ENTER DESIGN, EXIT SWEATER
3-D PRINTING IN THE FASHION INDUSTRY

- As we see 3D printing begin to impact on garment production, we showcase two innovators.

- Most 3D garment printers so far have printed clothes that are impractical for regular wear; Electroloom has had a breakthrough by producing clothes that are more natural. Its machine eliminates several processes in production and converts raw materials directly into a finished garment.

- Meanwhile, Knyttan's technology offers the same level of user-friendliness that 3D printing does, and has created a platform that allows an individual knitwear garment to be customized. It is conducting research on superior software that can be adapted for mass customization.

- This platform will reduce production lead time from 90 days to just a few days, and remove the highly skilled labor needed for setting up the design program and amending it every time a design changes.

- While both innovations are still in their developmental stages, they give a hint of the impact that could come from 3D printing in garment manufacturing

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3-D PRINTING IN THE FASHION INDUSTRY

If only creating a garment were as easy as feeding a design into a machine and pushing a button. Apparel manufacturing is as old as time and has constantly progressed through the ages. Everything was made by hand until the Industrial Revolution mechanized the manufacture of fabric. We have come a long way since then. Evolving technology and changing fashion have dictated the capacity and intelligence of the tools and machines used in the detailed, assembly-line production of garments.

3-D Printing in the Fashion Industry

New methods of manufacturing and advancements in materials engineering are changing garment manufacturing as we know it. Previously, 3-D-printed garments were produced with substances that gave them an unusual stiffness and eccentricity. These were typically just one-off statement pieces, as they didn't allow for the flexibility and durability required of clothing that's worn daily. Also, most garments are conventionally constructed with more than one material and have additional accessories depending on their functionality, neither of which 3-D printing processes could provide.

In this report, we examine two innovators that have the potential to disrupt apparel manufacturing, Electroloom and Knyttan. Electroloom has developed new substances and methods of synthesizing them into nonwoven, digitally created fabric that folds and drapes like woven cloth. Knyttan has created a customization platform for knitwear that allows users to design their own sweaters or scarves, without the need for a designer or knitwear technician to program the design for each unique product.

What Is a 3-D Printer and How Does It Work?

A 3-D printer is a machine that produces a three-dimensional object from a digital design file. In terms of apparel production, a 3-D printer can eliminate all the stages of a traditional factory production line. Currently, 3-D printers can work only with a few materials, such as plastics, resins, powders, metals and ceramics. The machines lay down continuous layers of the material, each building on the last, until the object is created.

Fabrican: The Creator of © Spray-On Fabric

Before 3-D-printed clothes became a reality, a London-based company came up with a way to convert substances into fabric without using a conventional production line. Fabrican, established in 2003, developed a method to join and dissolve threads inside a can so that they come out as material textile when sprayed onto a body or mannequin. Once the fabric is sprayed, the solvent evaporates and the strands bond, taking the shape of a body-hugging garment. Colored spray can be used to create designs, but most garments are plain. Though this product was initially developed to cater to the fashion industry, it has found numerous other applications in fields such as medicine, healthcare and sports.

nt T-shirt 2010 © Caroline Prew/Imperial College London

### Electroloom: The World's First 3-D Fabric Printer

Using a materials-processing technique similar to Fabrican's—converting a solution into fibers that bond to create fabric—a trio of engineers has developed the Electroloom, a 3-D printer that can print a seamless garment. What makes this printer unique is that the printed garment can stretch, fold and drape like a conventionally woven and stitched piece of clothing, unlike clothes that were made with 3-D printers previously.

How Does It Work?

A mold of the desired item of clothing is created with computer-aided design (CAD), and placed inside the printer chamber. A polyester-cotton blend solution is sprayed inside the chamber, where it transforms into solid fibers.

An electric field in the chamber guides these fibers to bond to the mold. The entire process takes a few hours. The makers say that the time it takes to produce a garment is directly related to the number of nozzles that spray the compound onto the mold, and that adding more nozzles might reduce printing time significantly.

Dyes can be mixed with the solution to create colored fabric; however, the developers have not yet come up with a method of controlling the saturation of the dyestuff or printing a garment with a design on it.
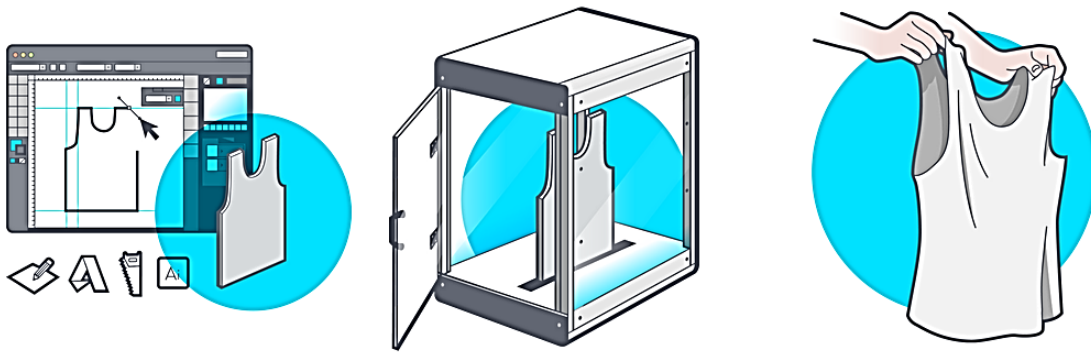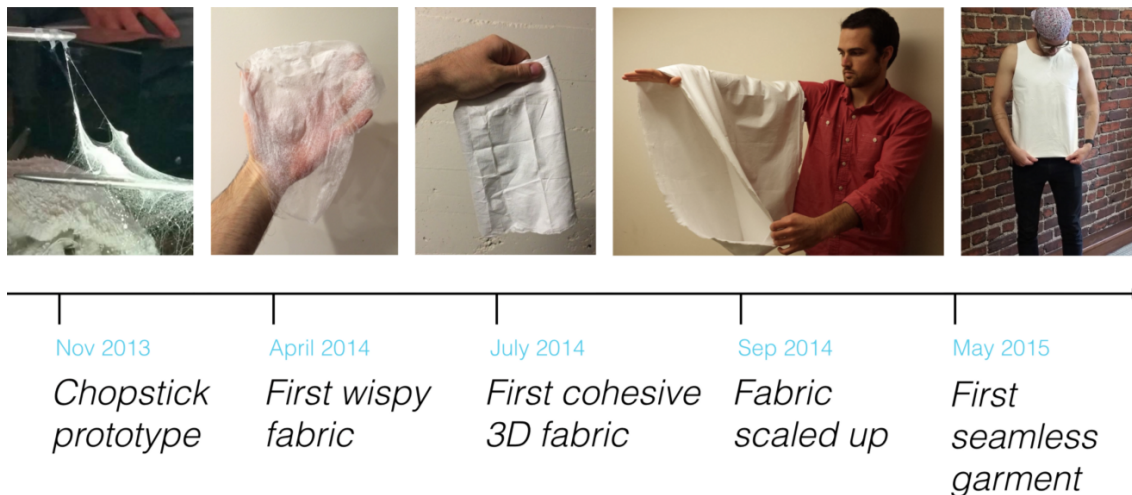

1. Design a mold in CAD and make it or have it made.

2. Place your design in the Electroloom and turn it on. Watch your custom fabric be created.

3. Pull your finished good off the mold. That's it!

Electroloom's Timeline from Prototype to Product

| Nov 2013	April 2014	July 2014	Sep 2014	May 2015
Chopstick prototype	First wispy fabric	First cohesive 3D fabric	Fabric scaled up	First seamless garment

Knyttan: A Knitwear Customization Platform that Borrows from 3-D Printing

Started in April 2013, Knyttan has capitalized on the popularity of customization offered by 3-D printing by developing a software platform that allows customization of knitwear garments. Knitwear manufacturing is more complex than other garment manufacturing for two main reasons: a knitwear technician needs to program each unique design into the knitting machine, and the specific capabilities of each machine limit the options for different designs. Also, the knitting yarn needs to be arranged and placed on the spindles carefully, so that the machine picks up the right thread at the right time, per the design, and the entire process before production begins can take anywhere from a few hours to a few days, depending on how advanced the model is. Most industrial machines are also expensive to buy and operate; in order to justify the high cost, production runs are usually done at a large scale.

How does Knyttan's Platform Work?

Knyttan has developed software for a conventional knitting machine that enables mass customization and eliminates the long hours of coding necessary to input a design. On Knyttan's website, one can choose to order a sweater, scarf or a blanket scarf; select a design; modify it slightly to preference; and have it knit on demand. A customer can even choose a color scheme from a preset selection of colors. The entire online purchase takes a few minutes, and the custom-made product is delivered to the customer in a few days.
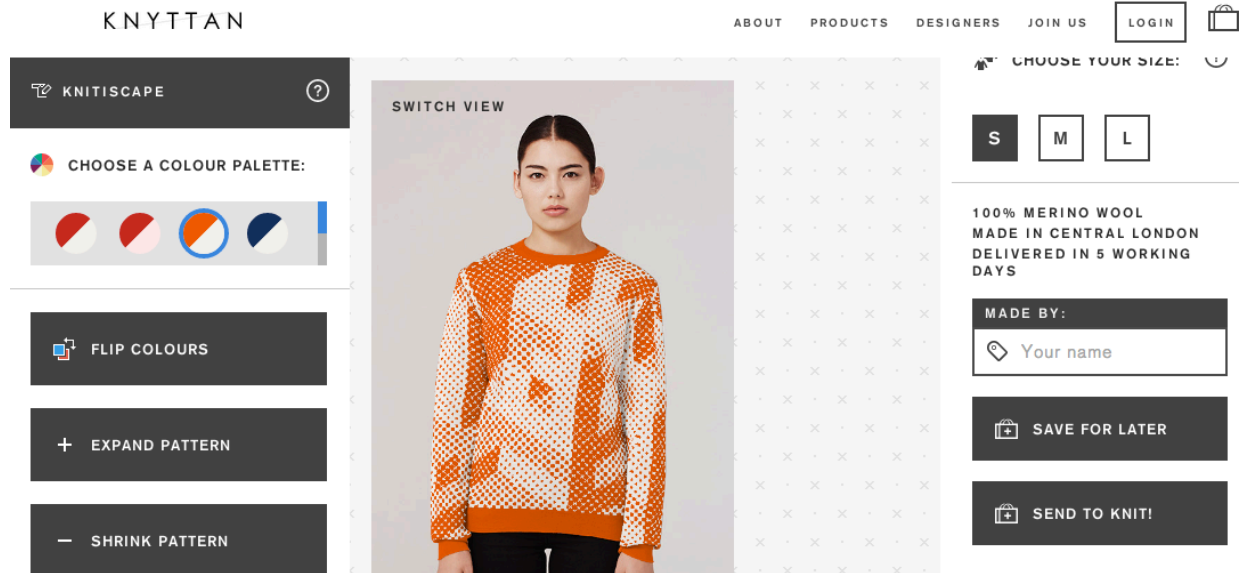
Knyttan doesn't intend to produce garments from substances other than wool. Its software works with a knitting machine similar to the ones being used in the industry currently; the software uploads designs to the system's interface. This software allows Knyttan to produce different knitwear garments in assorted colors, all in one flow and, in doing so, reduce the length of a process that traditionally has taken a few months to merely a few hours.

What We Think

While most 3-D garment printers so far have printed clothes that stand stiff like a crinoline and are impractical for regular wear, Electroloom has had a definite breakthrough by producing clothes that look and feel more natural. This single machine eliminates several processes in production, such as spinning yarn from raw materials, weaving yarn into fabric and sewing garments from cut fabric. Instead, it converts raw materials directly into a finished garment.

Knyttan's technology—though not a 3-D printer—offers the same level of user-friendliness that 3-D printing does. Knyttan has already created a platform that allows an individual garment to be customized, and it's conducting research on superior software that can be adapted for mass customization. This platform will reduce production lead time from 90 days to just a few days, and remove the highly skilled labor needed for setting up the design program and amending it every time a design changes.

As both Electroloom's and Knyttan's innovations are in their developmental stages, their technologies are not yet sophisticated enough to warrant regular use. If these innovators can develop machines that are cost-effective, user-friendly and able to work with a variety of materials, it may not be long before we see substantial disruption in the conventional, assembly-line production of garments.

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