STRATEGY AND TOOLS FOR SUSTAINABLE TEXTILE PRODUCT DEVELOPMENT

by

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May 2014

Masters project submitted in partial fulfillment of the requirements for the Master of Environmental Management degree in the Nicholas School of the Environment of Duke University

2014
ABSTRACT

Corporate sustainability strategy, assessment, and reporting continue to become more sophisticated as organizations develop new implementation tools. However, the majority of environmental impacts are concentrated in large firms, as are the resources needed to address them. Consequently, many of these tools are not accessible to early-stage ventures interested in growing a sustainable business. Struck By Nature is a new company developing a line of interior textiles. Using qualitative analysis informed by primary industry research, existing sustainability tools and guidelines, and business case studies, a preliminary sustainability strategy was defined for the company. The strategy promotes an iterative approach to environmental assessment and reporting, and is based on life cycle assessment methodology and current sustainability best practices in the textile industry. Potential environmental impact areas—including water use, waste, and greenhouse gas emissions—are identified for distinct phases of the product value chain. The strategy employs a cradle-to-gate scope and prioritizes actions in the early stages of product development, with particular emphasis on proper materials sourcing and supplier facility assessment. The structure of the strategy and its recommendations, which include a supplier evaluation tool, is adaptable to other product-based small businesses. Future updates should address the social aspects of sustainability as well as environmental impacts in the downstream portion of Struck By Nature’s product value chain.
STRUCK BY NATURE. Sustainability Assessment & Strategy Outline.

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1 INTRODUCTION

1.1 BACKGROUND

Struck By Nature, LLC, is an early-stage company founded by Marjorie Pierson, a fine art photographer based in Durham, NC. Under the Struck By Nature (SBN) brand, Ms. Pierson intends to produce interior textile goods featuring designs inspired by her photography. Ms. Pierson’s images strive to capture the enduring beauty of fragile coastal landscapes, like those in North Carolina and in her native Louisiana. She has taught photography to students at Duke University’s Nicholas School of the Environment, emphasizing the medium as a persuasive tool for communicating environmental issues.

Although Ms. Pierson envisions many products being developed under the SBN brand—including curtains, wall-coverings, and table linens—she will focus on creating a line of upholstery fabrics for the company’s pilot product. Ms. Pierson intends for her photographs to “create an emotional response that opens minds to the value of conservation” (Marjorie Pierson, e-mail message to author, October 25, 2013), and would like SBN’s products to extend the reach of this message. As such, it is an important part of the company’s mission to have an explicit sustainability strategy to guide business growth.

1.2 PROBLEM

Struck By Nature needs a roadmap for sustainable product development that makes sense for an early-stage company with limited resources and expertise in the area. While there are a growing number of tools available to help companies operate more sustainably, most are built for larger companies with established products or services. The majority of the textile industry’s ecological
footprint\textsuperscript{1} hinges on the supply chains of large corporations generating billions of dollars in revenues each year. Understandably, current efforts to make the industry more sustainable are focused on these companies and their existing product value chains.\textsuperscript{2}

Most of these efforts have been concentrated in the apparel sector. Nike has been researching the environmental impacts of materials used in its products for over a decade. Combining environmental life cycle data with other research, the company created the Materials Sustainability Index (MSI), which offers a relative environmental performance rating of nearly 50 materials, many of which are common textile fibers (Nike Inc. 2012). The MSI has since been incorporated into the Higg Index, the most complete apparel-specific sustainability assessment tool created to date. Developed by the Sustainable Apparel Coalition and released in 2012, the first version of this index contains separate Brand, Product, and Facilities modules, which assess sustainability across the entire textile value chain, from materials sourcing to end-of-life scenarios like recycling and reuse (SAC 2013b).

Still, these resources are not particularly accessible to a nascent business like SBN, with no product or revenue. The module structure of the Higg Index assumes that a product, brand, and supplier facility already exist. Standards and reporting guidelines can serve as planning tools, but full implementation requires time and expertise that most small businesses do not have. Consultants and ecolabels are expensive, and the benefits of certification can be difficult to quantify. Finally, information and tools for non-apparel textiles are less developed, and almost exclusively tailored to fabric suppliers rather than brands or consumer-facing products. There is a clear need, then, for a set of foundational guidelines that can help SBN make use of existing resources and begin to build a sustainable business from the ground up.

\textsuperscript{1} A measure of how much area of biologically productive land and water an individual, population or activity requires to produce all the resources it consumes and to absorb the waste it generates, using prevailing technology and resource management practices (Global Footprint Network 2012).

\textsuperscript{2} The complete set of activities required to bring a valuable product or service to market (UNGC 2013).
1.3 VISION FOR SUSTAINABILITY

The vision of SBN's sustainability strategy is to build a business around innovative, renewable systems that facilitate profitable growth and improved resilience, despite greater competition for resources and uncertain environmental conditions.

1.4 OBJECTIVE

The goals of the project presented in this paper are to:

1. Create a preliminary sustainability strategy (years 1-3) for SBN that will guide sustainability decision-making across the value chain.

2. Develop a manufacturer environmental assessment tool that will help SBN evaluate the environmental performance of potential contract manufacturers.³

The sustainability strategy will guide environmental decision-making, and will provide a framework for future sustainability innovation by SBN and other value chain partners. SBN may also choose to use the document as an outward facing communications tool, clearly explaining the company's approach to environmental sustainability to its stakeholders. Specific content will focus on identifying critical sustainability impact areas and their distribution throughout the textile value chain, as well as outlining goals and associated actions designed to address these impact areas. The document will highlight key tools and resources that will be useful in executing the strategy recommendations. It will be limited to defining a preliminary roadmap for sustainable business development, and will not report on any actual business or product performance.

The manufacturer environmental assessment tool will complement the strategy document by providing specific questions to consider when selecting contract manufacturers. Answering these questions will allow SBN to perform a baseline analysis of the impact of manufacturer facility

³ A manufacturer that contracts with firms to deliver components or products.
operations on product sustainability, and to better understand how product design choices might alter these impacts. The tool will be a simplified version of the Higg Index Facilities Module, making it accessible to a small, early-stage business looking to achieve its initial sustainability goals at minimal cost.

1.5 INDUSTRY-ENVIRONMENT LANDSCAPE

In recent years, as efforts to put a price on carbon emissions in the U.S. have stalled, and as international climate summits have failed to produce actionable results (Hulse 2010), the private sector has taken charge of environmental innovation across many industries. This trend has been particularly strong with retail and consumer products companies. Many of the largest retailers and product manufacturers, such as Walmart and Nike, have taken measurable steps to become more sustainable across their value chains—engaging with suppliers, forming industry consortia, and sharing best practices (Golden, Subramanian and Zimmerman 2011). For example, Walmart has spearheaded the development of The Sustainability Consortium, an industry organization developing tools to help companies build sustainable supply chains, while Nike has worked with academia and other consultants on extensive materials research (Nike Inc. 2012). The size and leverage of these companies has allowed them to invest in innovation and to influence broader industry trends, spurring many of their competitors into action as well. Though these companies are now seen as corporate sustainability innovators, their businesses depend on vast networks of suppliers and diverse customers, and implementing change is an incremental process. SBN has an opportunity to build a business that is optimized for sustainability from Day 1, designed to uncover opportunities for improved environmental performance throughout the value chain.

The Brundtland Commission’s 1987 report, Our Common Future, defines sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (41). The report helped establish a conceptual framework for
environmental decision-making and informed the development of standards for defining, measuring, and validating sustainability in different business contexts.

While social and environmental responsibility have quickly become part of the marketing lexicon, adoption of sustainability measurement and reporting standards has been less universal. However, many tools and guidelines have been developed to help companies implement sustainability initiatives and report their progress to stakeholders with accuracy, clarity, and comparability. Several of these systems have gained wide acceptance due to their applicability across different industries, organization sizes, and political boundaries:

- The United Nations Global Compact (UNGC) is an international corporate sustainability initiative encouraging the growth of responsible businesses through the adoption of ten high-level sustainability principles. Participation in the UNGC requires companies to incorporate these principles into the highest levels of governance and to communicate publicly the ways in which the principles are implemented (through annual reports or separate sustainability reports) (UNGC n.d.).

- The International Organization for Standardization (ISO) 14000 family of standards establishes international standards for environmental management, including Life Cycle Assessment (ISO 14040) and Environmental Product Declaration (ISO 14025). Through third-party verification of adherence to these standards, a company can demonstrate that it is taking concrete steps to address its environmental impacts (ISO n.d. [a]).

- The Global Reporting Initiative (GRI) is a non-profit that develops and maintains widely accepted standards for firm-level sustainability reporting. The GRI framework helps businesses identify and prioritize environmental impacts and determine what information is relevant for reporting (GRI 2013b).

\[\text{4 In addition to environmental sustainability, the ten UNGC principles cover human rights, labor, and anti-corruption topics. See appendix A for a list of all the principles.}\]
1.6 SUSTAINABILITY IN THE TEXTILE INDUSTRY

A textile is a flexible material typically made by weaving or knitting yarns, which are spun from individual fibers to create much longer strands. Textiles that have yet to be made into a finished product are often referred to as fabrics (The Textile Museum n.d., NCSU College of Textiles n.d.). The mechanization and automation of textile manufacturing has allowed for higher production volumes and greater quality control, but it has also increased the complexity of the product system and made sustainability assessment challenging. The development of manufactured cellulosic and synthetic fibers\(^5\) has also introduced new sustainability challenges across the textile value chain, from raw material feedstocks to manufacturing to product reuse and disposal (Organic Exchange n.d.).

![Fibers Table]

**FIGURE 1. NATURAL AND SYNTHETIC FIBERS (LENZING GROUP 2013).**

As consumers become more aware of the environmental impacts of textile products, many companies have recognized an opportunity to become sustainability leaders while improving the

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\(^5\) Manufactured cellulosic fibers are man-made fibers made from the plant material cellulose, often in the form of wood pulp, and include such fibers as Rayon and Tencel. Synthetic fibers are extruded from petroleum-based chemicals and include nylon and polyester (Lenzing Group 2013).
efficiency of their operations and the quality of their products. These companies include apparel industry leaders like Patagonia, Nike, and Adidas, who have partnered with the Outdoor Industry Association (OIA), the Sustainable Apparel Coalition (SAC), and other groups dedicated to improving the sustainability of the industry as a whole (Golden, Subramanian and Zimmerman 2011). The OIA and SAC are working to establish industry-specific tools for assessing the sustainability of product designs, materials, facilities, and manufacturing processes, as well as product care requirements and end-of-life scenarios (OIA n.d. [b]). Though geared toward the apparel industry specifically, there is much to learn from these efforts for all types of textile brands.

For both apparel and other textiles, the use of harmful chemicals in textile processing is a major concern. Organizations like OEKO-TEX and Bluesign have developed certification programs that weigh this issue heavily (OEKO-TEX Association n.d. [a], Bluesign n.d.). Other groups, like the Cradle to Cradle Products Innovation Institute, provide consulting services and environmental certification programs to help manufacturers and brands create and promote more sustainable products (C2C 2013). All of these existing resources are useful in defining and executing a sustainability strategy.
2 TOOLS AND METHODS

In this section, we explain several sustainability strategy models that were considered during the development of SBN’s strategy. We then discuss the research methods used to identify SBN’s significant environmental impacts and the appropriate goals and actions for addressing them.

2.1 CONCEPTUAL MODELS

In defining an approach to sustainability strategy development, several conceptual frameworks helped identify the business processes that this initial strategy effort should prioritize. Used together, these models offer foundational guidelines that can be used to build a more complete sustainability infrastructure as the business grows.

UNITED NATIONS GLOBAL COMPACT MANAGEMENT MODEL

The UNGC Management Model (fig. 2) helped define the scope of this project and offered a blueprint for integrating future sustainability efforts into business management and operations. The model is designed to be a six-step iterative process for guiding the development, implementation, and disclosure of sustainable business practices (UNGC and Deloitte 2010).

Struck By Nature is currently beginning the first iteration of Steps 1 through 3 of the UNGC model, defined as follows (UNGC and Deloitte 2010):

Step 1. Leadership commitment to mainstream the Global Compact principles into strategies and operations and to take action in support of broader UN goals, in a transparent way.

Step 2. Assess significant environmental impacts, opportunities, and risks.

Step 3. Define strategies, resources, and tools to address them.

By engaging in this project, the company has demonstrated an early commitment to pursuing sustainability (Step 1). The scope of the project itself encompasses the initial execution of Steps 2 and 3.
The goals and actions outlined in section 3.3 are the results of this process, and are intended to help SBN execute the rest of the management model (Steps 4, 5, and 6). Successive iterations of the model will fill in the gaps to build a more robust sustainability strategy and management system. A continuous evaluation process will be essential as operations become more complex and conditions change both internally and externally.

Details on how the Global Compact Management Model is being employed by participating companies can be found at http://www.unglobalcompact.org/AboutTheGC.
GLOBAL REPORTING INITIATIVE CONTENT GUIDELINES

The GRI reporting structure is designed to facilitate the disclosure of relevant sustainability information by businesses with an existing product or service, but it is also useful as a strategic planning tool. We used the Implementation Manual of the GRI to help define and prioritize the objectives of SBN's sustainability strategy.

The GRI General Standard Disclosure categories describe in detail the type of information that should be included in a fully compliant sustainability report (GRI 2013a). The following General Standard Disclosure categories were reviewed as part of research for this report:

- Strategy and Analysis
- Organizational Profile
- Material Aspects and Boundaries
- Governance

Going a step further, the Specific Standard Disclosures identify appropriate indicators for measuring and reporting company performance across the General Standard Disclosure categories. Particularly important at this stage is performance relating to what the GRI calls “material aspects”—significant environmental impact areas that are first called out in a company’s General Standard Disclosures (GRI 2013a).

SBN's significant environmental impact areas were identified by first considering a range of topics covering the company’s potential influence within a global sustainability context. These topics were drawn from the GRI's list of material aspect categories; the Higg Index, Nike MSI, and OIA EcoIndex (OIA n.d. [a]); a broader literature review; and an informal industry survey, including textile industry sustainability reports and interviews with industry experts. Table 1 lists these potential impact categories as they are defined by various indices.
Global Reporting Initiative (GRI) Environmental Aspects

Materials, energy, water, biodiversity, emissions, effluents and waste, products and services, compliance, transport, overall, supplier environmental assessment, environmental grievance mechanisms

Higg Index Facilities Module

Environmental management system or program; energy use and greenhouse gas emissions; water use, wastewater/effluent, emissions to air, waste management; pollution prevention/hazardous and potentially hazardous substances

Outdoor Industry Association (OIA) EcoIndex

Energy use and greenhouse gas emissions; water, waste, land use intensity, biodiversity, chemistry/toxics (people), chemistry/toxics (environment)

Materials Sustainability Index (MSI)

Chemistry, energy and greenhouse gas intensity, water and land use intensity, physical waste

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<th>TABLE 1. ENVIRONMENTAL IMPACT CATEGORIES INCLUDED IN VARIOUS REPORTING AND ASSESSMENT TOOLS (GRI 2013a, SAC 2012b, OIA N.D. [A], NIKE INC. 2012).</th>
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Potential significant impacts for SBN and likely stakeholders were prioritized using a methodology similar to that found in the GRI Implementation Manual (fig. 3). The results presented in section 3.2 are the product of the first two steps of this methodology: Identification and Prioritization.

Using these broad guidelines, qualitative analysis—in the form of product design research, interviews with industry experts, and review of textile environmental impact assessments (EIA) and life cycle assessments (LCA)—was performed with the following criteria, as outlined by the GRI (GRI 2013a), in mind:

- The likelihood of an impact;
- The severity of an impact;
- The likelihood of risks or opportunities arising from an impact;

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6 Impacts are frequently referred to as "Aspects" in GRI documentation.
• How critical the impact is for the long-term performance of the organization;
• The opportunity for the organization to grow or gain advantage from the impact.

The UN Global Compact Management Model recommends a similar analysis, encouraging participating companies to evaluate “risks and opportunities—in financial and extra-financial terms—as well as the impact of its operations and activities on the issue areas” (UNGC and Deloitte 2010, 12).

Several themes were extracted from the GRI criteria. First, the probability and potential magnitude of an impact determine its significance and the opportunities and risks associated with it. Second, a company’s effective response to impacts can present an opportunity to gain a competitive advantage or point of differentiation in the marketplace. Conversely, impacts can pose a threat to the long-term sustainability of a business if not addressed. Both the GRI and UNGC recommend using a combination of qualitative and quantitative assessment to identify the most significant impacts and the associated opportunities and risks generated by a business. Since SBN has no
product, revenue, or operations data, quantitative assessment was not an option in this case. The process of creating a preliminary strategy for SBN is prospective, and identifying critical action areas involves some degree of uncertainty and subjectivity (GRI 2013a).

2.2 RESEARCH METHODS

Using the examples above as conceptual models for strategy development, potential environmental impact areas were prioritized and appropriate goals and actions were identified using:

- A literature review;
- Local industry interviews; and
- Analysis of existing sustainability assessment tools.

LITERATURE REVIEW

A review of the literature produced two primary outcomes: 1) an understanding of the textile value chain and textile manufacturing processes, and 2) a comprehensive survey of existing research and practice in sustainable product development and supply chain management, both for consumer products generally and textile products specifically. Among the topics reviewed were:

- Natural and synthetic fiber production;
- Textile manufacturing;
- Textile environmental impact assessment and life cycle assessment;
- Sustainability management and reporting guidelines;
- Sustainability strategy case studies;
- Product certification standards.

See appendix B for a more detailed list of topics and their sources.
LOCAL INDUSTRY INTERVIEWS

A key insight of the literature review process was the identification of digital textile printing as the most likely technology for producing Struck By Nature fabric designs. Traditional screen printing methods cannot produce the necessary range of colors and image detail required by the photographic imagery that SBN intends to use in its designs (O Ecotextiles 2012). Digital textile printing is a relatively new technology that functions in much the same way as large-format printing on paper. The likely use of this technology by Struck By Nature influenced which organizations and individuals were consulted.

Though globalization has impacted the historically vibrant North Carolina textile industry (Duke CGGC 2007), a new generation of local textile products and research has taken hold in the region. The organizations listed in table 2 were consulted as part of the research process for this project.

<table>
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<th>ORGANIZATION</th>
<th>RELEVANCE TO SBN</th>
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<tr>
<td>NCSU College of Textiles, Digital Design Lab</td>
<td>Digital textile design and manufacturing research</td>
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<tr>
<td>Spoonflower</td>
<td>Digital textile printing</td>
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<tr>
<td>Cotton Inc.</td>
<td>Cotton production research and environmental life cycle assessment</td>
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<td>TC²</td>
<td>Digital textile technology research</td>
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<tr>
<td>Textile Exchange</td>
<td>Textile value chain sustainability resources and education</td>
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<tr>
<td>Cradle to Cradle Products Innovation Institute</td>
<td>Product sustainability consulting and certification; certified textile supplier directory</td>
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<tr>
<td>Advanced Digital Textiles</td>
<td>Digital textile printing</td>
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**TABLE 2. ORGANIZATIONS CONSULTED DURING PROJECT RESEARCH.**
North Carolina State University (NCSU) College of Textiles is the largest textile research organization in the nation (Wake County Economic Development n.d.). The school’s faculty specialize in everything from polymer chemistry to textile design and product management. The Digital Design Lab at the College is working with the latest technology to develop new products using digital textile printing. Recent advances in digital printing technology have spawned businesses dedicated to creating digitally printed fabrics. One of these businesses, Spoonflower Inc., is located near Struck By Nature in Durham, NC. Tours of the facilities and meetings with staff at NCSU (including the Digital Design Lab and fabric prototyping facilities) and at Spoonflower provided an opportunity to learn about the textile production process and how digital printing can influence sustainability.

Several industry organizations are also located in the Research Triangle area, including Cotton Incorporated and TC², a textile research and education organization focused on emerging digital technologies. Conversations with these industry experts brought valuable insight into current research, design and market trends, as well as the current state of textile technology.

Lastly, a day-long conference dedicated exclusively to sustainability in the textile industry was held at NCSU in May 2013. Textile Exchange, a non-profit organization “committed to the responsible expansion of textile sustainability across the global textile value chain” (Textile Exchange n.d.), facilitated the event, titled Evolving Textiles. Among the attendees were textile scientists, representatives from industry groups like Cotton Inc., and industry professionals from companies representing all parts of the textile value chain. At this conference, particular attention was paid to developing an overall approach to sustainability within a company, and to using the Higg Index to make informed decisions and achieve specific sustainability goals.
ANALYSIS OF EXISTING ASSESSMENT TOOLS

A review of existing textile sustainability assessment tools and associated documentation\(^7\) further aided the process of identifying significant environmental impact areas and specific goals and actions. It also informed development of the manufacturer facility assessment tool intended for internal use by SBN and its contract manufacturers. Both qualitative and quantitative tools were reviewed, and elements of each were considered in overall strategy development. The MSI and the Higg Index served as the primary models for developing Struck By Nature's own sustainability assessment strategy.

Along with these inward-facing assessment and decision-making tools, textile-specific environmental certification systems were also studied. These programs (table 3) are meant to help companies verify internal sustainability efforts and communicate their results to the public. They attempt to standardize and validate sustainability claims for selected aspects of the product life cycle and brand operations. Analysis of these certification and eco-labeling programs was used to identify relevant impact areas for specific textile product types, and to evaluate opportunities for SBN product certification.

\(^{7}\) Including research methods and development approach, training materials, and user help documentation.
OEKO-TEX. A European organization that develops and administers textile certification programs for clothing and other non-apparel textiles; primarily focused on addressing the use of harmful chemical substances; specific certifications include OEKO-TEX 100 Standard and Sustainable Textile Production (STeP); applicable to materials and products at all stages of the value chain (raw materials, intermediate, and end products).
https://www.oeko-tex.com/en/manufacturers/manufacturers.xhtml

Global Organic Textile Standard (GOTS). A worldwide standard for textile processing of organic fibers, GOTS uses ecological and social criteria that cover the entire textile supply chain.

Bluesign. A certification system focused on resource efficiency, emissions to air and water, and consumer health and safety; applicable both to brands and manufacturers, as well as chemical suppliers, but geared toward larger industry players.
http://www.bluesign.com/industry

Better Cotton Initiative (BCI). An industry-supported organization that promotes and maintains a set of holistic standards for the cotton supply chain, covering environmental, social, and economic sustainability.
http://bettercotton.org/about-better-cotton/better-cotton-standard-system/

Cradle to Cradle (C2C) Certified. A certification system that guides product designers and manufacturers toward creating products that use safe and reusable materials, use clean and renewable energy, protect water supplies, and advance social and environmental justice.
http://www.c2ccertified.org

| TABLE 3. SELECTED TEXTILE PRODUCT ENVIRONMENTAL CERTIFICATIONS (OEKO-TEX ASSOCIATION N.D. [B], GOTS 2013, BLUESIGN N.D., BETTER COTTON INITIATIVE N.D., C2C 2013). |
3 RESULTS

3.1 THE TEXTILE VALUE CHAIN

The first research outcome was a detailed understanding of the textile value chain. The value chain includes the upstream activities of suppliers and subcontractors, as well as downstream activities, like distribution and retail, over which an organization may have varying levels of control (UNGC 2013). Each of these activities is itself influenced by many other value chain systems. In the environmental LCA of any product or service, it is important to specify those activities that will be included in the assessment and those that will not. This process, which defines the project scope and determines which contributing activities to include in the study (called setting the system boundaries), is addressed by the LCA guidelines contained in ISO 14040 (Baumann and Tillman 2004).

Figure 4 depicts SBN's value chain. Research for this project, leading to the prioritization of impact areas and subsequent development of strategic goals, was purposely limited to value chain activities occurring prior to the point at which the product is ready to be packaged and distributed. This includes upstream activities, from fiber sourcing to fabric finishing, as well as SBN-controlled processes like fabric printing. The decision to use this scope, known as cradle-to-gate in LCA terminology (Baumann and Tillman 2004), was driven by several factors. First, existing textile sustainability assessment tools are weighted toward these life cycle phases, over which brands have greater control than downstream phases like product use and disposal (SAC 2012a, Bluesign n.d.). For apparel products, the product use phase contains the majority of overall environmental impacts due to laundry requirements (Laitala and Boks 2012), but these impacts are likely to be substantially smaller for upholstery. Finally, it is more difficult at this stage in business planning to evaluate downstream impacts, which depend more heavily on the specifics of business model development and logistics.
3.2 ENVIRONMENTAL IMPACT AREAS

The implementation of UNGC and GRI impact assessment methodologies, along with the three-part research approach described in section 2.2, led to the identification of environmental impact areas that are expected to be significant in the context of SBN’s operations. Selected from the initial topic list (table 1), these impact areas are projected to be material to SBN and to require explicit action.

UPTREAM IMPACT AREAS

MATERIALS

Most upstream impacts are embodied in the finished materials—primarily fabrics or fabric blends—that SBN will purchase from its suppliers. This makes materials selection a critical point of influence for the environmental sustainability of SBN products. Significant environmental impacts of these materials were deemed to fall under five main headings: water, energy and emissions,
waste, land use, and chemistry. For natural fibers, impacts stem from the agricultural production of fibers, raw materials processing, fabric manufacture and post-processing. For synthetics, they result from the extraction and refining of petroleum products and their manufacture into fibers and fabrics (NCSU College of Textiles n.d., Organic Exchange n.d.).

Significant materials impact areas:

- **Water.** Globally, agriculture consumes far more water than any other sector (UNEP n.d.), and SBN’s fabric sourcing will have significant upstream impacts on water consumption. The cultivation of natural fibers—particularly cotton, at 2.74 m$^3$ of water used per kilogram of fiber produced—is water-intensive (Cotton Inc. 2011). The production of synthetic fibers uses less water but has more significant impacts in other areas (figure 6).

- **Land Use.** Impacts on land use are again largely dictated by materials choices made in the product design phase, and the choice of natural or synthetic fibers will have significant implications (SAC 2013a). Supplier facilities and contract manufacturers have their own impacts, which should be assessed via separate facility evaluations. While natural fibers require substantial land for agriculture or pasture, synthetic fibers made from hydrocarbons require only the land area needed for raw material extraction. However, synthetic fibers are produced from non-renewable petroleum products and present different challenges in terms of energy consumption and reuse/disposal. Managing land use impacts will require the integration of product design considerations, such as fabric hand$^8$ and color fastness, with environmental performance.

- **Chemistry.** Impacts in this area come from the use of chemical substances in fiber refinement and fabric finishing. Environmental performance will be influenced by the type and quantity of chemicals used, how they are applied, and the fate of chemical wastes. The

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$^8$The quality of the fabric as perceived through the sense of touch.
discharge of hazardous substances into the environment—typically as part of water effluent—is the primary concern (Mead 2013). Because chemical finishes are intended to improve product performance, there can be trade-offs between environmental impacts from chemistry and impacts in other areas, like product maintenance or disposal. For example, treatments that improve durability and stain resistance can help a product last longer and require less cleaning, conserving resources but increasing risks associated with the use of hazardous chemicals. Textile chemistry is currently a major focus of sustainability programs in the industry.9

- **Waste.** At each step in the fabric production process, some amount of physical waste is produced. Relative comparisons of the quantity of waste produced for different fabric types are captured in the MSI (SAC 2013a).

- **Energy/ emissions.** Every step in the fabric production process consumes some amount of energy and emits an associated quantity of greenhouse gases (GHGs). Each impact area identified here contributes to the overall energy efficiency of the fabric production process. While energy use per unit of fabric is dependent on the type of fabric being considered, regional differences in climate and/or energy mix,10 as well as energy efficiency and renewable energy measures implemented by fabric suppliers, can significantly affect the magnitude of this impact category.

**SUPPLIER PRACTICES**

As mentioned above, differences in fabric supplier practices can mean that the same fabric type can have different embodied impacts depending on where it is sourced from. The MSI provides a high-level environmental comparison of different fabrics, but actual impacts can vary substantially

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9 Including Bluesign, OEKO-TEX, and Cradle to Cradle certifications; Roadmap to Zero Discharge of Hazardous Chemicals program; Evolving Textiles conference.

10 The types and proportional composition of energy generation supplying power to the electrical grid in a given region.
across different supply chains and manufacturing facilities. For this reason, the policies and practices in place at supplier facilities are a significant determinant of product sustainability. After a producer chooses a material, an environmental assessment of the supplier is the next critical step in ensuring upstream sustainability.

SBN OPERATIONS IMPACT AREAS

MANUFACTURER PRACTICES

The primary process in this portion of the value chain will be the digital printing of fabrics that SBN purchases from its suppliers. SBN will work directly with printers to achieve the desired results, which will depend heavily on product design decisions. This gives SBN more direct control over environmental impacts here compared to upstream value chain phases. For this reason, it makes sense to develop a more customized approach to environmental management within this phase. Impacts are almost exclusively dependent on the operational practices employed by SBN's contract manufacturers, namely digital textile printers. The following key impact areas were identified primarily through site visits to printing facilities and interviews with academics and practitioners in the field of digital textile technology:

- **Energy and Emissions.** The burning of fossil fuels (coal, natural gas, or oil) to generate electricity emits carbon dioxide and other GHGs that cause climate change. A standard comparison of the embodied energy and emissions in various fabric materials is included in the MSI, but the carbon footprint\(^\text{11}\) of SBN's product will also depend on the type (renewable or non-renewable) and quantity of energy that powers fabric printing facilities and other contractors employed by SBN. In addition to the energy required to operate the facility itself, energy consuming processes will include the operation of printers and heat...

\(^{11}\) In ecological footprint studies, this term is equivalent to CO\(_2\) area: the demand on biocapacity required to sequester (through photosynthesis) the carbon dioxide emissions from fossil fuel combustion (Global Footprint Network 2012).
fixation machines used to fix or permanently bond the ink to the fabric (Kerry King, e-mail message to author, May 2, 2013). This impact area therefore depends heavily on the printing facilities SBN chooses to work with and their willingness to engage with SBN to improve results.

• *Waste.* Material efficiency is the ratio of the weight of a given material in a finished product to the total weight of that material consumed in making the product, including waste (SAC 2012a). Any material used in the SBN value chain that does not become part of a product, or that cannot be reused at the end of the product’s life, represents a wasted material resource and lost profit (Nike, Inc. 2012). The set of materials used at various points in the SBN value chain (excluding packaging and other downstream phases) includes fiber, yarn, fabric, inks and dyes, and other chemical substances used in fabric finishing.

Fabric suppliers will dictate the efficiency with which fibers become fabric, but SBN’s own product design and cooperation with contract manufacturers in the printing, cutting, and sewing stages will influence overall fabric utilization (SAC 2012a). This metric, sometimes called marker efficiency\(^\text{12}\) in the apparel industry, is included in the MSI and Higg Index. Creating a design that makes efficient use of fabric yardage and accommodates the finished fabric size can significantly reduce waste.

Digital textile printing is well suited for high-flexibility, low-volume production (Kerry King, pers. comm.). This is relevant because SBN’s designs will use photography, with continuous color gradients and complex patterns, and because its initial production runs will be relatively low in volume. In contrast, traditional screen printing methods can only accommodate a limited number of colors and design complexity, and they can be prohibitively expensive for anything but very large textile printing runs (O Ecotextiles 2012). Screen printing requires large amounts of water, both to

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\(^{12}\) Marker efficiency refers to the arrangement of patterns on the marker plan, a thin piece of paper used in printing setup that dictates fabric utilization rates.
remove pigment from the screens between uses, and for chemical wet processing to fix the print to the fabric. Because no water is used in digital printing, no wastewater or effluent is produced (Kerry King, pers. comm.). For these reasons, water and chemistry were not deemed to be significant impact areas in this portion of the product value chain.

ALL VALUE CHAIN PHASES

MANAGEMENT AND GOVERNANCE

The magnitude of environmental impacts throughout the SBN value chain will depend on the efficacy of the company’s system of organizational management and governance. Failure to include an explicit approach to sustainability in this system, including environmental assessment and reporting, will leave SBN without the ability to react to opportunities and risks associated with each impact area. Over the long term, more robust tools will be required to effectively measure and improve the company’s environmental performance.

3.3 GOALS AND ACTIONS

Based on the environmental impacts identified above, the following goals and related actions are recommended:

NEAR-TERM

GOALS

1. Make sustainability a deciding factor in materials selection.

2. Make sustainability a deciding factor in supplier selection.

ACTIONS

Goals 1 and 2 address processes that occur in the upstream portion of the SBN value chain and can be achieved by addressing the corresponding environmental impact areas for activities in those phases: water, land use, chemistry, waste, and energy/emissions. Specifically, actions should target
impacts embodied in fabric materials as well as those associated with supplier practices and facilities. We recommend these actions:

Assess Materials. A recent push by the apparel industry to expand the use of sustainable textile materials has increased the availability of environmentally certified fabrics (Gill 2013). As a startup, SBN lacks the capacity to perform its own materials analyses and must take advantage of the existing research and development that fabric certification represents. Though many existing tools are inaccessible to product developers looking for straightforward guidance on choices that affect product sustainability, the MSI has succeeded in communicating the information it contains in a way that is easy for anyone to understand.

FIGURE 5. “MAKING” MOBILE APP BY NIKE (NIKE, INC. N.D.).

The most user-friendly access to MSI data is through the Making mobile application recently released by Nike (figure 5). The app makes the sustainability rating of any material contained in the Index accessible in seconds, allowing the user to quickly explore materials performance across the MSI’s four primary impact categories (Nike Inc. 2012). The app also includes adjustments for
environmental attributes like recycled and organic content. These relative performance ratings can then be compared with those of other materials being considered in product design. Figure 6 gives a detailed look at the factors considered in the MSI scoring of two fabrics. A new interface for exploring MSI data was also recently published at http://msi.apparelcoalition.org. In addition, the SAC has released an online tool called the Rapid Design Module, which lets the user explore the impacts of various design decisions based on Higg Index Product Module criteria.

![Figure 6. Environmental trade-offs between cotton and polyester](image)

**FIGURE 6. ENVIRONMENTAL TRADE-OFFS BETWEEN COTTON AND POLYESTER (NIKE INC. 2012).**

The MSI might help SBN choose cotton over polyester, for example, but not all cotton is created equal. To answer the question of which cotton to choose, SBN will need to leverage the growing ecosystem of environmental certifications (table 2). Which certification SBN uses to verify the environmental integrity of its fabrics will depend on the type of fabric material being sourced.
Assess Supplier Facilities. A separate assessment of supplier practices is necessary in order for the company to make informed decisions about materials sourcing. For example, the overall environmental impact of one GOTS-certified fabric may differ from that of another because its practices are unique to the facility in which the fabric is produced. These practices may not be directly related to the manufacture of the fabric itself or captured in GOTS metrics. Carefully vetting supplier facilities is therefore another crucial aspect of achieving Goals 1 and 2 (page 25). The following criteria will ensure that suppliers meet a baseline environmental performance in the operation of their facilities:

- Compliance with ISO 14001, which sets the criteria for an environmental management system.
- Use of a Restricted Substance List (RSL) for hazardous chemicals management.
- Prior completion of the Higg Index Facilities Module, for suppliers that also produce fabrics for apparel.

MEDIUM-TERM
GOALS

3. Measure and evaluate product-level environmental data.

4. Communicate the environmental performance of products clearly, accurately, and comparably.

ACTIONS

Achieving Goals 3 and 4 will require actions that address value chain activities directly controlled by SBN. Collecting environmental data at the product level requires full engagement with SBN’s contract manufacturers by means of supplier facility assessment. Understanding and communicating data derived from such assessment requires the identification and development of measurable product performance variables. The following actions are recommended:
Engage the Manufacturer. In the same way that supplier facility performance is important in choosing the source of materials, understanding the manufacturing practices of SBN’s contractors—specifically, digital textile printers—is essential for evaluating the overall environmental performance of SBN’s product.

Completing an assessment with the Higg Index, as well as many other sustainability decision-making tools, requires substantial resources and expertise from the various value chain stakeholders, including facility operators. Initially, manufacturers with whom SBN works with directly will be small to medium-sized businesses and will likely be unable to provide the granular information that tools like the Higg Index require. Moreover, demanding compliance with ISO environmental management standards might leave SBN without a viable printing option, since the number of digital textile printers is currently limited. For these reasons, we created a simplified facility assessment tool (figure 7) to allow for early-stage engagement with contract manufacturers and to initiate movement toward more rigorous standards. The topics addressed in this tool were derived primarily from the Higg Index Facilities Module (SAC 2012b). It is divided into the following sections:

- Environmental management system;
- Energy use and greenhouse gas emissions;
- Water use;
- Wastewater/effluent;
- Emissions to air;
- Waste management; and
- Pollution prevention/hazardous substances.
<table>
<thead>
<tr>
<th>1 Environmental management system</th>
<th>2 Energy use and greenhouse gas (GHG) emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Do you know what this site’s environmental impacts are (positive or negative)?</strong></td>
<td><strong>Does this site track and measure, at least annually, energy use from all sources, including energy used on-site (direct) and purchased energy (indirect)?</strong></td>
</tr>
<tr>
<td>Score</td>
<td>Score</td>
</tr>
<tr>
<td>Select...</td>
<td>Select...</td>
</tr>
</tbody>
</table>

If yes, answer the following questions:

What are this site’s most significant impacts? List up to 10.

Are one or more members of management responsible for coordinating this site’s environmental management activities?

If yes, answer the following questions:
List the name(s) and title(s) of all people responsible.

Does this site have a program or system for monitoring compliance, regulations, and permits, for itself and all sub-contractors processing products and contractors operating on the facility’s property?

If yes, answer the following questions:
What environmental areas does this site have permits for (e.g., air emissions, wastewater, etc.)?

If requested, are you able to provide copies of these permits?

Has the government cited this facility for being out of compliance any legal requirements/permits any time in the past 12 months? If so, please describe the citations.

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**FIGURE 7. SCREENSHOT OF CUSTOM FACILITY ASSESSMENT TOOL CREATED FOR SBN.**
Track Product Performance. In addition to assessing facilities, establishing product performance metrics is a key part of product-level sustainability evaluation. Initially, it is recommended that SBN gather the product-level data outlined in table 4 from its contract manufacturers. It should work toward more complete data collection based on the Environmental category of the Specific Standard Disclosures in Section 4 of the GRI Implementation Manual (GRI 2013a), with the goal of eventually including the data in firm-level reporting that complies with GRI standards.

<table>
<thead>
<tr>
<th>IMPACT CATEGORY</th>
<th>METRICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials (Upstream)</td>
<td>Percent renewable inputs</td>
</tr>
<tr>
<td></td>
<td>Percent recycled inputs</td>
</tr>
<tr>
<td>Energy</td>
<td>Total consumption within SBN operational phases</td>
</tr>
<tr>
<td></td>
<td>Energy intensity ratio&lt;sup&gt;13&lt;/sup&gt;</td>
</tr>
<tr>
<td>Waste</td>
<td>Total weight of waste by type and disposal method</td>
</tr>
<tr>
<td></td>
<td>• Hazardous or non-hazardous</td>
</tr>
<tr>
<td></td>
<td>• Reuse, recycling, composting, recovery (including energy recovery),</td>
</tr>
<tr>
<td></td>
<td>incineration, landfill, on-site storage, other</td>
</tr>
</tbody>
</table>

TABLE 4. BASIC PRODUCT PERFORMANCE METRICS FOR SBN’S SIGNIFICANT ENVIRONMENTAL IMPACT AREAS (GRI 2013a).

A partial calculation of energy intensity, based on the energy required by one digital textile printer model, demonstrates how this type of problem might be approached (DigiFab n.d., Advanced Digital Textiles n.d.):

<sup>13</sup> Energy intensity expresses the energy consumed per unit of activity, output, or any other organization-specific metric (GRI 2013); kWh per kilogram of fabric, for example.
1. **StampaJet Digital Textile Plotter:**
   - 3 kW working power consumption
   - 39 linear yds/hr
   - $3 \text{ kW} \div 39 \text{ yds/hr} = 0.077 \text{ kWh/yd}$

2. **Standard Cotton Duck Fabric:**
   - 58.5” print width
   - 0.20 kg/yd$^2$
   - 1 linear yd. @ 58.5” width = 1.625 yd$^2$
   - $1.625 \text{ yd}^2 \times 0.20 \text{ kg/yd}^2 = 0.325 \text{ kg fabric}

3. **Energy Intensity**
   - $0.077 \text{ kWh} \div 0.325 \text{ kg} = 0.24 \text{ kWh/kg fabric}$

*Prepare Environmental Product Declaration.* The ISO 14025 standard establishes guidelines for product-level environmental reporting through the Environmental Product Declaration (EPD) (ISO n.d. [b]). The EPD system goes beyond the mere *accounting* of environmental impacts in terms of energy intensity, carbon emissions, water consumption or effluent generation—known as life-cycle inventory analysis in LCA—and defines how various impacts should be *characterized*, in terms of their potential contributions to global warming, air pollution, or eutrophication, for example (Baumann and Tillman 2004). Preparation of an EPD involves substantial product-level LCA expertise and will likely require an outside consultant. It is therefore recommended as the last of the medium-term measurement and reporting actions.
LONG-TERM

GOALS


6. Achieve product certification.

ACTIONS

Execution of the recommended actions for achieving Goals 1 through 4 above will complete the final three steps of the UNGC Management Model: Implement, Measure, and Communicate (UNGC and Deloitte 2010). The final two goals are meant to ensure that successive iterations of the model occur. Achieving Goal 5 requires a system of management and organizational governance that emphasizes iterative evaluation processes and continuous improvement. Goal 6 subjects the environmental performance of SBN products to third-party review, provides a means for identifying environmental best-practices, and offers a simple way to communicate product sustainability to customers.

*Establish Regular Sustainability Reporting.* Maintaining a sustainability reporting system requires continuous performance monitoring so that progress that occurs during each reporting period can be recorded. Along with fulfilment of the previous goals, the following steps can help SBN build a more robust environmental assessment approach and eventually a system for regular sustainability reporting:

1. *Review product and firm performance data annually* (see Goal 3), re-prioritize impact areas, and update goals and actions.

2. *Define quantitative thresholds* for the materiality (significance) of environmental impacts. Due to the prospective nature of this report, only qualitative research was used in the prioritization of impact areas. As SBN begins to source materials and manufacture its product(s), it can incorporate quantitative metrics into the prioritization process.
3. **Conduct firm-level environmental impact assessment.** SBN intends to develop additional products as its business grows. When that happens, product-level sustainability measures will no longer be sufficient for implementing the company’s environmental strategies. Performing firm-level impact assessment will give SBN the insight it needs to update its sustainability strategies to fit a more complex business. The following steps are recommended for a more complete firm-level assessment:

      - B Corps are businesses that have achieved certain standards for environmental and social sustainability, as defined by B Lab. The B Impact Assessment is a way for businesses to measure their current performance against these standards.

   b. **Assess supplier facilities and brand operations using the Higg Index.**
      - If the Higg Index expands to include non-apparel textiles, have potential suppliers complete the updated Facility Module and use results to improve upstream sustainability.
      - Assess firm-level sustainability using the future non-apparel Brand Module (timing for development of a non-apparel Higg Index is TBA; in the meantime, the current Brand Module may be adapted for use by SBN).

4. **Produce a GRI-compliant sustainability report.** After several years of performance tracking, SBN should understand its significant environmental impacts well enough to create its first company sustainability report. Compliance with GRI standards should not be compulsory initially, but the GRI Implementation Manual will be a useful reference.

   [https://www.globalreporting.org/reporting/g4/Pages/default.aspx](https://www.globalreporting.org/reporting/g4/Pages/default.aspx).
Achieve Product Certification. Coupling firm-level environmental assessment with individual product certification will help SBN address the full range of environmental impacts associated with its business. One existing certification for upholstery fabrics is the NSF/ANSI 336 certification (NSF International n.d.). After implementing the above recommendations, SBN should pursue this certification as a way to measure and communicate the sustainability of its product.

GOALS AND ACTIONS RECAP

- **Goals 1 and 2 (UNGC Management Model Step 4)**
  Implementation of the strategies defined herein.

- **Goals 3 and 4 (UNGC Management Model Steps 5 and 6)**
  Measurement and communication of implementation results.

- **Goals 5 and 6**
  Iterative management and continuous improvement.
4 DISCUSSION

4.1 KEY FINDINGS

In this report we identified key resources and actions that will allow SBN to build a comprehensive sustainability strategy that addresses environmental impacts at both the product and firm level. The following topics highlight these results:

MODELS FOR MANAGEMENT AND REPORTING

In the early stages of product and business development, conceptual models like the UNGC Management Model can help SBN establish a consistent approach to evaluating and responding to sustainability risks. Sophisticated reporting guidelines like those from the GRI are useful as a planning tool and can help SBN understand what information is important to track as the company grows and as detailed reporting becomes feasible.

DIRECT ENGAGEMENT WITH LOCAL SUPPLIERS AND CONTRACTORS

It is clear that digital textile printing will become increasingly common (and affordable) in the coming years, and that the technology has real environmental advantages over screen printing. Fortunately for SBN, this type of printing is particularly well suited to photographic imagery. Interacting with local textile technology researchers and printing facilities will allow SBN to keep pace with the latest industry developments, engage its partners in environmental management, and potentially work with researchers on projects that are mutually beneficial to the industry and SBN.

The magnitude of SBN’s environmental impacts will be largely dependent on activities controlled by its suppliers and contractors. Understanding the prevailing systems for environmental management, such as ISO 14001 and Restricted Substance Lists for chemical substances, will allow SBN to intelligently engage with its value chain partners.
TOOLS FOR IMPACT ASSESSMENT AND ENVIRONMENTAL CERTIFICATION

The MSI and Higg Index, as well as the custom facility assessment tool created for SBN, should be used as decision-making tools when possible. As SBN establishes relationships with value chain partners who share its environmental commitment, more complete integration of these evaluation tools into product and facility assessment is recommended.

Environmental certification programs offer a means of verifying and communicating sustainability efforts, as well as a way to integrate continuously updated standards into product management. Uncertainty in the development of SBN’s value chain and potential costs of certification make this step more attractive at a later stage.

4.2 CONCLUSION

This project is prospective in nature and it is likely that significant adjustments to SBN’s product(s), business model and sustainability strategy will be made over time. The hope is that by using emerging and standard practices, and by emphasizing continuous improvement through the iterative processes of environmental management, certification, and reporting, this initial effort will give SBN the tools to take on sustainability challenges as they evolve. Future efforts should incorporate sustainability impacts that were beyond the scope of this project, including social and labor issues and downstream processes.
5 APPENDICES

APPENDIX A. The ten principles of the UN Global Compact.

HUMAN RIGHTS

- **Principle 1**: Businesses should support and respect the protection of internationally proclaimed human rights; and
- **Principle 2**: make sure that they are not complicit in human rights abuses.

LABOUR

- **Principle 3**: Businesses should uphold the freedom of association and the effective recognition of the right to collective bargaining;
- **Principle 4**: the elimination of all forms of forced and compulsory labour;
- **Principle 5**: the effective abolition of child labour; and
- **Principle 6**: the elimination of discrimination in respect of employment and occupation.

ENVIRONMENT

- **Principle 7**: Businesses should support a precautionary approach to environmental challenges;
- **Principle 8**: undertake initiatives to promote greater environmental responsibility; and
- **Principle 9**: encourage the development and diffusion of environmentally friendly technologies.

ANTI-CORRUPTION

- **Principle 10**: Businesses should work against corruption in all its forms, including extortion and bribery.

SOURCE: (UNGC AND DELOITTE 2010).
**APPENDIX B. Topics covered in the literature review and selected sources.**

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>SOURCE</th>
</tr>
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<tbody>
<tr>
<td>Natural and synthetic fiber production</td>
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<tr>
<td></td>
<td>NCSU College of Textiles n.d.</td>
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<tr>
<td>Textile manufacturing</td>
<td>Organic Exchange n.d.</td>
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<td>Kaes 2005</td>
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<td>Lacasse and Baumann 2004</td>
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<td></td>
<td>O Ecotextiles 2012</td>
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<tr>
<td>Textile environmental impact assessment and life cycle assessment</td>
<td>Shen, Worrell and Patel 2010</td>
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<td>Chen and Burns 2006</td>
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<td>Sandin, Peters and Svanström 2013</td>
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<td>Textile environmental impact assessment and life cycle assessment</td>
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<td>Steelcase Inc. 2012</td>
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GOTS 2013  
Bluesign n.d. |
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