

# **Manufacturing Challenges Using Discarded Textiles: The Secondary Textile Supply Chain as a Resource**

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## **Abstract**

San Francisco collects and ships annually to landfill approximately 22,000 tons (3.5% of all solid waste collected) of discarded textiles. This case study investigates a collaborative effort in the city of San Francisco among government, business and the local apparel/sewn products trade organization for the purpose of converting textile waste into a manufacturing resource, as San Francisco moves closer to “zero waste” by 2020.

The discarded textiles of one product category, tablecloths and napkins (estimated in excess of 100 tons annually from the local hotel & restaurant supply industries) was designated as the secondary textile supply source. Originally designed as flat yardage with few sewn seams, the woven fabric tablecloths are of polyester and cotton fibre blends, all approximately 8 oz/sq yd (300 g/m<sup>2</sup>). Initial design analysis revealed tablecloths could be repurposed: cut, sewn and digitally printed for new consumer products. The shopping bag category was selected for the first new product using this supply source.

There are challenges implementing a secondary textile supply into a traditional manufacturing model: 1) Designs to embrace the imperfections of the discarded tablecloths during the printing process; 2) New strategies to sort, collect and store the supply; 3) Awareness to adjust the sewing factory's usual organization to cut and sew for maximum efficiency. The low cost of the discarded textile product is offset by the labor required to prepare the tablecloths for production. This study reveals strategies for a new secondary textile supply chain model using discarded textiles to develop new manufactured products.

### **Introduction**

San Francisco leads all cities in the United States currently diverting 80% of its solid waste from the landfill (SF Department of the Environment, 2012). However, San Francisco has not organized collection of discarded textiles that are thrown away by consumers and businesses. The current method to remove discarded textiles from solid waste is to donate to charity organizations to help raise funds for the charity by selling the clothing and other textile products in their resale shops. However, approximately 20% of all donated textile products are sold, with the remainder bundled in 500 pound bales sold to textile recyclers for USD.10-.18/pound(.5kilo). (interviews, CEO of SFGoodwill and warehouse manager of Salvation Army's Adult Rehabilitation Center in San Francisco, 2009).

Cities do not have an organized method of collecting and sorting discarded textiles, and municipal garbage collectors usually send these products to landfill. The US Environmental Protection Agency designates textile waste as non-recoverable, meaning that all textiles will eventually be shipped to landfill (USEPA, 2009). Clothing and other textile products are either donated to a charity for resale or shipped to landfill. The discarded textile products are viewed by industry and municipalities as having no value.

In 2009, discarded textile products were estimated at 12.7 million tons, or 5.2% of all municipal solid waste collected by garbage services in the United States (USEPA, 2009). Less than 15 percent of all textile waste placed in the garbage was recovered (reused, recycled, or exported) (USEPA 2009). The remaining 85 percent goes to landfills (Smart 2012). For every ton of textile products diverted from landfill and reused, an estimated 20 tons of CO<sub>2</sub> emissions are eliminated from the atmosphere (Hunt 2011: 14).

The documentation of textile waste created by the hotel and restaurant industries is lacking. More than 16 million people visited the city of San Francisco in 2012, spending USD8.93 billion; business and leisure travel is on the rise (San Francisco Visitor Industry Statistics, 2012). Restaurants and banquet tables require clean

tablecloths and napkins for each seating of customers, creating textile waste when stains, holes and other damages are created from continual use. All of these damaged tablecloths and napkins are discarded. The City and County of San Francisco has pledged to reduce solid waste deposited into landfills to zero by 2020 (Resolution 530-04, 2004). However, it has no plan to remove these tablecloths or other discarded textiles from the waste stream. New collection and manufacturing models must be explored to create value and extend the life of discarded textile products, thus diverting them from the traditional textile recycling industry and landfill.

This case study investigates a collaborative effort in the city of San Francisco among government, business and a local trade organization for the purpose of converting textile waste into a manufacturing resource. The ultimate goal of the study is to understand what usable discarded textiles from the waste stream of the hospitality industry can be diverted as a consistent supply for repurposing into new products. An additional component of this study is the heightened consumer interest and demand in purchasing products with a perceived environmental impact that correlates with its true impact (Chen and Burns, 2006). In this paper, the term “repurpose(d)” is used to define the collecting and sorting of discarded materials as the resource for new products designed and manufactured in the location of discard. As the rise and influence of LOHAS (Lifestyle of Health and Sustainability) consumers grow, so will the demand for and growth of repurposed products (Blossom 2011).

## **1. Considering Two Textile Supply Chains in Manufacturing New Products**

The traditional fiber and textile industry is dependent on a continuous supply of new fiber to produce new textiles. All industries that use textiles always request newly produced fiber and textiles. While there is now effort to use existing textile resources to produce new products, the activity is uncoordinated and unfocused. There have been developments over the past 20 years that have shown that it is possible to create fiber using existing resources: 1) Polyester fiber produced from plastic bottles; 2) Cotton yarn from mill fiber waste; 3) Cotton yarns from cut fabric waste; 4) chemically recycled polyester fiber from existing polyester fabrics. All these examples require specific collection and complex sorting procedures.

### **1.1 Primary Supply Chain for Textiles**

The textile, clothing and sewn products industry, was built on the model of a one-way, cradle to grave system (McDonough and Braungart 2002) with resources grown or manufactured for singular use and disposed of. Virgin fiber (produced newly) requires large amounts of energy, chemicals, water and perhaps GMO seeds (if cotton fiber) and large amounts of energy and petrochemicals and other chemicals (if manufactured fiber, particularly polyester). These two fibers (nearly 90% of all fiber

produced is cotton or polyester) are produced in many geographic locations and shipped to yarn and fabric mills for new textiles. The finished textile products are consumed and later discarded by the final consumer, so the fiber resources are lost to the textile supply chain. The discarded textile products are viewed as not valuable, even though increasingly scarce petroleum-based products are used in the production of these fibers and fabrics. There is an assumption by manufacturers, retailers, and consumers that textiles will always be available, and fiber supply for the production of new textile products will be unlimited.

## **1.2 Secondary Supply Chain for Textiles**

There is a desire in the fashion industry to find alternatives to the traditional “always new” fiber resources, yet the industry lacks the understanding of how to do scalable production using existing textile products. Supported by the Japanese fiber companies’ fiber chemical recycling programs, the developing textile waste diversion efforts, and the emerging interest by specific consumer market segments seeking products made from recycled or repurposed materials, a secondary supply chain of discarded textile products, collected for reuse has emerged (Owen 2011). However, the complexity of fiber blends, dyeing and finishing techniques, and complicated apparel designs have made collecting and sorting appropriate textile products for reuse or recycling very difficult.

Manufacturing previously used fabric into new products provides an opportunity to keep fabric out of the waste stream and remain in a new, secondary fiber/textile supply chain, a cradle-to-cradle model (McDonough and Braungart 2002). The collection of discarded textile products for manufacturing of category-specific new products provides the spark to invent new manufacturing models and perhaps a new industry. The intent of this study is an exploration of a new collection, sorting and manufacturing system for the repurposing of textile waste.

## **2.0 The San Francisco Tablecloth Project**

Hilary Near of the San Francisco Department of the Environment (SFDOE) reached out to The San Francisco/Bay Area sewn products trade association, PeopleWearSF, to explore potential methods to divert and reuse this textile tablecloth waste, estimated by Ms. Near at 100 tons annually. PeopleWearSF is the San Francisco/Bay Area trade association for the apparel/sewn products manufacturing industry. Its membership includes established industry businesses and new, fast-growing apparel businesses. PeopleWearSF (PWSF) is a collaborative network of industry professionals whose mission is to use their knowledge and skills in designing, manufacturing, and marketing products that have a positive impact on the planet, people and the local economy (About PeopleWearSF, 2013). Several board members of the

trade association accepted the challenge to find a solution to divert these discarded tablecloths from landfill, forming the SF Tablecloth Project.

In its continuing effort to reduce solid waste going to landfill, the city of San Francisco passed a law banning the distribution of single-use plastic bags in October, 2012. Shopping bags provided by retailers must be compostable, recyclable, or reusable up to 250 times, capable of carrying 25 pounds. The SF Tablecloth Project team designed and locally manufactured 3 sizes of shopping bags from these discarded tablecloths, that would meet the reusable bag ordinance requirement.

### **2.1 Designing the Shopping Bags**

A priority for design was to incorporate the “used” nature of the materials into the shopping bag, creating new value materials’ the transformation into something new (Norris 2010). The PeopleWearSF team determined that these tablecloths were a good textile resource for the following reasons: 1) The fiber content was either 100% polyester or high-content polyester, blended with less than 30% cotton fiber. Using mostly polyester fiber content in the collected tablecloths allowed for allowed the use of dyefast disperse-dye printing and later, potential chemical fiber recycling when the technology is available in the US (Baugh, 2011); 2) The tablecloths were manufactured as flat yardage with a rolled and stitched hem, so it was anticipated no costly disassembly was required; 3) The cloth was durable, yet had a good hand, and could be manufactured into a new product capable of carrying 25 pounds.

All the shopping bags were designed with an outside pocket, which could be custom-printed, using the digital printing format on heat-transfer paper. Pocket design graphics and markings were formatted for heat transfer printing onto one tablecloth. Pocket-printed tablecloths were then added to the manufacturing process for cutting and sewing.

### **2.2 Creating the Manufacturing Model**

The tablecloths were collected from several hotel locations within the city of San Francisco. Approximately 800 tablecloths were sorted by size and stored at the sewing factory. When an order for a bag size was received, the tablecloths were low-stacked, cut, and prepared for line sewing. The newly-cut printed pockets were added to the sewing line. The PWSF team trained the sewing factory because the factory (as with all sewing factories) was organized to use new fabric on a roll (not individual sections of fabric-tablecloths), and to cut around stains or imperfections (rather than including them as usable fabric). The sewing line also needed support because fabric color shades of white and off white did not match and there were the minor stains on the cut pieces. Unlike the usual sewing manufacturing, the shopping bag design accepted color shade variance and stains in the production of the new shopping bags.

### **2.3 Completed Shopping Bags**

The production of the new shopping bags from discarded tablecloths was completed in approximately 2 weeks time. Numerous visits to the manufacturing factory were required to help train the cutters and sewers to use an existing textile product in production. The final pressing before shipment gave the bags a new appearance, similar to any sewn product using virgin textiles. To date, approximately 700 shopping bags have been manufactured and distributed, always customizing the heat-transfer printed graphics on the outside pocket.

### **3.0 Conclusions**

The desire to focus on opportunities to revalue discarded textile products, viewing them as a resource (Moore, 2012), hence reducing their disposal into landfills was achieved. The design and manufacture of new shopping bags, that included new, colorfast printed images, showed the capability of a cutting and sewing factory to use carefully sorted discarded textiles for new manufacturing purposes. Through the production process, the challenges of using discarded textile products were illuminated. Although the materials did not have an initial “cost” there was no monetary savings in the production process because of the required additional labor and training. The SF Table Cloth project addresses both the operational concerns associated with collecting and processing secondary supply chain textile products, and the strategic challenges associated with branding repurposed textile products to create viable and profitable business models.

### **3.1 Sorting and Storage Tablecloths – The Collection Process**

The initial decision process for the repurposing of secondary supply textiles, in this case discarded tablecloths requires greater research and visibility. It needs to be identified as a step or costed procedure in the manufacturing process. Businesses that intend to give away discarded textile products do not consider these products valuable, so they are often discarded in heaps, or folded and bundled as trash. . The sorting of the discarded tablecloths took many labor hours, as there was a wide range of dimensions in length and width, which necessitated the location of the woven label for size documentation. The basic hand or feel of the tablecloths was an additional sorting procedure, as some were deemed too stiff, coarse or damaged for repurposing into the shopping bags. Tablecloths for repurpose were folded after sorting, ready to be collected for storage or moved into the cut and sew process.

More effort to strategize the collection process is required to ensure that the donating business can discard the tablecloths, and other used textile products, in an organized manner. Storage is required, as the decisions for discarding and repurposing

do not occur on a planned timeline. The objective is to prepare the repurposed textiles for the cutting and sewing factory so the tablecloths could be stacked and sewn with greater efficiency.

### **3.2 Training the Cutting and Sewing Factory**

Manufacturing facilities in San Francisco, as in most locations, are trained for productivity in cutting new fabrics rolled on a tube, and sewing these materials into finished products. Working in a new manner, with wrinkled, stained, and folded fabrics is less efficient, and not preferred. As manufacturing is moving back to the San Francisco Bay area, factory space is in high demand, and there is little need or desire to take on new production processes. Currently under investigation are alternative cutting and sewing processes, outside the usual sewing factory. Charity organizations and correctional facilities in San Francisco currently have training programs and may be interested in the opportunity of the SF TableCloth project. If working with repurposed materials is not viewed as different, or difficult, but viewed as part of the manufacturing process, a new workforce will be recognized as part of the solution. One organization that has been approached is SFGoodwill, a charity organization. It receives donations of gently-used items that are resold in its stores, and uses the funds to support job training for those who lack skills and opportunities. The ultimate goal of SFGoodwill is to invest the revenue from retail sales into workforce development opportunities for those in need (Overman, 2008, DOL, 2011).

In 2007, Nick Graham, the founder of Joe Boxer, a famous men's underwear company, teamed up with SF Goodwill, "to fashionably recycle the 23 million pounds of clothing donated annually to Goodwill" (Rubin, 2007). The concept was to turn second-hand clothing from Goodwill, into remade fashion apparel. Using a new brand name "William Good" and promoting Mr. Graham's involvement, the William Good clothing was merchandised as a separate shop within the Goodwill store. The idea failed because the new styles were not clear or appreciated and the prices were deemed too high amidst the usual, low-priced charity store environment. In the city of San Francisco, the project intent was well-intended and a valuable lesson learned. In 2012, SFGoodwill engaged in an extensive re-branding campaign, focused on the premise that they re-value undervalued materials and undervalued people, with the motto "See the good and grow it," (conversation, Tim Murray, Marketing Director, SF Goodwill). Goodwill is supportive of our Tablecloth Project, understanding that a correctly identified revalue brand proposition will generate additional revenues by adding sales from a potential new customer and provide significant opportunities to generate new business.

### **3.3 Printing the Pockets**

The digital printing process does not use color separation (no screens required), and the use of disperse dye in the heat transfer process means the printed images are colorfast, using a polyester fiber content in excess of 50% (Cohen and Johnson 2010). Customization is maximized because the inkjet printing process does not require high production minimums, color, or image limitations. The pocket becomes a “canvas” on which companies have the ability to print logos, messages or other dye-fast graphic images of their choosing.

A challenge to the digital printing process for the secondary supply chain, tablecloths is the variation in fiber content, weave structure, shrinkage, stain or hole placement, and the hemmed edges (which must be cut off before printing). A separate digital calibration had to be made for each tablecloth, to maximize the quantity of pockets that would fit, because of the tablecloth size variation. Small holes, stains or fabric imperfections were over-printed, providing greater printing efficiency, with the sorting for pocket usage determined during cutting process.

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## **4.0 Further Opportunities**

### **4.1 New Design Concepts**

The SF TableCloth Project has identified the need for a revised supply chain, with greater emphasis on the responsibility of identification, sorting and storage of the secondary supply chain textile resource, as well as a manufacturing process that embraces the complexities of the materials. The design process, or choice of what to design also must be reconsidered based on an analysis of the initial production runs of the shopping bags. Possibly a product that requires less cutting and sewing, such as simply printing the tablecloth for resale, or cutting into placemats would be sufficient for some end users. It has been suggested that a laundry bag would be a more cost efficient product choice, with less competition from the multiple low cost shopping bag vendors responding to the San Francisco bag ordinance.

It has been suggested that some consumers may be hesitant to purchase what may be termed “used” textile products. As the rise and influence of LOHAS (Lifestyle of Health and Sustainability) consumers grows, our projection is that so will the demand for and growth of repurposed products (Blossom 2011), such as those made from the tablecloths. Further, the practice of buying new, using and throwing away does not work for young adult millennial shoppers (Vouchilas & Ulasewicz, 2013). It continues to be the combination of the social and environmental components of the new products made from repurposed materials that will create value for customers (Ulasewicz & Baugh, 2013).

The ultimate goal of this study was to understand what usable discarded textiles from the waste stream of the hospitality industry could be diverted as a consistent



supply for repurposing into new products. That goal was met, as there is a continual stream of tablecloths and napkins for use as a repurposed material, orders continue to be accepted for the current bag styles, and as the project gains more momentum, more orders are expected. Clearly there is value in what was considered waste. Tablecloths from the hospitality industry should be banned from landfill, and there should be an incentive given to those who repurpose them, and purchase them in their new design form. It is our responsibility to continue to promote the productive use of the resource, the secondary textile supply chain.

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