next 15," says Perlinger.

Textiles will go from being the superstructure that supports sensors, connectors and power resources to being the self-powered sensors and connectors themselves, Perlinger explains. The convergence of the internet of things, 3D printing and nanotechnologies is creating massive opportunities for fashion and apparel. A growing number of products that integrate textiles with sensors to generate and respond to data and create new forms of wearable technologies are already on the market. Smartphones and smartwatches are only the beginning, he says. Wearables will become "disappearables" as the devices become the garment itself. "Our clothes will be able to respond to us in radically different ways as we move into the future."

Smart textiles: More than electronics

Smart textiles are research and development intensive, but they are much more than just the integration of electronics into garments. Smart textiles include any textile with the ability to interact with its surrounding environment and react to the changes in that environment. This interaction can go from simple processes such as the absorption or

release of moisture to complicated ones such as the diagnostics of ambient data. There are three generations of smart textiles: the garment that holds the sensor in place, the garment that has the sensor embedded in it and the garment that acts as the sensor itself.

From simple to complex, scientific strides in the following areas have allowed smart textiles to flourish:

- **Nanotechnology** (the manipulation of matter on an atomic, molecular and supramolecular scale) has made it possible to integrate small molecules to almost any structure, enhancing features such as stain repellence, antimicrobial protection, health and wellness, and colorfastness. Examples are already being produced by such companies as [SilverClear](#), Nanosphere (acquired by [Luminex](#)) and [Nanophase](#).
- **Energy**, considered the “Holy Grail” for smart textiles, and its harvesting, generation and storage are essential elements for future growth of smart textiles. The conversion of ambient heat, body heat and near and far infrared and kinetic energy has at least two outcomes. It powers sensors within garments and it increases autonomy by freeing the user from the limits of battery life. [Thermolite](#) is on the forefront of infrared technology.
- **Circuitry**, the ability to make flexible circuitry within the fabric will remove the fragility and discomfort of current sensor technology. Two avenues of flex circuitry are being pursued by [Panasonic](#), which incorporates printed wiring using flexible polymers and resins; and [Google Project Jacquard](#), which is using woven wiring sewing tradition processes such as knitting and jacquard weaving.

“We’ll have the ability in the future to move beyond clothes,” says Perlinger. “Consider smart bedding in hospitals that relays real-time information to medical professionals and loved ones, or smart seating that tells when a passenger on an aircraft is not wearing their seatbelt. The possibilities are endless!”

What’s in store for the future?

- Fashion and entertainment: USD2.8 billion
- Health and Wellness: USD65 billion
- Medical: USD69 billion
- Fashion and entertainment: USD2.8 billion
- Technical: USD1.4 billion

“Remember today, take a good look at what you are wearing and think about what these garments are doing for you,” says Perlinger. “Now look at your smartphone and dream.”

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