

THESIS

DESIGN FOR THE ENVIRONMENT: AN EXPLORATORY STUDY ON THE PROCESSES
THAT GUIDE THE DESIGN OF INTERIOR TEXTILE PRODUCTS

Submitted by

Sage Calamari

Department of Design and Merchandising

In partial fulfillment of the requirements

For the Degree of Master of Science

Colorado State University

Fort Collins, Colorado

Spring 2014

Master's Committee:

Advisor: Karen Hyllegard

Juyeon Park

Ajean Lee Ryan

Copyright by Sage Calamari 2014

All rights reserved

ABSTRACT

DESIGN FOR THE ENVIRONMENT: AN EXPLORATORY STUDY ON THE PROCESSES THAT GUIDE THE DESIGN OF INTERIOR TEXTILE PRODUCTS

In order to meet the daily product needs of consumers worldwide, an estimated 85 million metric tons of textiles were produced in over 50 countries in 2011 (Platzer, 2012). This figure suggests that the integration of more sustainable practices relative to the production and consumption of textiles has the capacity to reduce some of the negative impacts on human health and the environment. Recently, researchers have begun to examine the relationship between production and sustainability, including the role that designers play in the life cycle of products (McDonough & Braungart, 2002). This calls for a deeper look into design and development of interior textile products and Design for the Environment (DfE) oriented products.

The purpose of this study was to gain an understanding of the processes that guide the design of interior textile products. In particular, this study explored designers' perspectives on the design processes in relation to human health and environmental considerations throughout the life cycle of interior textile products. A qualitative research approach, specifically interviews with twelve design professionals engaged in the creation of interior textile products, was employed to address the design practices and processes that are currently utilized in the industry. Findings from this study are discussed in relation to three research questions that explored the design processes for interior textile products, the distinctiveness in DfE-oriented design processes, and the considerations for human health and the environment throughout the design processes. Findings from the content analysis of the narratives about the design processes, and

DfE-oriented approaches, provided by professionals in the interior textile design industry were, to some degree, consistent with accounts of the processes provided by educators and students, as reported in prior research. However, the narratives in this study revealed additional details and emphasis related to specific themes associated with the design processes for interior textiles. Also, in regard to DfE-oriented approaches and life cycle consideration, all participants recognized the various human health and environmental impacts of interior textile products. However, it was apparent that all designers worked within the limitations of their companies and the industry at large and could not address all potential impacts within their design decisions.

ACKNOWLEDGEMENTS

Without the support of my family and friends this work would not have been possible. To my mother, Vicky Singer, whose patience and understanding helped me through many difficult moments. To my sister, Samantha Calamari, for keeping me grounded. To Elisa Cantero for encouraging me throughout my graduate work. And to Joe Gambles for always believing in me. Thank you all for listening, consoling and celebrating.

I would like to give a very special thank you to the professors in the Design and Merchandising department for their guidance during my time at CSU. In particular, to my committee members and my advisor, Dr. Hyllegard, for pushing my work and encouraging me to meet my potential. Also to Dr. Miller, the head of the department, for kindness and support.

Finally I would like to recognize everyone who works to better the world around us. To anyone and everyone who stands up and fights to change a system that allows industries to pollute our bodies and our environment. Especially to my friend Mia Davis, whose dedication and leadership has inspired me to keep working to enact change against all odds.

DEDICATION

I wish to dedicate this work to my late father, Ralph Calamari, the memory of whom pushes me to challenge myself and always strive to have a full and meaningful life.

TABLE OF CONTENTS

ABSTRACT.....	ii
ACKNOWLEDGEMENTS.....	iv
DEDICATION.....	v
DEFINITION OF TERMS	viii
CHAPTER ONE: INTRODUCTION.....	1
Purpose.....	3
Justification.....	3
Research Questions.....	4
CHAPTER TWO: REVIEW OF LITERATURE.....	5
Design for the Environment (DfE)	5
Interior Textile Product Life Cycle.....	5
Product Design.....	6
Material Selection	7
Textile Production Processes	8
Textile Product Maintenance	10
End of Textile Product Life.....	13
Conceptual Framework.....	14
Design Process	15
DfE Conceptual Model	17
Environmental Criteria.....	20
CHAPTER THREE: METHOD	23
Participants.....	23
Data Collection	24
Data Analysis.....	25
CHAPTER FOUR: RESULTS	27
Participant and Company Profiles	27
Design Process for Interior Textile Products.....	27
Resources and Research.....	27
Consumer Need and Trend Identification	30
Inspiration	31
Creative Exploration	33
Product Samples.....	36
Design Completion.....	38
Human Health and Environmental Consideration Throughout the Life Cycle of Interior Textile Products	38
Raw Material Selection.....	39
Textile Fabrication: Weaving, Printing and Dyeing	40
Finishes and Treatments.....	43
Packaging and Transportation.....	45
Consumer Use and Care.....	48
Post Use.....	51

Current Challenges and Future Practices.....	53
3 rd Party Standards	56
Sourcing and Partnerships	59
CHAPTER FIVE: DISCUSSION AND CONCLUSIONS	64
Summary of Findings.....	64
Implications	70
Limitations	72
Future Research	72
REFERENCES	74
APPENDIX A.....	84
Interview Questions	84
Table A1. Participant and Company Profile.....	86

DEFINITION OF TERMS

1. Interior textiles – Decorative textiles used in the home such as upholstery, window treatments, rugs, bedding and bath linens, table linens, and pillows (there is no industry or academic consensus for the definition of this term).
2. Design process – A step-by-step mapping of a design concept method (Watkins, 1988).
3. Design for the environment (DfE) – Refers to a shift in product and building design methods/processes wherein the environmental impact (rather than solely the economic impact) guides the direction of design decisions Kim, 2010; Lindahl, 2001; Mackenzie, 1991; Ramani et al., 2010; Yang, Yu, & Sekhari, 2011).
4. Product life cycle – The major activities or stages in the course of the product's life-span from design, raw material acquisition, production, distribution, consumer use and maintenance, to final disposal (Brown & Wilmanns, 1997; McDonough & Braungart, 2002).
5. Fast fashion – A manufacturing and retailing philosophy that shortens production time to produce fashionable items more quickly, increasing trend cycles and reducing the quality of garments (Cachon & Swinney, 2011; Tokatli, 2008).
6. Fast furnishings – The manufacturing, marketing, and consumption practices of interior furnishings that follow fast fashion principles (this term is not commonly used in the industry or academic research).
7. Environmental design criteria – Seven stage criteria developed by DesignTex, a leading textile manufacturing company, to assess the environmental impact of their products

during the design phase which includes: raw materials, construction, production, application, useful life, end of use and reutilization (Environmental Design, 2012).

8. General textile – A textile sold by yardage to the public for general use.
9. Contract textile – A textile for commercial use and sold only to design professionals. This type of textile requires certification by an industry approved 3rd party.

CHAPTER ONE: INTRODUCTION

During the twentieth century a manufacturing strategy known as planned obsolescence was implemented to encourage the design of products that would go out of fashion after a relatively short period of use (Whiteley, 1987). Although products designed using a planned obsolescence strategy provide some economic benefits for the manufacturer, such products have potential to negatively impact human health and the environment through all stages of their life cycle, from cultivation of raw materials to manufacturing, use, and disposal of the finished good. The textile and apparel industry utilizes a planned obsolescence strategy to stimulate consumer demand for current trends of fast fashion and fast furnishing. Fast fashion is an approach in apparel manufacturing and retailing that requires rapid design and production of goods in order to increase the number of trend cycles per year, reduce the quantity of each garment cycle, and promote exclusivity at lower prices for increased demand (Cachon & Swinney, 2011; Tokatli, 2008). Fast fashion has been isolated as a contributing factor to the increase of apparel disposal (Birtwistle & Moore, 2007). Similarly, fast furnishings involve shortened cycles in the manufacturing, marketing, and consumption of residential and commercial interior textile products such as upholstery, window treatments, carpet, bedding, and decorative pillows.

There is considerable evidence to suggest that the production, use, and disposal of interior textile products can be harmful to human health and the environment (Araji & Shakour, 2013; Coggan, 1996; Ip, Miller, & Ellis, 2003; Tremblay, Peng, Kreul-Froseth, & Dunbar, 1999; Wright, Zhang, & Mihelcic, 2008). For example, the flame retardant finish DecaBDE is a hazardous chemical commonly used during the production of interior furnishings that seeps into the environment during its slow decomposition and thereby negatively impacts the health of

humans and wildlife (Wright et al., 2008). Furthermore, research suggests that decisions made during the design process (i.e., the first stage of the product life cycle) can influence the human health and environmental impacts of textile products during subsequent stages of the product life cycle including, production, use, and disposal (Giudice, La Rosa, & Risitano, 2005; Laitala & Boks, 2012; Niinimäki & Hassi, 2011; Stegall, 2006). As a result, designers may choose to implement strategies at the design stage of the product life cycle in order to minimize the negative impact that textile products have on human health and the environment (Gam & Banning, 2011; Laitala & Boks, 2012).

Design for the Environment (DfE), a term introduced in the 1990s, refers to a shift in product development and architectural planning methods/processes wherein both environmental and economic factors guide the direction of design decisions (Kim, 2010; Lindahl, 2001; Mackenzie, 1991; Ramani et al., 2010; Yang, Yu, & Sekhari, 2011). DfE reflects an emerging perspective that designers can act as instruments of social change by reducing the negative impact that products have on human health and the environment through decisions related to raw material selection, manufacturing methods, and product use, care, and disposal (Kim, 2010; Fuad-Luke, 2009; Ramani et al., 2010; Stegall, 2006). Despite the negative impact that interior textiles often have on human health and the environment, as well as the influence that decisions made at the design stage may play in the life cycle of these products, there are currently no published studies on the process that designers engage in to create interior textile furnishings, or whether this process involves the integration of sustainable design principles and/or DfE-oriented approaches to design.

Purpose

The purpose of this research was to gain an understanding of the processes that guide the design of interior textile products. In particular, this study explored designers' perspectives on the design processes in relation to human health and environmental considerations throughout the life cycle of interior textile products. As such this study highlights the relationships among interior textile product design, human health, and the environment. A qualitative research approach, specifically interviews with design professionals who are engaged in the creation of interior textile products, was employed to address the design practices and processes that are currently utilized in the industry.

Justification

In order to meet the daily product needs of consumers worldwide, an estimated 85 million metric tons of textiles were produced in over 50 countries in 2011 (Platzer, 2012). This figure suggests that the integration of more sustainable practices relative to the production and consumption of textiles has the capacity to reduce some of the negative impacts on human health and the environment. Most studies that examine the environmental impact of interior textiles have focused on the contamination of indoor air quality during the use of the product (Coggan, 1996; Ip et al., 2003; Tremblay et al., 1999), whereas few studies have addressed the human health and environmental impacts that result from the production or disposal of items in this product category (Chivas, Guillaume, Sainrat, & Barbosa, 2009; Wright et al., 2008). More recently, researchers have begun to examine the relationship between production and sustainability (McDonough & Braungart, 2002). This includes the role that designers play in the development of DfE-oriented textile and apparel products as well as the possibility that the design stage of the product life cycle may enhance the overall environmental sustainability of

textile and apparel products (Kim, 2010; Fuad-Luke, 2009; Margolin, 2007; Ramani et al., 2010; Stegall, 2006).

Research Questions

Consumers' daily use of and reliance upon interior textile products, and the negative impact of interior textile products on human health and the environment, prompt a look at the role of the designer in the development of interior textiles, as well as at how their decisions may influence human health and environmental impacts throughout the product life cycle. This study will examine the relationships among interior textile product design, DfE-oriented approaches, human health, and the environment. In order to explore these relationships, the following research questions are asked:

RQ1: What are the processes that inform the design of interior textile products?

RQ2: What are the processes employed by designers who practice DfE for interior textile products?

RQ3: In what ways do designers of interior textile products consider the impact of the design process on human health and the environment?

CHAPTER TWO: REVIEW OF LITERATURE

Design for the Environment (DfE)

Research regarding environmentally sustainable product design has increased in recent years owing to consumer interest in environmental issues (Lindahl, 2001). Multiple terms, strategies, and environmental assessments have been coined by scholars and industry professionals in an attempt to create more sustainable design and manufacturing methods (Niinimäki & Hassi, 2011). Design for the Environment (DfE) refers to the focus of environmental influences, not just economic ones, on the direction of design decisions (Kim, 2010; Ramani et al, 2010; Lindahl, 2001; Mackenzie, 1991; Yang et al., 2010). Five goals that influence DfE (i.e., choosing ecological materials, extending the life cycle of the product within the design, increasing recyclability, minimizing environmental damage in disposal, and calculating energy waste in production and distribution) are to be considered during both product design and evaluation (Kim, 2010). However, this DfE criteria does not encompass all sustainability issues such as social and ethical principles and must account for each aspect of the life cycle of products in order to be effective (Knight & Jenkins, 2009).

Interior Textile Product Life Cycle

The life cycle theory was introduced by researchers in the 1970s to describe the stages of a product or service from its design to its decline (Ryan & Riggs, 1996). The textile and apparel industry generates environmental harm at all stages of the product life cycle, from raw material cultivation to the disposal of finished goods (Gam & Banning, 2011; Gam, Cao, Farr, & Heine, 2009). Work addressing the environmental impact of textiles isolates six stages of the life cycle (i.e., product design, material selection, production processes, distribution, product maintenance,

and end of life) for the evaluation of products and has since become commonly used in a life cycle assessment (LCA) (Brown & Wilmanns, 1997).

Research has contributed to our understanding of the environmental impact of apparel and textiles by examining an array of issues across the product life cycle and throughout the supply chain (Chen & Burns, 2006; Goldbach, Seuring, & Back, 2003; Kogg, 2003). Each company within the supply chain of a textile product can be subject to a LCA therefore transparency of operations throughout the textile supply chain is crucial in improving environmentally sustainable production (Caniato, Caridi, Crippa, & Moretto, 2012; Goldbach et al., 2003; Kogg, 2003). In addition, this information can be used by designers within the design phase of the product life cycle to assist in making decisions that may reduce the impact to human health and environmental (Chiu & Chu, 2012; Ramani et al., 2010).

Product Design

Decisions made in the early product design phase affect 70-80% of manufacturing costs and can impact the environment through use of harmful chemicals and non-renewable materials resulting in harm to the environment during the production, use, and disposal stages (Ramani et al., 2010). When examining the life cycle of products it may be seen that most products are designed to have a short life span and no end use, that is, a product goes from cradle (raw material) to grave (landfill) (McDonough & Braungart, 2002). This type of design is perpetuated by the widespread industrial manufacturing systems that promote planned obsolescence (McDonough & Braungart, 2002). Cradle to cradle products are ones that are designed to have a no impact life cycle, that is, have a positive impact on the environment or contribute to new products at the end of their life (McDonough & Braungart, 2002). A cradle to cradle perspective challenges the notion of how products are designed and then manufactured. This viewpoint

emphasizes the difference between an “eco-friendly” and environmentally sustainable product design. For example, a reduction of pollution or harmful chemicals during production does not mean a product is environmentally sustainable as the chemicals are still present. One argument for a true cradle to cradle product design it must result in a biodegradable end of life, because as waste it will act as food for another organism (Stegall, 2006).

DfE methods in textile and apparel product design research include: cradle to cradle apparel design (Gam et al., 2009), design for disassembly (Gam, Cao, Bennett, Helkamp, & Farr, 2011), slow design (Clark, 2008; Faud-Luke, 2009), and green fashion design (Kim, 2010). During the product design phase a prototype or pilot design of the concept is created therefore, current design research has focused on model building and prototyping. For example, in a 2009 study integrating cradle to cradle principles in apparel design, a sustainable product design process model was first developed and then tested by implementing the model to make children’s knitwear (Gam et al., 2009). The prototypes of knitwear were then analyzed based on performance, cost, and the triple bottom line of sustainability (economic, social, and environmental) (Gam et al., 2009). The prototypes were found to improve upon current textile and apparel design and production as it pertains to negative human health and environmental impact, however, not all life cycle factors were incorporated, such as, water use during raw material acquisition, or energy use during manufacturing and transportation.

Material Selection

Studies focused on the production and acquisition of raw materials for textile products provide evidence that decisions made at this stage of the product life cycle generate various environmental impacts (Giudice et al., 2004). For example, the production of conventional cotton involves the use of large amounts of pesticides and insecticides, some of which remains in the

finished textile product throughout its life cycle (Chen & Burns, 2006). The decision to use organic cotton in the production of textile goods mitigates the environmental impact minimally; however, the cultivation of organic cotton requires an enormous amount of water in comparison to other fibers, even conventionally grown cotton (Muthu, Li, Hu, & Mok, 2011). Another consideration in raw material selection is the impact on the end of the life cycle or disposal stage, because the selection of natural fibers that are biodegradable can reduce the overall environmental impact of the textile product (McDonough & Braungart, 2002; Thiry, 2009). By comparison, examinations of textile product disposal practices challenge recent claims that recycled polyester is a sustainable fiber choice because polyester takes a significant amount of time to break down when it inevitably ends up in a landfill (Thiry, 2005). Raw material selection is an important decision in the production of a textile. Regardless, the use of highly sustainable materials may not lead to a sustainable end product when consideration is given to the entire product life cycle.

Textile Production Processes

Studies examining the environmental impact of textiles at the production stage indicate that decisions regarding specific manufacturing methods and processes influence the degree of environmental impact that may result from a given fiber type throughout the product life cycle (Nieminen, Linke, Tobler, & Beke, 2007). Textile production processes like scouring, dyeing, and finishing are often performed with chemicals that are harmful to human health and the environment (Araji & Shakour, 2013; Coobing & Ruffinengo, 2013; Thiry, 2005). Furthermore, textiles may be exposed to chemical finishes during the production stage such as stain resists and flame retardants, which may then be released into the environment during later stages of consumption and disposal (Wright et al., 2008). Other toxins that can be released into the

environment in later stages of the product life cycle are found in the adhesives commonly used in production (Tremblay et al., 1999). Despite the regulation of certain chemicals in the United States and Europe, much of the U.S. and European textile manufacturing has moved to countries where the environmental standards are less strict and these chemicals are more likely to be used during production (Abreu, Castro, Soares, & Silva Filho, 2012; Niinimäki & Hassi, 2011). Regulation of chemicals used is necessary, as some of these chemicals can be toxic to those who handle the fiber and fabrics during production (Coobing & Ruffinengo, 2013; Goldbach et al., 2003). Chemicals used in textile production have also been found to contaminate the water supply of communities surrounding factories that do not have proper water treatment facilities (Chen & Burns, 2006; Coobing & Ruffinengo, 2013; Goldbach et al., 2003).

Distribution

The transportation of materials from one factory (or country) to another results in energy consumption and emissions (Caniato et al., 2012) and can result in accidents and toxic spills (Lenox & Nash, 2003). A case study investigating energy consumption for transportation in an apparel supply chain, revealed a dramatic difference in environmental impact based upon mode of transportation (i.e., rail, truck, or air) (Hopkins, Allen, & Brown, 1994). The researchers discovered that air transportation creates a greater negative environmental impact due to energy use than do all other modes of transportation combined (Hopkins et al., 1994). However, recent transportation figures also suggest that heavy duty trucks account for 22% of the overall greenhouse gas emissions produced by transportation (United States Environmental Protection Agency, 2013). Some textile companies have developed solutions to reduce emissions from distribution practices by requiring shorter transport routes, sourcing materials locally, and selling

products directly to consumers, rather than to wholesalers, thereby reducing the need for intermediary transport (Caniato et al., 2012).

Product packaging, which may include materials needed to protect goods during shipping as well as materials for product displays in the retail environment, also may be considered at this phase of the life cycle (Brown & Wilmanns, 1997; Handfield, Melnyk, Calantone, & Curkovic, 2001). For example, Patagonia reduced its packaging waste by 15 tons when it switched from using plastic to paper packaging for its men's underwear products (Brown & Wilmanns, 1997).

In addition to energy usage and waste, this phase of the product life cycle can be hazardous to human health through the chemicals used in packaging textiles for transport (Coobing & Ruffinengo, 2013; Preisser, Budnik, & Baur, 2012). Research provides evidence that several types of chemicals, including formaldehyde and various fumigants, are used to treat shipping containers (Preisser, Budnik, & Baur, 2012). These chemicals can pose health risks to the workers who apply the chemicals, unload the shipment, and remove the products for retail display (Coobing & Ruffinengo, 2013; Preisser, Budnik, & Baur, 2012).

Textile Product Maintenance

Recent studies indicate that the consumption stage (i.e., purchasing, use, and care) of the textile product life cycle may be most detrimental to the environment owing to two factors: (1) the growing over consumption of these products, and (2) the energy and water used to care for these textile products (Chen, & Burns 2006; Hu, 2012; Laitala & Boks, 2012; Laitala, Boks, & Klepp, 2011; Saxce, Pesnel, & Perwuelz, 2012). Consumption of textiles in the United States represents one third of all textiles produced globally (Wallander, 2011). This overconsumption is in part driven by fast fashion trends (Claudio, 2007). Although shortened fashion cycles have affected the quality of garments, decreased the longevity of clothing, and encouraged the rapid

consumption and disposal of apparel products (Laitala & Boks, 2012; Niinimäki & Hassi, 2011; Saxce et al., 2012), quickly changing design trends also have led to an abundance of low price and low quality items for the home (i.e., fast furnishings), which has similarly encouraged rapid consumption and disposal. In the past 20 years, an increased number of inexpensive home furnishing retailers in the marketplace (e.g., IKEA and Home Goods) concurrent with an increased merchandise assortment in this product category among mass merchandisers such as Wal-Mart and Target has heightened consumer demand for fast furnishings.

Despite evidence of increasing consumer preference for environmentally sustainable products, researchers have had difficulty isolating the drivers of consumer acquisition of sustainable apparel and textiles (Connell, 2010). Some large companies such as Patagonia, Nike, Target and Wal-Mart have incorporated eco-friendly textile products, such as organic cotton garments, into the mainstream apparel market. The easiest way to introduce a sustainable product to market is to maintain a similar price and design as the conventional counterpart, and to simultaneously offer information about the potential human health or environmental impacts of a particular product to influence consumer adoption (Sathe & Crooke, 2010). This illustrates one challenge that designers and companies may face in incorporating larger sustainability efforts into their product development activities and other business practices, including those activities or practices that would require a change in consumer behavior.

Research indicates that the consumption of interior textile products contributes to the overall negative impact on the environment as a result of the water, energy, and chemicals used in the laundering of these products (Chen & Burns, 2006; Hu, 2012; Laitala, et al., 2011). Although no analysis of the environmental impact of laundering a specific interior textile product, such as a sheet or towel, has been identified, one study estimated that the energy needed

to launder a polyester shirt over its lifetime is six times the amount of energy needed to make the garment (Franklin Associates, 1993). Unlike apparel, an interior textile such as a bed sheet is more likely to be used until worn out; therefore, it has been argued and found that increasing the quality of the bed sheet should increase the life span and decrease the environmental impact of the product (Saxce et al., 2012). Other ways to dramatically decrease the negative environmental impacts at this stage of the product life cycle include reducing water temperatures and dryer settings, washing clothes less frequently, reducing dryer use/adopting line drying practices, and using a biodegradable detergent choice (Hu, 2012; Laitala, et al., 2011). Although companies cannot directly control how textile products are used and/or cared for by consumers, designers can make decisions at earlier stages of the product life cycle that can help minimize environmental impacts from product care. For example, incorporating wool or silk in textile products would require that the items be washed in cold water and not machine dried (Laitala, et al., 2011).

The impact of interior furnishings on human health during the use phase of the life cycle is also of interest to researchers (Coggan, 1996; Ip et al., 2003; Tremblay et al., 1999). A common issue that arises during the use of interior textiles and fast furnishings is the negative impact on indoor air quality (Araji & Shakour, 2013; Coggan, 1996; Daisey, Angell, & Apte, 2003; Ip et al., 2003; Tremblay et al., 1999). Studies examining interior spaces with high concentrations of furniture, such as schools and offices, have found that poor indoor air quality can result in “sick building syndrome” a physical reaction to indoor air quality usually in the form of fatigue and respiratory problems (Jaakkola, Øie, Nafstad, Botten, Sammelsen, & Magnus, 1999). The three major features of interior furnishings that contribute to sick building syndrome are: chemicals in the material, chemicals on the surface, and the release of chemicals

during the “gas phase” through product usage (Uhdea & Salthammer, 2007). The most common irritants found within interior textiles are, formaldehyde, volatile organic compounds (VOCs), biological contaminants (i.e. dust, mold) and terpens, a natural hydrocarbon found in plants and cleaning agents (Uhdea & Salthammer, 2007). In combination with poor ventilation or environmental changes (e.g., humidity), these contaminants can negatively impact human health (Uhdea & Salthammer, 2007). Contamination can even happen over time as interior furnishings commonly ‘off-gas’, that is, they release chemicals into the indoor environment, in part, due to the chemicals used during manufacturing such as fabric finishes (Jaakkola, et al., 1999; Thiry, 2005). The chemical particles that are released into the indoor environment over time can cause health problems in children and adults (Jaakkola, et al., 1999). For example, soft wall materials (i.e. textile wall coverings) and carpet can trap allergens such as mite and mold and have trace amounts of formaldehyde (Tremblay et al, 1999). These contaminants trapped in a closed environment can cause allergic physical reactions such as irritated eyes, nose, and throat (Jaakkola et al., 1999).

End of Textile Product Life

The final stage of the textile life cycle is product disposal. Research that has addressed the disposal stage of the textile life cycle suggests that apparel reuse and recycling is less harmful to the environment than is the manufacturing of new garments from raw materials (Woolridge, Ward, Phillips, Collins, & Gandy, 2006). However, in 2010 of all U.S. textile waste, (roughly 5% of total municipal waste), only 15% was recovered for recycling (Wallander, 2011). Consumer behavior studies reveal a propensity for consumers to donate used clothing to charitable organizations or to buy second hand clothes as a means of reducing textile waste (Albinsson & Perera, 2009; Bianchi & Birtwistle, 2010; Birtwistle & Moore, 2007; Steinbring &

Rucker, 2003). However, few studies address the role of the designer or manufacturer in increasing the recycling and reuse of products based upon design decisions made earlier in the life cycle (Pammi, Geetha, Danford, & Charles, 2012; Gam et al, 2012).

One approach to improving product sustainability is to predict the end of a product's life by addressing questions of how long the product will perform, whether it can be recycled, and what happens in decomposition (McDonough & Braungart, 2002; Thiry, 2005). Disposal of interior furnishings in the residential textile market is increasing due to the popularity of interior remodeling and redesigning (Aktas & Bilec, 2011). The low cost of interior items such as sofas, chairs, linens and rugs is been partially due to the technological advances in the manufacturing of textiles (Rastogi, 2009). Polyester and other synthetic materials are often used to make interior textiles owing to their inexpensive, durable, and hydrophobic qualities. At the same time, particleboard and adhesives have replaced solid wood and hand crafted furniture traditions. Research indicates that there are two primary drivers in disposing an interior product, deterioration of material and social or economic factors (Aktas & Bilec, 2012). As a result of increased interior textile use, greater quantities of lower quality products are manufactured which, in turn, leads to increased waste and pollution (Rastogi, 2009).

Conceptual Framework

To better understand the process (or processes) that guides designers of interior textiles products, as well as the processes that inform designers who employ a DfE-oriented approach to design, this study will be informed by an integrated conceptual framework that draws from scholarly conceptualizations and models of the design process as well as from industry criteria that foster the design of sustainable textiles. A systematic approach to the design process can be an effective way to incorporate the principles of DfE in order to design products with reduced

impact on human health and the environment. Further, a criteria (e.g. life cycle assessment), is needed to isolate which areas of the textile product life cycle have the most impact on human health and the environment. The conceptual model developed by Handfield, Melnyk, Calantone, and Curkovic (2001) used to explore the inclusion of environmental performance criteria into the design process, and the environmental design criteria employed by DesignTex (a leader in the contract interior textile industry) to encourage sustainable design practices, will serve as the integrated conceptual framework for this study.

Design Process

Attempts to better understand the terms *design*, *design process* and *designer* have intrigued researchers and theorists for decades (Lawson, 1997). Though the word “design” can be defined in multiple ways, as a verb, it means “to create, fashion, execute, or construct according to plan” (“Design”, n.d., para. 1). The plan, also referred to as the design process, involves “...a sophisticated mental process capable of manipulating many kinds of information, blending them all into a coherent set of ideas and, finally, generating some realization of those ideas.” (Lawson, 1997, p. 10). A critical component of this definition is the word ‘information’ as it is through the processing of information that designers create a foundation for generating design solutions (Watkins, 1988). With gathered information a designer may create a plan to achieve a desired outcome or solve a particular problem, such as an approach to developing more environmentally sustainable products. Theorist Margolin (2007) described designers as “creators of models, prototypes and propositions, [who] occupy a dialectical space between the world that is and the world that could be” (p. 4). Margolin’s definition implies that the role of designers is to engage in imaginative exploration that fosters solutions to present and future societal needs. As such, designers have the unique opportunity to envision and enact design solutions to modern

problems, such as issues surrounding human health and environmental sustainability (Faud-Luke, 2012).

Since the 1960s, researchers have attempted to understand the step-by-step process that designers use to ideate and create products in a variety of fields, including textiles, (Watkins, 1988). The mapping of the design process, and the steps involved in the process, may sometimes appear to be specific and linear, but the process also can be very general and nonlinear, as it is argued that designers often jump between “...rational periods of thought at the imaginative periods they might identify as creative thinking” (Watkins, 1988, p. 336). Though there is no singular way to approach design, certain commonalities have been identified across industries (Gagnon, Leduc, & Savard, 2012; LaBat & Sokolowski, 1999). As such, varied approaches to design have been adopted and modified by researchers and practitioners for application to diverse fields, and especially for the advancement of education in those fields (LaBat & Sokolowski, 1999; Laamanen & Seitamaa-Hakkarainen, 2008). One such example is the work undertaken by Lamb and Kallal (1992) to more fully understand the importance of the design process in problem solving for the development and advancement of apparel for consumers with disabilities. The authors introduced a framework based upon a six-step design process that accounted for the functional, expressive, and aesthetic needs of the consumer (Lamb & Kallal, 1992). The six step process included: problem identification, preliminary ideas, design refinement, prototype development, evaluation and implementation (Lamb & Kallal, 1992). The application of the design process for apparel garments in the purpose of this study demonstrates the potential role of the design process in problem solving on a larger societal scale.

Labat and Sokolowski (1999) later examined the role of the design process within multiple fields in order to bridge the gap between education and industry work. Upon their

review of research relating to the design process, the researchers identified three stages common to the process across industries: problem definition and research, creative exploration, and implementation (Labat & Sokolowski 1999). The researchers subsequently defined and expanded upon each stage of the process to more adequately explain the apparel design process. For example, the researchers expanded the conceptualization of the creative exploration stage to include ideation, design refinement, and prototyping, then evaluation of the prototype (Labat & Sokolowski, 1999). Once the design process stages were defined, an apparel industry partner was chosen to supply a design problem to a university design team that, in turn, utilized the three-step design process to create a solution to an apparel design problem (Labat & Sokolowski 1999). The researchers concluded that a systematic approach to design was beneficial in fostering communication between the design team and industry professionals and in contributing to an adequate design solution, and thus the results of this study further demonstrate the importance of understanding the design process (Labat & Sokolowski, 1999).

DfE Conceptual Model

Authors of a 2001 study examining the integration of environmental issues into the product design process for a variety of goods, including office furniture (which often involves the use of textiles) concluded that a gap existed between DfE principles and industry practices (Handfield et al., 2001). As a result of their findings, the researchers developed a conceptual model to assist corporations in making environmentally responsible decisions relative to product design and development (Handfield et al., 2001). The model is based upon three propositions about ecologically sustainable organizations. The first proposition is that designers in these organizations give explicit consideration to environmental issues in order to meet corporate and product design goals (Handfield et al., 2001). The second proposition is that such organizations

explicitly measure environmental objectives or criteria at major points throughout the product design process, and that these environmental criteria carry equal weight to other performance criteria (Handfield et al., 2001). The third proposition is that such organizations integrate environmental issues into the design process by measuring environmental outcomes and incorporating outcomes into strategic planning (Handfield et al., 2001). The second proposition is of greatest interest in the present study because it focuses directly upon the product design/development process, which is conceptualized as a five step process that includes: concept, product design, process design, package design, and product launch, as well as the systems that may be utilized to support the design process (Handfield et al., 2001). At the center of this proposition is the idea that environmental objectives or criteria can be encouraged and evaluated during each stage of the design process. For example, the concept stage is when designers are engaged in creative exploration to identify potential environmental problems and develop DfE-oriented solutions. This stage may include identifying environmentally sustainable material options and ideas for use and disposal planning. Once the concept is developed the designer focuses upon the “three P’s”, product, process and packaging, to influence the environmental outcome. The product design stage involves decisions related to product specifications and may include raw material and end of life planning, and incorporates DfE-oriented strategies such as using materials that can easily be recycled (Handfield et al., 2001). The third step, process design, is the manufacturing and assembly plan. This step considers all human health and environmental aspects of the manufacturing facilities and may include how the facilities effectively manage wastewater and pollution. Packaging design involves decisions regarding how finished product will be packed for shipping for both purposes of protection and presentation at retail and may include choosing materials that have little environmental impact,

reducing the amount of materials use, and/or modifying the manner in which the product is transported. The final step, product launch provides an opportunity for the designers to assess the environmental impact of the product using existing DfE assessment tools and with the help of sustainability experts. As such, the second proposition of the conceptual model developed by Handfield et al., (2001) provides a basic framework for exploring the process that guides the design of interior textiles, in general, and the design of DfE-oriented interior textile products, in particular.

To examine the strength of the propositions that serve as the foundation for Handfield et al.'s (2001) conceptual model of the role that the environmental issues play in the product design process, the researchers conducted an exploratory study of the perceptions and actions of two groups of individuals who are involved in the design process. The first group included individuals employed in various job positions (primarily environmental specialists) and who support the use of environmentally responsible manufacturing practices. The second group included individuals employed as product designers who have practiced aspects of DfE (Handfield et al., 2001). Interviews with two participants (an environmental specialist and a product designer and) from ten separate organizations revealed that the propositions were not fully supported but rather, consideration of environmental issues within the design process was limited and focused mostly on checklists (i.e., minimum environmental standards) and material consideration (Handfield et al., 2001). In general, the companies that support environmental initiatives did not judge the success of product design based upon environmental attributes, but rather upon the cost and time required to manufacture the product (Handfield et al., 2001).

Environmental Criteria

Another stream of research (i.e., case studies) has examined individual companies that consider environmental issues throughout the design process (Brown & Wilmanns, 1997; Hogevoid & Svensson, 2012; Meyer & Hohmann, 2000). These case studies have tended to focus upon the importance of corporate strategy in influencing environmental initiatives as well as the barriers that companies face in enacting such initiatives, with emphasis on the parameters in which designers work (e.g., specific industry factors). Design Tex, a textile company that embraces DfE principles, employs a seven-stage product life cycle model (raw materials, construction, production, application, useful life, end of use, and reutilization) that infuses environmental design criteria throughout product development and evaluation (Environmental Design, 2013). Design Tex considers environmental impacts at all stages of the product life cycle. Giving consideration to environmental impact at each stage is crucial to creating an ideal “closed loop” product life cycle, or a product that can be reused biologically (i.e., composting) or in re-manufacturing (Environmental Design, 2013). The textile product life cycle begins with the selection of raw materials to be used in finished goods, and in order to minimize the negative environmental impacts of finished goods designers are encouraged to select materials that are renewable, recycled, and/or organic. The construction stage of the textile product life cycle involves establishing a plan for developing the product throughout the subsequent stages of the life cycle and provides an opportunity for designers to ensure the product will have closed loop qualities. For example, the construction of a product may dictate if and how a product can be disassembled and whether component parts may be reused in the future. The production stage involves activities such as the weaving, knitting, and dyeing of the textile products at which point a designer may make decisions to minimize the use of energy and water as well as to

reduce the waste that occurs during manufacturing. During this stage, companies rely heavily upon their partners in the supply chain to provide accurate information about production practices and processes and oversee the proper regulation of procedures and facilities (Environmental Design, 2013). The application stage is when a textile is applied to its intended product such as a piece of furniture (upholstery textile) or wall (surface textile). As discussed above, there are a variety of chemicals used to apply textiles to their intended surfaces (i.e., glue), the application stage is an opportunity for a designer to consider alternative methods of textile adhesion, such as sewing or stapling. The useful life refers to how the product will perform during its lifetime as well as the possibility that emissions will be generated due to use and care for the product. One way for a designer to consider the use phase of the life cycle is to choose raw materials that can be cleaned with a non-toxic formula. This also is the step that would include planning for performance criteria and intended length of use. The end of use is a program that will allow the product to be returned for reuse. At Design Tex the end of use stage incorporates a take back program in which the company offers specific products that can be sent back to the company to be recycled for remanufacturing. The final step, reutilization, is the point at which the product is recycled, reused or composted, thereby completing the closed loop cycle. In order for this final stage to be achieved, the designer must give full consideration to environmental impact at all proceeding stages to ensure the textile can be safely and easily removed from its surface and does not contain any finishes or raw materials that would be environmentally hazardous in decomposition or remanufacturing.

For this research, the environmental design closed loop model used by Design Tex will be implemented as a framework by which to evaluate interior textile designers application of general DfE-oriented practices and processes the product life cycle. Additionally, the Design Tex

model complements the Handfield et al. model as a way to evaluate each stage of the design process, and in particular to examine decisions related to the “three P’s” (product, process, packaging). Taken together, these conceptual models provide a framework for examining both the processes that guide designers of interior textile products as well as the considerations that designers may give to the potential human health and environmental impacts of the finished products.

CHAPTER THREE: METHOD

A designer's reflection on his/her process can result in theory building and assist in expanding the knowledge of the discipline (Bye, 2010). Therefore, a qualitative approach was appropriate for examining the processes that guide the design of interior textile products from the perspective of design professionals who work in the industry.

Participants

The participants for this study included textile designers and managers who specialize in the development of interior textiles using conventional and/or DfE-oriented approaches to design. Twelve participants were identified through an internet search of interior textile companies. The represented interior textile design companies range from small wholesale businesses to large contract corporations.

Multiple sources were used to identify participants for this study. First, internet websites and trade magazines dedicated to home furnishings and interiors were used to identify companies and designers engaged in the development of interior textiles. Second, trade organizations that list member companies on their websites (e.g., textileexchange.org, sustainablefurnishings.org, organicconsumers.org) as well as companies that utilize one of two textile industry certifications, Global Organic Textile Standard (global-standard.org) and Oeko-Tex (oeko-tex.com), both of which list textile companies that comply with their standards also were used to identify participants. Given the comparatively small number of companies engaged in DfE-oriented interior textile production, however, participants included as well as designers who classify their work as sustainable and/or eco-friendly. More specifically, the participants for this study included only individuals who play an integral role in, or have direct influence upon, product

design and development. As these appropriate individuals (e.g., textile designers) were identified, an introductory email with an attached cover letter explaining the purpose of this research was sent to each designer inviting him/her to participate in the study. All participants recruited for this study were located in the United States. The incentive for participation was access to the results of the study.

Data Collection

A qualitative approach was used to collect data for this study. Upon receipt of the participant's consent to take part in the study, the participant was asked to provide written responses to questionnaire items via email that pertained to the participant's educational background and current employment position. Next, in-depth telephone interviews with the participant were conducted to obtain information about the processes that the designer employs to create and develop interior textiles. The interviews ranged in time from 30 to 80 minutes. In-depth interviews comprised of open-ended questions were used to gather data on the topic because this approach can better "...capture the nature and meaning of creative experience from the perspective of the research participants themselves" (Mace, 1997). The interviews were audio-recorded, transcribed verbatim, and coded. Each participant received the transcription of their interview to verify their answers. Interview questions (Appendix A) were drawn from the review of literature (e.g. Handfield et al., 2010; Mace, 1997) and were designed to address the previously stated research questions. The interview questions incorporated the approach from Handfield et al.'s (2001) work in which designers were interviewed to gain knowledge about the creative process they engage in during product design and development. The interviews from Handfield et al.'s (2001) study began with questions regarding the design process (i.e., people involved, length of time) and were followed by questions about the implementation of

environmental issues within the design process, such as tools used for environmental assessment (Handfield et al., 2001). For the present study, interviews were conducted using an in-depth, semi-structured approach to help guide the conversation and ensure that the primary research questions were addressed as well as to allow for follow-up questions when new ideas or topics were introduced.

Data Analysis

The data collected for this study consisted of written responses to questionnaire items and written transcriptions of audio taped interviews. Upon completion of the interviews, the transcriptions and notes taken by the researcher were read and organized through thematic analysis (Shank, 2002). The researcher utilized open inductive coding to isolate relevant themes in the data (Strauss & Corbin, 1998). Due to the relatively unexplored nature of the research topic, grounded theory and constant comparison approaches were used to systematically code, categorize and compare the data throughout the data analysis process (Glaser & Strauss, 1967; Glesne, 2011; Strauss & Corbin, 1998). To categorize the data, the researcher took notes during the initial reading of each transcribed interview in order to isolate important fragments of text (Guetzkow, 1950), which were then used to develop key concepts or meanings in the data as well as to make comparisons across the transcripts. As data analysis continued, concepts and categories were developed into a coding guide that was applied to all twelve interviews. Throughout this process of rereading and analyzing the interview data based upon the established coding guide, the researcher continued to identify and compare themes across the transcripts.

To ensure accuracy and consistency in the data analysis, an audit coder checked the researcher's application of the coding guide to approximately one-fourth of the data. When disagreements occurred in the coders' interpretations of the data, these differences were

negotiated until agreement was achieved. Interrater reliability with the audit coder was 73%. The interrater reliability coefficient was calculated by dividing the total number of agreements by the total number of decisions made. An additional measure used to increase the trustworthiness of the findings from the research was to make the transcripts available to the participants to verify the information gained from interviews.

When employing a grounded theory approach to qualitative data analysis it is important to recognize potential biases of the researcher, that is, the possible impact that his/her own experiences and background may have on the research (Glesne, 2011). Although it may not be possible to identify all biases that may impact the data collection and analysis, it is important to address the potential viewpoints that may influence the research findings. First, it is the opinion of the researcher that there may be limitations to the number of practical methods that can be employed to improve upon the sustainability of interior textile products. Second, the researcher and consumers in general share the concern that many companies promote unsustainable practices under the guise of eco-friendly products.

CHAPTER FOUR: RESULTS

Findings from this study of the processes that guide the design of interior textile products are presented in this chapter. First, general information regarding the participants and the companies they represent is presented, followed by a discussion of the findings from the qualitative analysis.

Participant and Company Profiles

In order to explore the processes that informed designers of interior textile products, a total of twelve participants were interviewed for this study, including designers and developers of interior textile products at both small and large textile companies. The participants varied in regard to their job titles, professional backgrounds, and years of experience in the textile design industry. The companies at which the participants work differed in size of operations, product offerings, and in their use of conventional or sustainable approaches to design. The profile of participants and companies is provided in Table 1 (Appendix B).

Design Process for Interior Textile Products

Participants' narratives of the design process revealed six main themes related to engagement in the conceptualization and development of interior textile products. These themes included, resources and research, consumer need and trend identification, inspiration, creative exploration, sampling, and design completion.

Resources and Research

The first theme identified through data analysis was resources and research, which provided the foundation for initiating the design process. Participants from both small and large textile companies expressed the idea that prior knowledge or experience was used in a very

general manner and informed all steps in the design process. The foundation for the design process included formal education, industry expertise, and knowledge gained through independent research. As demonstrated in the following quote, knowledge obtained through formal education was identified as having an impact on design work.

There are a lot of foundational things that I learned as a design student with regard to things like color theory and things like that which obviously makes a difference in the quality of the product (Participant 1).

It is implicit in this statement that past educational experience was drawn upon for the participant's design process. Further, this quote implies that understanding of color theory, which the designer learned in school, had a direct impact on product quality. Industry experience also was identified as important, as revealed in one participant's discussion of fabric choice.

For different patterns you would use different fabric ...different fabrics take dye differently...we kind of know all that stuff from doing it all these years (Participant 9).

This statement suggests that acquiring 'on-the job' experience or knowledge throughout one's professional career contributes to one's expertise when making specific decisions during the design process, such as selecting an appropriate fabric for pattern design and dye type.

Knowledge gained from research was viewed as important to those participants who focused on DfE approaches to design. Participants from medium sized DfE-oriented companies stated that in-house research and development departments or in-house environmental experts sometimes serve as sources of information for designers. Participants from small DfE-oriented companies indicated that they generally engaged in their own research to find more sustainable approaches to inform the design process. As the following quotes imply, there was general agreement among participants regarding the need to engage in research in order to obtain relevant environmental information and to make informed design decisions. When addressing the

importance of research, this DfE-oriented designer suggested the need to obtain specific information before starting the projects.

I researched substrates [printing materials] that I wanted to use and researched [textile] printers who were sensitive to what I need and [the printers are willing to] learn about sustainability and work with products they may have not worked with before (Participant 1).

This statement indicates that this designer's understanding of specific product needs involved research to identify appropriate materials and printers. In addition, this designer worked with partners who understood the specific goals of a DfE project. All five designers from DfE-oriented companies expressed the importance of being knowledgeable about advances in textiles as well as environmental standards and practices when making decisions about product materials. During another conversation on the subject of prior knowledge, one participant spoke specifically to the need to obtain information about sustainability and industry standards.

I do know a lot about the standards, even the Organic Trade Association [GOTS] has a set of standards and there are certain dyes to use and the kind of, the way the plant is grown whether it is organic cotton or organic hemp there are all these little, a list of things that you have to know (Participant 5).

This statement demonstrates the need to have foundational information outside of design expertise, such as, knowing how an organic raw material is produced. Also evident in this statement is the notion that designers must be knowledgeable of, and adhere to, detailed standards in order to apply DfE approaches to textile design. This information appeared to be particularly important to DfE-oriented designers who use the Global Organic Trade Association (GOTS) and additional formal standards to make informed design decisions relative to fabric selection and finishing processes.

Consumer Need and Trend Identification

The second theme related to engagement in the conceptualization and development of interior textile products was the identification of consumers' needs and product trends.

Interviews revealed that the act of choosing a design direction for a textile project required participants to identify a specific target market and to develop understanding of consumer needs and product trends. When describing the beginning of a project, one participant identified the role of textile designers as 'problem-solvers' for the target market.

We're kind of solution finders and each product should be answering a market question, or need or problem that's in the market (Participant 12).

Implicit in this statement is the notion that textile design is driven by market needs or demands, rather than by a designer's personal sense of aesthetic quality or creativity, and that the product's end use will provide a solution to a consumer problem.

For the participants interviewed, the two most common ways to isolate consumer needs and product trends was to communicate directly with sales representatives or, in some cases, to engage with the company's marketing director or team. The majority of participants in this study (all but three) worked for companies that sold products in a wholesale capacity, meaning that the fabrics were sold through showrooms or by independent sales representatives, rather than through company-owned retail outlets. As such, most participants relied on sales representatives to articulate the demands and tastes of their consumers.

We have a dedicated sales force talking to the consumer on a daily basis and bringing back information . . . they (customers) have needs or they're excited about this competitor's product in the marketplace, or from a color standpoint, my geographical region has a certain palette that's not being addressed (Participant 11).

This quote stresses the importance of the sales representative in the design process by noting two instances in which project direction might be influenced by a sales representative's experience or

knowledge. The first instance involves a sales representative's knowledge of a competitor's product line and the second instance reflects a sales representative's understanding of consumer tastes preferences, and as such, what might be missing in the company's product line. Also, this quote reinforces the notion of the designer as a "solution finder", in this case customer need was for a different color option, and it was the job of the designer to create a product to satisfy that need.

Another strategy employed to develop a project's direction was to identify popular trends in areas not related to textiles specifically. For example, one company held an annual forecasting meeting at which the design team and other departments discussed general trends in a predevelopment phase.

...Everyone in the creative team, all the designers and marketing people discuss trends, social trends, technological trends, color trends, and materials and everything, and then we kind of boil them down and that helps us a lot [to] kind of marry with different inspirations of different designers on our team to get a specific item (Participant 6).

This quote reflects the collaboration that occurs among multiple designers and other members of the product team in order to analyze and synthesize information from a variety of sources and to establish focus and direction for a project. In addition, implicit in this quote is that all trends, even those outside of the interior textile industry, were seen as valuable for informing product development.

Inspiration

Participants explained that once the parameters of a project were set, the third theme, inspiration was isolated as a starting point to engage in actual design work. As evidenced by the following quote, all participants referenced a variety of sources of inspiration. These varied sources of inspiration included, but were not limited to, art, fashion, furniture, historic textiles, nature, and the materials they use.

Inspiration is where I start, and that comes from all different types of ideas whether historical as in archives, I do a lot of research from books, fashion is a big influence for me, when I travel, colors . . . the overall state of the world, global ideas come into play (Participant 4).

This statement presents inspiration as a reflection of the designer's interests and experience. In addition to tangible sources of inspiration, such as textile archives and color, this participant recognized that inspiration came from intangible sources such as global issues. This suggests a broad scope of inspiration sources for textile designers. Though the participants frequently identified a broad range of sources, they also identified common sources of inspiration. For example, three participants identified apparel fashion as a source of inspiration for their design choices. Another three participants referenced a specific artist or artistic style as a source of inspiration. Two DfE participants revealed the act of being in nature and natural forms as their primary source of inspiration.

I go on what I call 'trend hiking' because I really like to be out in nature so now I go out at least two times a week with my camera and look for inspiration (Participant 3).

This participant expressed an enthusiastic and personal connection to nature, which served as a source of inspiration. Also, in this quote "trend" implies that things found in nature, rather than in the marketplace, can be sources of inspiration. Another source of inspiration that was frequently identified by participants was the company's existing collection of fabrics.

We don't just design it as a pattern, we design it as a collection but the catch for me is that a product has to stand alone and speak on it's own but work with existing ideas (Participant 4).

Here the participant noted the challenge of creating a cohesive collection, and at the same time designing an individual product that exhibits unique properties. Because the designers were often working within styles associated with the company's brand identity and existing collections, inspiration sometimes came from within the company's own textile patterns. Several participants

pointed out that the designs were not intended to match other patterns, but rather to work together and thus served as inspiration for new patterns.

Creative Exploration

The next theme identified through data analysis was creative exploration. Although design decisions could be made at anytime during the process, according to the designers, creative exploration relative to those decisions occurred once the project direction was established and the source of inspiration was identified. For all participants, creative exploration involved putting design ideas to paper, either through hand drawing or a computer program, and then experimenting with design options. Creative exploration involved experimenting with color, pattern, repeat, and fabric choice. As the following quote demonstrates, it was common for designers to use computer programs to explore with different colors and repeats of the potential pattern.

I ultimately go to the computer, even if it's something that's hand done, and then manipulate it to put it into repeat and try different colors (Participant 12).

For this designer, even if the design was put to paper by hand, it eventually resulted in going to the computer to explore pattern repeat and color. Also, this quote demonstrates the advantage of computer programs to put a design into the repeat, which is a more accurate way for the designers to see how their pattern will look on the fabric. For the participants who worked with computer programs, current technological trends allowed the designers to see patterns in a variety of colors (i.e., colorways or colorworks) before the textile was manufactured. Almost all participants utilized technological tools and services. The tools most frequently utilized were the computer software Photoshop for pattern rendering and Pantone (a color trend forecasting service) for color selection. In fact, two designers used technological tools to share their patterns with friends and clients and received input before sending their patterns to be manufactured.

What I've done lately is put designs up on my Facebook page and let my fans vote for colorways they want to see and not only can they vote but they can suggest things like "I want to see it in orange" and because color changing is so quick and easy on the computer I can just whip it up (Participant 3).

This quote demonstrates how computer programs can facilitate creative exploration in regard to color choice. Further the programs allowed the designer to involve consumers in the design process before the textiles were manufactured.

The type of printing process also, in part, influenced creative exploration related to the textile pattern. The following excerpts provide one designer's perspective on the distinction between the two printing processes, screen and digital printing.

With screen printing you send the artwork to the mill, your finished repeated artwork and then they have to create a film from your artwork, so there's this other layer that happens it's someone else's hand that creates this film and then that's transferred to a screen that's stretched on a frame so the end product I happen to really really love, the hand screen print it's different feel, it looks more crafted and because it's transferred from a film and screen printed your digital image, if it's a little bit off, a little bit fuzzy it doesn't matter because it's going to, the gel's going to be pushed through a screen and printed onto your fabric (Participant 5).

This participant acknowledged the rotary screen-printing process for the aesthetic results of the printed fabric. For this designer the screen-printing resulted in a more personalized product, exposing the hand of the printer and hiding mistakes by the designer. The perception expressed by this participant is that there is more room for error in the process of designing a pattern for a screen printer. Whereas, the same participant's perception of digital printing was that the artwork had to be exact, as illustrated in the following quote.

The digital world is a whole different animal because the artwork has to be really perfect because that digital file is what's going to happen on the fabric, if it's kind of weird, and it's not drawn properly and the repeat's off that's what you're going to have on your fabric, it goes right from your file on your computer to the cloth so I really spend more time on the artwork for the digital printing but it's a wonderful thing because you can print a yard or you can print 100 yards you can print one color or you can print 27 colors and the price per yard doesn't really change much where with the screen printing you

have to print a certain minimum. In order for the mill to survive they have to run yardage, a lot of it (Participant 5).

This designer's opinion reflects advantages and disadvantages to digital printing. First, the artwork for digital printing took more time and the artwork had to be more precise than when preparing for screen-printing. However, digital printing provided opportunity for more variety in color and smaller minimums, things that screen-printing facilities did not offer without a higher cost. For these reasons, two designers expressed the opinion that the digital format was at the forefront of positive technological changes in the industry. However, owing to the nature of the digital printing process, three participants expressed the belief that the quality of digital prints was not as high as that achieved with woven or screen-printed textiles.

Another aspect of creative exploration for multiple participants was the investigation and selection of fabrics. Designers explained how particular fabric constructions (e.g., weave structures) were chosen based upon the type of pattern, printing process, color, price, and the intended end use of the finished product. Further, content analysis of interview data revealed that fabric construction choices impacted design choices, such as pattern design and fiber choice.

There are different looks and for different patterns you would use a different fabric so if you have something that's really fine and it's a toile that has very, very, fine line work you would want to pick a fabric that is not too chunky so you can print that pattern on it (Participant 9).

This designer explained that the type of fabric impacts the aesthetic qualities of the pattern. This example shows that the weight of the fabric will influence the appearance of the pattern and therefore, fabric choice will be determined by the type of pattern. Another print designer stressed the same point by comparing two types of fabric, jersey and linen.

You have to know that every pattern is not going to translate to every base cloth. You're going to a very different look printing on a jersey as you would on a linen and you have

to be aware of that and you have to know the printing process and if what you're imaging is even going to translate (Participant 10).

Explicit here is the importance of understanding that a pattern will render differently on various types of fabric and that fabric selection may impact the desired look of the design in its finished form. This quote also emphasizes the importance of understanding the relationship between the printing process and fabric selection.

Participants expressed the idea that the specific project parameters influence creative exploration, in particular when choosing fabric type. Noted below are examples of requirements relative to a commercial textile project.

We either use a construction we're familiar with or we like, or use a new construction or if the need, if for hospitality, and we have to meet a certain price point, and certain colors...so we'll pick our source based on the need and the rationale of the product (Participant 12).

This quote demonstrates that fabric construction may be determined by project requirements such as end use, color, and price point, but it also expresses the idea that such requirements provide a justification for product development and sourcing and implies that the designer must negotiate the options to develop and deliver a product that fulfills the desired needs or requirements.

Product Samples

The fifth theme observed through the interviews conducted with textile designers relates to the acquisition or manufacturing of textile product samples. Upon approval of the design, more than half the participants reported that they engage in the production of textile product samples, which are then tested for performance and quality (e.g. abrasion resistance, washability, shrinkage) and sometimes revised to modify visual elements such as color and/or pattern. All participants indicated that they relied on experts at the textile mills to provide assistance in the

product sampling process including, but not limited to, fiber sourcing, weaving, and fabric sourcing, and printing. Once the pattern is woven or printed, the design process frequently involves receiving print or fabric samples prior to production and samples are then inspected for appearance.

We see a sample or a blanket or a strike off of our design and there's tweaks that go on throughout that we may loop back and reconstruct a little bit or adjust the design once you see it in a big piece or try it in a few colorways to make sure it colors in a way we are looking to do (Participant 4).

Explicit in this quote is the need to view the design in fabric form in order to assess the quality of the print relative to desired outcomes. By examining samples, the designer is able to determine if there is a need to revisit previous steps in the design process in order to fine-tune the design in regard to color and/or pattern.

Another aspect of the sampling process that was addressed by participants was the testing of materials. Each of the four companies that sell contract textiles explained that in-depth material testing was required to meet the established regulations for commercial textiles. For commercial fabrics, testing is conducted by both internal and external agencies to ensure that the products meet standards for performance and safety.

We have trials and we have to test yardage which we look at, we analyze for different quality, go through a battery of tests because it's a commercial end use we have to meet tons of requirement and standards, flame redundancy and abrasion, performance (Participant 6).

Explicit in this quote is the importance of quality assurance and assessment in the development of commercial textiles, including the need to meet industry established standards of quality, performance, and safety for fabrics, based upon product end use. Also implied here is the need on the part of the designers to be knowledgeable about industry standards as well as the specific types of testing methods used to assess quality, performance, and safety.

Design Completion

The last theme related to engagement in the conceptualization and development of interior textile products is the completion of the design process culminating in the launch of the product marketing. Participants interviewed for this study viewed the design process as finalized when products were introduced into the marketplace or delivered to a client. In many cases, however, designer involvement is required in the marketing and selling of finished goods, beyond the production stage. Although more than half the represented companies employed sales teams and individuals to introduce product lines to consumers, as the following quotes suggest, designers often play an important role in marketing and selling the products as well.

Everything gets sent to our sales reps along with training videos that the creative [design] team puts together to communicate our vision, our inspiration (Participant 6).

When I'm trying to get a new rep I certainly spend the time putting those things [sample books] together with my whole back story in a beautiful book and that's sent off to her (Participant 5).

Both quotes demonstrate the role of designer in introducing the designs to the market. Also, the quotes convey how the designers and their process play an integral role in how the products are visually presented. Implied is the commitment of the designers to ensure that their products are represented in a way that is true to their creative vision.

Human Health and Environmental Consideration Throughout the Life Cycle of Interior Textile Products

To investigate the ways in which designers of interior textile products consider human health and the environment throughout the product design process, participants also were asked to address product life cycle. Content analysis of these data revealed six themes pertaining to the life cycle of an interior textile product. These themes were, raw material selection, textile

fabrication: weaving, printing, and dyeing; finishes and treatments; packaging and transportation; customer care, and post use.

Raw Material Selection

The first theme of the interior textile life cycle identified by participants was the selection of raw materials. The raw materials sourced by participants included both natural and synthetic fibers and/or fabrics such as cotton, linen and polyester. In addition, two DfE-oriented companies manufactured their own bio-based or biopolymer fibers for their textiles. Participants indicated that raw material selection was generally based upon a variety of characteristics, including but not limited to, fiber content, hand, aesthetic quality, performance, intended end use, and cost. One participant discussed how the textile properties influenced fiber choice.

It's primarily influenced by the textile itself, we're really influenced by how something feels...we're not going to put a two color print on a bad cotton base cloth, a lot of what we want are things that have washability, but very high quality (Participant 10).

This quote highlights the significance of the textile's hand, as well as quality and performance when selecting a fabric. Further, the statement implies that these characteristics do not have to be compromised when negotiating between desired qualities.

All participants expressed the need to see and feel materials before manufacturing, in part due to the need to plan for end use. For instance, one participant explained the need to choose appropriate fiber content for window draperies.

There are folks who feel very differently about the use of polyester, but...I know having some polyester in the fabric is going to help as far as draping...There are a lot of people who don't like 100% linen or 100% natural fiber because it's going to wrinkle easily so I feel that the polyester content, which is only 20% and all recycled, serves a practical function in drapery application...so watching the balance between natural and polyester fibers is important (Participant 1).

This quote emphasizes the need to be educated on fiber content when choosing fabrics for products that have specific end uses in the home. Further, the participant highlighted two

conflicting issues in regard to raw material choice, the consumer demand for wrinkle free fabrics and the stigma of using polyester versus natural fibers. This designer identified a solution of manipulating the percentage of fiber content by type and incorporating recycled fibers to please consumers and critics.

Analysis revealed one notable difference between conventional and DfE-oriented designers in regard to material selection. DfE-oriented designers gave greater attention to fiber content as it relates to environmental impact than did conventional designers, who tended to focus more upon product performance needs. For example, when speaking about a wallpaper textile product, one DfE designer explained that the material “had a really nice sustainability profile, good recycle content, it didn’t contain PVC, POAs or any harsh chemicals, very low VOC emissions” (Participant 1). Even though conventional designers spoke of fiber content, as well as the environmental impact of fiber content, their choices were not driven primarily by human health or environmental considerations.

Textile Fabrication: Weaving, Printing and Dyeing

The next theme pertaining to the life cycle of a textile was textile fabrication, which includes the weaving, printing and dyeing processes. After the raw materials were selected, the textile was typically fabricated by one of two methods, either by weaving a pattern from dyed yarns, or printing a pattern on top of a woven base cloth. Participants’ accounts on the subject of weaving, printing and dyeing included reference to; weave construction, type of printing process, and type of dye used during the printing process. Of the twelve participants, six represented companies that design woven textiles. The other half represented companies that design printed textiles, or both wovens and printed textiles. Dobby and jacquard weaves were identified as

common methods of production for woven fabrics and screen and digital prints were identified as common methods of printing.

The companies represented in this study chose the method by which to fabricate textiles for a variety of reasons including, but not limited to, market demand, type of pattern, quality, experience with process and aesthetic preference. One designer praised the use of woven textile due to nostalgia for the craft.

Weaving is something that's been around forever and I think there's been an increase in value and attention to artisanal mills and fibers (Participant 12).

Implicit in this quote is a respect for the history and quality of the woven textile, and in particular for textiles that are created using manual processes. Other than the mention of support for individual weavers, participants did not address the relationship between human health and environmental impact and type of textile fabrication, except in the case of digital printing. Two DfE-oriented designers praised digital technology because, unlike a screen print that has to be built and cut for every pattern, the digital printer can create any pattern easily and therefore smaller yardage minimums are required for production. As a result, designers are able to print small runs of their fabrics to sell according to demand, thus reducing the potential for waste in the form of unused fabric. In addition, the three DfE-oriented designers noted the advancement of the digital technology to produce more color variety.

There are new interesting venues to make products and for us a lot of that can be digital imaging which is really cool from a print perspective for most production in the past you're limited to a certain number of colors to have in the design...you're also able to print on different substrates, metal, wool, and different wall covering (Participant 12).

In addition to the color variety, this participant noted the attribute of printing patterns on different substrates. Implicit in the quote is the notion that digital printing creates an opportunity for companies to explore more material options for products.

Only two participants stated that they were directly involved in selecting the dyes used for the weaving and printing processes. The remaining participants stated that dyeing decisions were made by the mills or printers, which limited the choice of dye. However, four participants stated that the mills were chosen because they used “environmentally” or “water based” dyes. In addition, type of dye was generally determined by the way the dye was to be applied to the fiber or fabric, what type of raw material was used, and the intended end use of the product. One participant worked in a screen print facility and therefore chose the ingredients used to produce dyes.

Our pigments are water based and low tox...base products are essentially a binder, a thickener and our base pigment, our saturated base pigment, and there are a whole other variable element-let's just call them, for lack of a better word-chemicals, that you would add to things to make it different properties maybe, you add another additive when you printed on an already treated material and that helps it suck into the fiber which is kind of like rubbing alcohol. You might add a mildew [resistant] or UV [protectant] additive so the pigment lasts longer in direct sunlight. For most pigments you typically don't add any of those things, it's water, it's a binder, it's a thickener and a base color (Participant 7).

This participant explained how dyes are constructed and implied that water based dyes are less toxic than other types of dyes. However, as stated, water based dyes can include additives to improve the performance (e.g., colorfastness, stain resistance) of the finished product. The following quote refers to solution dyeing, which is the process of applying a dye directly to synthetic fibers at the solution stage of fiber production before the yarn is produced and the textile is woven, and the potential benefits to this process.

If it's a solution dyed fiber for instance then we know it can be cleaned with harsher chemicals, it can be cleaned with bleach and color won't be released from the fiber so we have some advantages to perhaps leaving the finish off and have a lower environmental impact that way (Participant 11).

This quote demonstrates the different environmental consequences considered when deciding dye processes. As noted above, when the dyeing occurs before the fiber is formed the dye

becomes a part of the fiber (i.e., the solution), thereby making the finished textile more colorfast (Kadolph, 2010). Thus, solution dyeing provides companies with an opportunity to manufacture a high performance textile without additional performance finishes (e.g., UV protectant, stain repellent) and eliminating these finishes reduces the environmental impact. As such, the designer is able to influence later stages in the life cycle, such as the application of finishes, by choosing the type of dye process such as, solution dyeing.

Finishes and Treatments

The third theme identified through content analysis was textile finishes and treatments. Although textiles can be treated at different points throughout the weaving and printing processes, a majority of the participants addressed finishes that were applied after a textile is manufactured. Narratives on the subject of textile finishes and treatments focused upon intended use of product, imposed regulations, and human health and environmental impact due to the type of chemicals used. In particular, the participants who created contract textiles are required to use performance enhancing finishes in order to comply with safety and performance standard requirements, and differ from standards for textiles used in residential furnishings and clothing. Participants from contract companies explained that because contract textiles were used in hospitals, offices, and schools they were subject to higher traffic and different needs than textiles intended for residential use. These fabrics need to be high performance textiles meaning that they need to be more durable, to withstand cleaning by harsher chemicals, and to follow state and federal guidelines for safety. Through participant accounts of textile finishes, it was found that chemical finishes are applied to the textiles for a variety of reasons including, but not limited to, industry imposed standards (i.e., flame-retardant, antimicrobial) and market demands related to

performance (i.e., UV protection, stain resistance). The following quote speaks to the reasoning behind using a performance finish.

We choose our finishes based on the market that we want to go after...for instance, we have a textile coming out we want to market towards a higher education application and hospitality so both of those fields look for high abrasion results and for stain resistance, and kind of bigger, more hefty [fabrics]. So we'll use [name omitted] it's basically a finish on the top and back [of the textile] and it's very high performance...Where as something like our [collection name omitted] is more corporate and more expensive, it's probably not going to get a lot of wear so we probably won't finish it at all (Participant 8).

This statement demonstrates that fabrics, when intended for heavy traffic, will require the application of finishes so that the textile can last longer in the intended setting, whereas textiles exposed to lighter customer use may not require performance enhancing finishes. Further, the quote implies that different consumer markets will look for specific characteristics when choosing textiles, such as performance enhancing finishes.

Three DfE-oriented designers explored nanotechnology as an alternative to chemical finishes, however, almost all participants recognized that the healthiest textiles are the ones without any finish treatment.

We are really big believers in no finish is the best finish...there are many finishes that won't allow bacteria to grow but then the finish is bad for the environment, bad for you to inhale so we don't go that route (Participant 6).

This participant advocated for not using finishes due to their negative impacts on the environment and human health (i.e., air quality). This quote also demonstrates the contradiction in the purpose of some treatments, which is that although a finish may eliminate one problem, such as bacteria, it also may create other health and environmental problems. Customer concern over this issue was expressed by a participant representing a non DfE-oriented company that carries some products without finishes.

A few companies offer greener options as far as finishes...but the greenest way to finish a fabric honestly is not to finish at all. And it really comes down to the market, for instance, in California, a lot of people won't use fabrics that have any finishes so we do warehouse a few of our popular fabrics that come with a standard finish, [or] without a finish (Participant 8).

This participant explained that finishes can be harmful, even the ones promoted as better for the environment, and thus the 'greenest' approach is to avoid the use of finishes altogether. This participant also acknowledged that some consumers are aware of the danger of finishes, which influences the company's product assortment. Specifically, this company addresses the varied consumer demand for textiles by carrying fabric both with and without finishes.

Packaging and Transportation

The fourth theme related to the interior textile product life cycle was packaging and transportation. More than half of the participants indicated that their companies sourced materials or manufactured component parts of the textile product through mills in the United States and in Europe or Asia, which, in turn, necessitates product packaging and transportation. Though participants rarely addressed the topics of packaging and transportation in the interviews, waste, cost, carbon footprint, and chemicals were mentioned relative to these topics. All participants expressed the desire to reduce packaging and transportation impacts, however, the ways by which products are packed and shipped were viewed as out of the control of the designer, either because the product was packaged at the mill or because it was handled by another department in their company. One participant expressed awareness of package waste, but indicated that control of how things are packed was in the hands of another employee.

Some of our rugs, they're in a bag inside a bag, inside a bag, and then we re-bag them. It's something our warehouse manager has been looking at, but it takes looking at something after a container comes in and broken down and product put on shelves, the amount of waste is a lot (Participant 10).

This participant demonstrated an awareness of package waste and emphasized the role of the mill and warehouse staff in controlling the amount of packaging used to ship a product before it is displayed in a retail setting. This participant conveyed dissatisfaction with the practice of over packaging and concluded that it results in a large amount of waste. Also, it was recognized that the amount of waste could only be seen at the end of the transportation chain. Another participant saw the opportunity to influence packaging for products in a retail setting by using recycled and reusable packaging.

I print all my [letter] head on it (hemp paper), I print my business cards on it, I use recycled brown tissue paper and recycled brown pages for my products...I use recycled paper from [name omitted] if I'm sending pages and pages of my eco data to someone (Participant 5).

The above quote demonstrates a variety of ways in which one designer utilized environmentally sensitive materials for the presentation and promotion of the textile products. The quote also highlights this designer's holistic approach to using environmentally sensitive materials for daily operations such as business cards, as well as decorative elements such as wrapping the products.

Similar to packaging, participants viewed method of transportation as outside the scope of their control. One participant, however, addressed transportation issues when drawing a comparison between the carbon footprint created when sourcing cotton in the United States versus India.

Three or four years ago and I tried to analyze the carbon footprint of India production vs. US production because I was curious about how different was it to be coming from so far away. Because in the United States the fabric was bouncing around from so many different locations and being fully vertical in India, the footprint in India was much larger but not as drastic as you would think. Trucking is so much more carbon intensive than boat which is how the fabric gets to us, by boat and then by train (Participant 3).

Though the specific information in this quote cannot be validated, a 2013 study by the Environmental Protection Agency shows that heavy duty trucks account for 22% of the overall

green house gas emissions produced by the transportation sector versus 3% emissions from boats (United States Environmental Protection Agency, 2013). Thus, this quote highlights issues regarding the environmental impact of varying types of transport resulting from specific production methods and locations and proximity to point of sale. The implication here is that vertically integrated production in another country may have a lower than expected environmental impact compared to domestic sourcing, which often involves horizontally integrated production (i.e., weaving, dyeing, and finishing occurring at separate locations) and greater reliance on truck transportation throughout the production processes. Another company addressed production of carbon emissions by imputing all of its energy use, including employee transportation, into a computer program to calculate carbon footprint.

We look to make reductions across many activities that impact carbon, heating and lighting our facilities, transportation as it related to both our people and our product...we're imputing things like our utility bills, our employees' travel records flying and driving (Participant 11).

This participant was the only one to address reductions in its company's carbon footprint in regard to all forms of transportation during the life cycle of a product, including employee travel. Also taken into account here is the environmental impact of the business itself, including day-to-day operations.

Another issue pertaining to the transportation phase of the interior textile life cycle was the use of chemicals to protect freight while being shipped. One participant claimed that formaldehyde is frequently used in containers shipped from countries such as China and India.

I don't care if it was organic in India or organic in China because it has then been sprayed with formaldehyde when it's brought into this country so it's really no longer organic and that is a really amazing awareness to have, especially when the marketplace advertised as this such desired quality...in essence unless it's been flown in, that's the only thing that prevents it from being sprayed with formaldehyde...that element is very important because on top of the carbon footprint, which is huge because you're shipping something

from another country, you're also exposing it to formaldehyde which negates the organic element (Participant 7).

Research suggests that fumigants are used in shipping containers and can be harmful to the human health of workers, even those who handle apparel, however, the claim specific to organic textiles is not addressed in current research (Preisser, Budnik, & Baur 2012). This quote raises yet another issue regarding the human health and environmental impact resulting from the selected method of product transport; specifically the potentially harmful chemicals or other substances that fabrics or products might be exposed to during this phase. This participant's account of chemical use at the transport stage suggests that exposure to chemicals influences human health and the organic nature of a product, and, therefore, textiles should only be air freighted when sourced internationally. Further implied is that what happens during the transportation stage should be transparent to the consumer, in particular for credibility of an organic labeled product.

Consumer Use and Care

The sixth theme discovered through participants' narratives of the textile life cycle, was the consumer use and care of products. Participants' accounts of consumer care focused primarily upon the topic of textile cleaning, whereas accounts of consumer use focused upon how long the product was to be used in the home. Even though more than half of the participants gave care recommendations for their products, once the textile was transported and sold to the customer, as yardage or as an interior product, the way the textile was used and cared for was seen as something outside the control of the designer. Interviews with the participants revealed that care instructions were dictated by either the mill or the designer, and varied depending on the end use of the product.

We do ask the mill what their cleaning instructions would be for the qualities, but we also look into it ourselves and make the best recommendations for the clients (Participant 6).

The above quote clearly suggests a relationship between cleaning methods and textile qualities, or characteristics. This quote also implies that client satisfaction is an important consideration at this stage because the designer and company do not rely entirely upon the recommendation of the mill, but rather, engage in independent research to ensure that the most appropriate care instructions are provided to the client. As indicated in the following quote, more than half the participants who design general textiles or textiles for residential purposes recommended specific care instructions for their textile products.

We have washing instructions on our site which is basically using environmentally detergent and hang dry when you can, all of our fabric can be put in the dryer but for environmental reasons we recommend hang dry (Participant 3).

This quote highlights two care issues, type of detergent and method of drying, that are addressed on the company website to assist customers with product care. Also, explicit in the quote is the company's effort to encourage care methods that will reduce negative impacts on the environment. One DfE-oriented designer expressed a desire to be more responsible toward consumers by providing more information about textile product care.

I think today we feel responsible to our consumers, it's a more direct scientific care instructions...we did our staining studies on this and this is how you would address specific oil based, water based, or tougher health care stains (Participant 11).

This participant explained the need to provide more scientific care instructions based upon research that the company conducted to examine the effectiveness of different care methods when addressing specific types of stains on textiles. In particular, implicit in this quote is that there are varied care needs for different uses and settings, such as in health care. For some designers, consumer care of textile products was seen as outside the control of the designer. The

following quote illustrates the point that designers need to fully consider how consumers might choose to care for a product, despite the care instructions or recommendations that are provided.

The care is a huge huge thing and most people in the US want to machine wash and tumble dry and we try to do that as much as possible and it's always a consideration, well is somebody really going to dry clean that because there are a surprising number of returns because people don't follow the wash care and then say the product is faulty (Participant 10).

In the opinion of this participant, consumers have a preference for machine washing and drying, and thus do not always follow the care instructions for products. The implication here is that designers need to give consideration to this preference, because it may lead to damaged goods, returned products, and lower consumer satisfaction.

Four participants addressed issues related to the potential impacts to human health during the use phase of the textile product life cycle, including mentions of chemicals in the home, indoor air quality, and off-gassing. When addressing sustainability issues in relation to interior textile production and product use, one participant highlighted human health impacts.

It's (about) making something that lasts that isn't going to affect us in any harmful way, leaching chemicals or off-gassing in my case (Participant 5, 8/20).

This participant's statement suggests knowledge that the chemicals in interior textile products can be harmful during the use phase, specifically due to products off-gassing. Further, the use of the word "my" implies a sense of personal responsibility to create products that will not be harmful to human health due to products releasing chemicals into the home.

Perspectives on consumer use of interior textile products, and their intended length of use, varied among participants. The participants from contract companies viewed longevity in terms of the textile double rub test for fabric strength (i.e., wear and tear). It was explained that heavy-duty textiles are those that meet the highest standards (i.e., top classification) for wear and tear usually using the Wyzenbeck test for abrasion performance (e.g., 100,000 double rubs),

which refers to the number of times the textile can be rubbed in a back and forth motion before the fibers begin to deteriorate and impact product appearance and performance. This term is meant to predict the life of the textile for its particular end use (e.g. commercial or residential use) and was achieved through the selection of raw materials and finishes.

I don't know if we would plan for a shorter (product) life, depending on where the product is going you can kind of expect there are different lifetimes for different end uses... You want to make it bullet proof if you're doing something that's going in to an auditorium or stadium and part of the expectation of that item is high, and (fiber) content does come into play... we have an extreme performance category [that] for us has an abrasion (score)...and then it typically has a high performance finish (Participant 12).

This quote suggests a relationship between material abrasion rating, product use and product longevity. Also, it implies that the designer must consider wear and tear when making material and finish choices to better predict the length of the textile's life.

Post Use

Post consumer use was the final theme of the interior textile product life cycle revealed through participants' accounts. Post use was presented as relevant in four ways, product longevity, consumer waste, product return programs, and fiber choice. Two designers described their products as timeless and expressed the hope that their products would never be disposed of, but rather might be donated to a museum or passed down to others.

The U.S. consumer is really, really wasteful and, again, it's something in our company, we want to make things that you're going to pass down, we don't sell products that you're going to throw away (Participant 10).

Explicit in the above quote is the belief that the company is creating products that will become heirlooms to be passed down through generations and therefore used and cared for in a precious way. The idea of reducing waste by investing in a product that would exist or perform overtime was noted by two participants in relation to consumer clothing use and disposal.

Nobody buys clothing anymore to sit in your closet for ten years, they buy it and get rid of it, think about what that does for the environment, because they can buy for 10 dollars versus investing in something that will last a long time (Participant 4).

This participant referenced a growing tendency among consumers of buying inexpensive products that do not last very long and are often discarded after a short time. Also, implicit in the quote is the idea that if consumers buy better quality products that perform better and wear longer the environmental impact of clothing consumption will be lowered. None of the participants discussed upcycling, the act of reusing materials at the post use stage of the life cycle, as a strategy for waste reduction; however, the one alternative to post use disposal that was addressed was a company-operated textile product return program.

We have a responsible return program, you can send it back and it will get burnt down and made into energy or something else in the polypropylene line (Participant 6).

The program described above encourages the consumer to return products after use rather than simply throwing products away. When returned, the company can remanufacture the textile into raw material form. Further, this statement suggests that a textile can serve as an energy source after consumer use.

Another topic, related to post use, that arose in participants' narratives was planning for disposal when choosing a raw material and using natural versus synthetic fabrics due to the difference in how the fibers decompose.

The materials I've chosen to use are kinds of materials that literally can be put into a landfill and biodegrade, they're not just sitting there forever (Participant 5).

This quote highlights the participant's awareness of the issue of products that sit in landfills and take an extensive amount of time to decompose. Though this designer's products may not be biodegradable per se, the statement suggests that the raw materials are chosen because they can naturally decompose and therefore do not take as long to breakdown, as do synthetic material

options. Two companies addressed the issue of decomposition and reuse at the post use stage of the product life cycle by manufacturing fabrics that are biodegradable (compostable) or are made from waste products.

We are looking to find ways to create products that do not end up as waste and that incorporate waste as their feed stock to begin with...the best model is a very recently developed product that's 100% recycled polyester fabric where the inputs, the feed stock for it, comes partially from our own recycled panel fabric cutting waste from the workroom floor...and that goes into a process of being made into yarn and woven into the fabric and the fabric itself goes through the same process (Participant 11).

The idea represented in this quote is that the post use stage of the product life cycle can be planned for and anticipated through material choices and changes in production methods. In this case, the fabric is manufactured by incorporating textile waste and previously manufactured textiles, therefore reducing waste and the need to manufacture new raw materials. This statement suggests that within the life cycle of the fabric, the post use stage and the raw material stage of the product life cycle are interconnected, and that in such a model efforts are undertaken to eliminate product disposal in landfills.

Current Challenges and Future Practices

Content analysis of participant interviews revealed additional themes pertaining to DfE-oriented design approaches on the topic of industry challenges and future practices. Designers who practiced both DfE-oriented and conventional approaches to design addressed industry challenges and future practices related to environmental and human health impacts. These themes included, but were not limited to, the DfE-oriented consumer, 3rd party standards, and sourcing and partnerships.

DfE-Oriented Consumer

Participants' narratives about the consumers of DfE-oriented interior textile products revealed both challenges and possible future practices in the textile industry. When speaking

specifically about DfE-oriented textile consumers, participants addressed the subthemes of product demand, knowledge, and education. Although participants acknowledged an increase in the popularity of DfE-oriented products, one participant also spoke to inconsistencies in consumer demand for other DfE-oriented approaches, such as locally made and hand stitched textiles.

I find it so disappointing that we have customers that want to buy a handmade product and that's part of the allure but when they get it, if there's a slight imperfection because somebody has stitched this by hand or cut this by hand, people want to say they have a hand made product but want machine made consistency (Participant 10).

This quote speaks to the challenge of meeting consumer demands or tastes for artisan textile products and simultaneously meeting consumer expectations for product quality that may be influenced by mass production methods or standards, such as with the noted example of regularity in stitching. Further, the quote clearly conveys the fact that the designer is disenchanted by the consumer's fickle demand for handmade vs. machine made products.

Though the market for DfE-oriented textile products appears to be relatively small, analysis revealed that participants perceived an increase in consumer demand for, as well as greater availability of, environmentally-friendly or sustainable products and materials over the course of participants' time in the industry.

There's more organic cotton, more choices in construction of weaves, because customers are asking for it, even interior designers ask for it. I'm amazed that they say "I'm coming in because you're offering an eco fabric and I can't find it around here". I never heard that when I started out, they were like "what does it mean? I thought organics were only in food" (Participant 5).

This quote suggests growth in the demand for DfE-oriented products, which is derived through an increase of DfE-oriented raw materials and fabric construction methods and supported by a growing awareness of DfE-oriented textile products among consumers. It also implies, however,

that the availability of such products is still limited, which may pose a challenge to clients, such as interior designers, who desire sustainable products for residential and commercial interiors.

In addition to the perceived increase in demand for the DfE-oriented interior textile products, designers perceived an increase in consumer demand for information about or knowledge of the potential human health and environmental impacts of the textile manufacturing processes.

The textile supply chain is a fairly deep and long one and accessing data from far upstream has become more important to our end customers, there's a lot of demand for transparency whether that be around issues of ...how employees are treated...chemical input and their potential health or hazard, it could be related to energy and carbon aspect (Participant 11).

In this case, it is implied that consumers are becoming more educated about the potential harm of textile manufacturing, however, the challenge lies in accessing the information on behalf of the consumer. In particular, it appears that some information can only be obtained through a detailed understanding of the supply chain of textile products, and that some of this information may be concealed or difficult to acquire.

Although some participants noted an increase in consumer knowledge of issues surrounding the production of textiles, four participants addressed the need to educate consumers on human health and environmental impacts of interior textile products.

You have the whole process of educating people on...bringing materials into your home that may be off-gassing and how much time they spend inside (Participant 1).

Explicit in this quote is the concern that consumers need to be educated about the potential human health impact from exposure to chemically-treated textiles in the home, including the relationship between chemical exposure and the amount of time spent in the home. In particular, this participant noted the need to educate consumers about the issue of off-gassing and poor indoor air quality, which can occur in the home environment through the use of glues and stain

resistant finishes on carpeting, upholstered furniture, and other textile products. The implicit challenge here is how to educate consumers so that they may make fully informed choices relative to the selection of environmentally-friendly or sustainable interior textile products. Two participants acknowledged the role of consumer education as crucial to the DfE-oriented design industry and took it upon themselves to become educators about issues surrounding textile manufacturing.

I think my calling is probably education and doing more on that because I think what's really missing is that the consumer doesn't understand why it (sustainability) is important and unless somebody tells that story they're not really going to know (Participant 3).

Implicit in this quote is the difficulty faced by DfE-oriented designers who consider human health and environmental issues when creating products, yet they often encounter consumers who have yet to become aware of the importance of these issues. Additionally, it is assumed that this type of information would be seen as relevant if understood by the consumer. This participant also shared the belief that information regarding the textile industry is not readily available and thus creates a need for formal education.

3rd Party Standards

The second theme pertaining to industry challenges and future practices that was identified through content analysis was 3rd party standards, testing and/or certification. Participants explained that 3rd parties were used for material testing, industry certification, and to monitor the environmental and social records of mills and materials. As such, half of the participants cited 3rd party testing and standards as a way to decrease the human health and environmental impacts of textile production and to establish more sustainable practices to gain credibility in the market.

The two most frequently cited 3rd party organizations by participants were GOTS and ACT (Association of Contract Textiles). GOTS was primarily used by smaller DfE-oriented companies to assist in choosing raw materials from sources that adhere to particular environmental and social standards and are then monitored by the organization. The ACT standards are “the guidelines for all the colorfastness, light, abrasion, flame retardency, durability” (Participant 6) required for all certified contract textiles on the market. Designers from the four contract companies referenced ACT guidelines specifically as the 3rd party standard used for their textiles. Regardless of which 3rd party organization was employed, all participants’ accounts of mill and fabric choices referenced some type of 3rd party standards or testing.

The (fabrics) are coming from a company that focuses on how the workers are treated, how the fibers are being grown, all those kinds of things, but to a certain degree you have to rely on 3rd parties for those things (Participant 1).

As conveyed in the quote above, 3rd parties provide specific information about environmental and social business practices that are increasingly perceived as important to the production of textiles. Further, this quote implies that companies may not be able to easily or fully obtain information about raw material and fabric production practices without the services of 3rd parties. All participants who sourced materials from foreign companies expressed reliance upon 3rd parties in order to gather credible information regarding environmental and social business practices. For example, 3rd party certification, such as that provided by the ISO (International Organization for Standardization), was used to verify production standards related to working conditions and environmental impacts in foreign factories.

Every mill we work with goes through a very strong check, background check from us in terms of being ISO 9000 certified...what happens in the mills, water consumption, recyclability, how they treat employees...being a provider of textiles, we make sure our mills are behaving properly (Participant 4).

Implicit in the quote is the possibility that mills may not comply with particular social and environmental standards deemed important to this company, and for this reason, 3rd parties are needed to thoroughly investigate these mills. This quote also demonstrates the variety of criteria that can be evaluated by 3rd parties, such as water treatment and employee relations. Participant narratives also revealed some limitations regarding the current scope of 3rd party standards and certifications. As the following quote indicates, some DfE-oriented fibers, such as hemp, are not certified by GOTS.

It's hemp that I focus on, you know you can't even get hemp certified it's just not in the parameters [of GOTS] (Participant 5).

Although this fiber was considered outside criteria of the GOTS standard, this designer continued to use it for DfE-oriented textile products. Demonstrated by this designer's challenge with certification, this quote expresses the limited scope of 3rd parties in regulating or encompassing all possible DfE avenues in textile production.

Participants suggested that the expansion of 3rd parties could be a way towards achieving higher environmental standards for textiles and promoting accountability for textile companies. Three designers addressed the need to have a group that regulates how products are marketed to the public and that can enforce regulations that require companies be more transparent regarding their textile production methods.

What I believe would help is more accountability. It is way too free, anyone can say anything and there's no accountability there's no one to hold them to what they're saying...I think there should be a 3rd party team...(that) would actually do something when people don't do what they say they're doing, putting things out there like vinyl which is a proven human carcinogen and putting it next to green vinyl or recycled vinyl (Participant 6).

Evident in this quote is the participant's belief that companies can take advantage of loose or non-existent regulations by promoting their textile products in ways that may be deceptive to the

public. Explicit in this quote is a call for 3rd party regulation so that only companies that comply with environmental standards would be able to promote themselves as such. In addition to increased regulation, half of the designers spoke of 3rd parties as a way by which to improve human health and environmental standards for textiles production.

Years down the road [sustainability] might be something that is more strictly enforced and be a standard because there are so many different aspects, there are thousands (of) different aspects that make one textile look really environmental...I think having that tool simplifies it for not only the mill but the developers...the consumers so they really know what they're buying and having it simple and comprehensive (Participant 8).

This participant raised the need for additional standards to address the complexity of the issue, that is, the magnitude of factors that need to be considered when attempting to produce a more environmentally sensitive product. The opinion of this designer is that a 3rd party could provide a simplistic, yet comprehensive, system or tool by which to evaluate standards for sustainable practices that would benefit companies, mills and consumers.

Sourcing and Partnerships

Another challenge revealed through analysis of the participants' interview data was how to identify and select mills and other supporting industry partners. Identifying the right partnerships was viewed as a challenge as well as an avenue towards establishing a more sustainable industry. Participants' accounts of challenges related to sourcing and supporting industries included product quality, sourcing location, and technological advances within the textile industry.

Participants' accounts of sourcing and supporting industries included references to fiber or fabric mills, dye suppliers, colorists, converters, weavers, printers, sewers and upholsterers. Participants stated that they chose mills based upon a variety of factors, including the need of the project (i.e., residential, contract) and the type of company (i.e. printer, wholesaler, retailer).

Other factors identified were, previous experience with the mills, environmental and social practices of the mills, quality of the material, type of product offered, and accessibility to mill. All participants addressed quality issues when talking about the challenges associated with product sourcing, and most isolated color matching as a prevalent quality issue.

You can have a swatch of fabric and say “match this color”...they (mills) have over the years sent me strike offs for color approvals and I don’t know why because it never matches what I pick (Participant 3).

This quote conveys the frustration one designer has experienced when working with mills, specifically the inconsistency in color between the pattern design and sample textile product. Also, that the designer had been experiencing this problem over a long period of time, but continued to work with the mill, implies that color-matching may be a challenging aspect of textile development, which a designer may not be able to control. In addition to color matching, raw material quality and textile print quality were viewed as important issues when selecting locally or globally sourced materials.

This is our third U.S. printer, the first two have closed. The first one lost our business, not because they closed, though they since have closed, but they lost our business because the quality control was atrocious. It was so disheartening, we went to India not in search of cheap but in search of quality and we get better quality...and that’s why I’m so torn about Made in the USA, if you can get me a quality product I would be happy to stay here, if not I can’t, if I don’t have a quality product, I don’t have a business (Participant 3).

This participant expressed frustration with the quality of print work provided by supporting industries in the United States. Although the designer expressed a desire to work with domestic printers, the designer also explained that the primary criterion for choosing a mill was its ability to provide high quality prints, which is essential to the success of the business. One participant noted the paucity of U.S. companies that are able to provide the materials needed to make their textile products.

There were twenty-five textile factories of our variety and now there are five. The supporting industry has wildly gotten smaller and there are really only two companies in the country that provide all of the base products we need (Participant 7).

This quote demonstrates the dramatic reduction in the number of U.S. based textile factories, and the subsequent reduction in the number of supporting industries as well. Collectively, this reduction in U.S. partners has created difficulty in sourcing raw materials domestically.

Five participants noted that their companies currently source raw materials from U.S. producers, and/or have domestic manufacturing capabilities, either within their own company or through contract production with factories in the United States. Half of the participants articulated the desire to source and manufacture locally. When addressing future practices that could influence DfE-oriented design, one participant noted that sourcing in the US could have positive economic and social impacts.

I think if we could have more cotton grown in the US, if we could have more products made in the US, kind of focusing on nationality, making things accessible...having more people employed in the US, I think that would all help (Participant 1).

Expressed in the above quote is the idea that sourcing materials and manufacturing products domestically might drive demand by improving the availability of products. Also, that domestic sourcing and manufacturing could increase opportunities for employment in the United States. Though sourcing locally was viewed as positive, one participant expressed the idea that it is important to partner with overseas farmers.

It's like I have hands in both worlds, I like to be able to support India cotton farmers and I like to support Texas cotton farmers...I think we are all connected no matter where we are (Participant 3).

This participant viewed raw material sourcing as a way to support farmers, regardless of their location. Implicit in the quote is that, as a participant in a global industry, designers have a responsibility to provide equal support to domestic and overseas partners. Though other

participants did not articulate this specific perspective, content analysis revealed very little resistance towards sourcing overseas. One of the participants from a company that utilizes U.S. manufacturing, viewed overseas partnerships as a possibility if the manufacturer was aligned with the company's values.

As of now we have not done anything in Asia, it's not out of the question we just haven't found the right partner, there's a lot of things we don't agree with when we try to do business out there (Participant 6).

This quote suggests that overseas manufacturing companies may have disparate values that prevent this company from partnering with them. This statement highlights the importance the company assigns to its own standards and the difficulty that they have matching these standards to those of overseas manufacturers. In addition, that when this company does find a mill that conforms to these values, they may move domestic production overseas.

Four participants expressed the idea that establishing partnerships with supporting industries that employ technological advances, such as digital printing and bio-based materials, is important to the future practices of the textile industry.

Taking what's available to you in order to make this product and doing the best you can with what's available and incorporating new technology and new ingredients as they become available ...I think a lot of that is awareness and partnering and teaming with people who are on the cutting edge of making these changes (Participant 12).

Explicit here is the idea that designers work to develop the best possible products by utilizing current technology and by partnering with businesses that adopt advanced technology to ensure that better techniques and materials will emerge. For example, when discussing a new plant-based pellet to use for textile manufacturing, one company took the initiative to develop the right partnership to develop this technology.

It really stemmed from finding out about this one company, contacting them and doing the research together to get to this point (Participant 6).

This quote demonstrates the benefit of partnering with other companies in the research and development of new technologies. In that it can be advantageous for companies to collaborate, because those partnerships can lead to the advancement of technology and improvement of the textile industry.

CHAPTER FIVE: DISCUSSION AND CONCLUSIONS

The purpose of this study was to gain an understanding of the processes that guide the design of interior textile products. In particular, this study explored designers' perspectives on the design processes in relation to human health and environmental considerations throughout the life cycle of interior textile products. Findings from this study are discussed in relation to three research questions that explored the design processes for interior textile products, the distinctiveness in DfE-oriented design processes, and the considerations for human health and the environment throughout the design processes. In addition, the implications and limitations of the research are addressed and recommendations for future research are provided.

Summary of Findings

Findings from the present work provide insight into the development of interior textile products by addressing three research questions. The first research question asked: What are the processes that inform the design of interior textile products? Participants' accounts of design processes revealed six themes related to the conceptualization and development of interior textile products, including: resources and research, consumer need and trend identification, inspiration, creative exploration, textile sampling, and design completion.

Previous research on the design process in the context of textiles and apparel has focused upon the processes employed by educators and design students (Gam et al., 2009; Labat & Sokolowski, 1999; Parsons & Campbell, 2004; Lamb & Kallal, 1992; Watkins, 1988) as well as theoretical model building in relation to apparel design processes and apparel product development processes (May-Plumlee et al., 1998; May-Plumlee & Little, 2005). Few studies have applied these models or other theoretical foundations to existing business practices

(Handfield et al., 2001). Findings from the content analysis of the narratives about the design processes provided by professionals in the interior textile design industry for the present study were, to some degree, consistent with accounts of the processes provided by educators and students, as reported in prior research. However, narratives obtained in this study revealed additional details and emphasis related to specific themes associated with the design process. Most notably, participants stressed previous experience, and sources of inspiration as important aspects of the design process; yet these items were not explored in previous research. Also, the design processes for interior textile products presented in this study differ from previous research in the way that specific material sourcing as well as consumer need and product trend identification impact design decisions.

One key finding from this study relates to discussions surrounding two themes, research and resources and inspiration, which differs from prior research that rarely isolated these concepts as specific themes that influence the design process. Participants spoke to prior knowledge and information, as well as research, as providing the foundation for design projects. Another difference in the participants' narratives in this study was the emphasis given to, inspiration. Participants explicitly noted the importance of inspiration in the design process and highlighted a variety of sources of inspiration that served as a starting point for the actual design work. Also, in previous studies of apparel design process models the most common starting point is generally acknowledged as "problem identification" followed by "research" (Gam et al., 2009; Labat & Sokolowski, 1999; Lamb & Kallal, 1992; Parsons & Campbell, 2004). Interestingly, none of the participants' interviewed for this study cited problem identification as a basis for design work, but rather noted that projects were assigned to them or initiated organically through inspiration.

Another key finding was that the remaining themes identified through content analysis (i.e., consumer need and trend identification, creative exploration, textile sampling, and design completion) were consistent with findings from previous research, but the depth and specific considerations given to each theme differed; particularly in regard to the application of these themes in a professional, rather than a classroom setting, and in the context of interior textile production. For instance, design process research typically includes a step within which designers explore material options (Gam et al., 2009; Labat & Sokolowski, 1999; Lamb & Kallal, 1992; Parsons & Campbell, 2004); however, such research has not explored the relationship between raw material and design decisions. The participants in this study frequently spoke to the importance of a variety of qualities that are sought out in material selection and how these qualities impact design decisions. Also, the relationship between the designer and mill was noted as a significant factor that influences design decisions and ultimately the final product.

Consistent to previous research (e.g. Lamb & Kallal's 1992 FEA Consumer Needs Model), participants' narratives revealed a particular emphasis on role of consumer information in the design process. However, for interior textile products, consideration of consumer needs also may include attention to industry performance requirements, product pricing and product availability. The data from the present study also suggests that designers and developers of interior textile products gathered information on product trends to guide the direction of design projects. Though this type of "competitive analysis" is addressed in LaBat and Sokolowski's 1999 apparel design process study, findings from this study demonstrate that participants placed a high value on product trends and used research in this area to guide design decisions. In fact, one company held annual meetings to discuss trend forecasting, including areas outside of the textile industry, such as social and technological trends. Taken together, these findings offer

some insight into the processes that inform designers of interior textile products. Most notably that the interior textile design process does overlap with apparel design process research, but that it also involves a more in-depth process that may be the result of creating interior textiles products for a mass market.

The second research question asked: What are the processes employed by DfE-oriented designers of interior textile products? DfE-oriented approaches to design processes have been researched across disciplines, leading to the development of numerous process models (Gagnon et al., 2010). Previous research indicates that variations to conventional design processes are necessary to incorporate human health and environmental considerations into the activities or operations, the primary variation being that deliberate considerations are undertaken throughout the design decision making process (Gagnon et al., 2010; Gam et al., 2009; Handfield et al., 2001). Content analysis conducted for this study revealed findings similar to those in prior research, specifically that all DfE-oriented designers addressed human health and environmental considerations in regard to all aspects of the design process, the single exception being with regard to inspiration. Even though this was the only difference attributed to the processes employed for DfE-oriented textile design as compared to the processes employed for conventional textile design, some variations of the DfE-oriented design processes were noted. These variations included the depth of research conducted on the topic of raw materials as well as on the type of testing required for fabrics. The differences were often attributed to the size of the company (i.e., employee size, revenue) and type of textile produced (i.e., contract, general textile).

An important finding from this study was the steps at which DfE-oriented designers were most likely to consider the human health and environmental impacts were resources and

research, and creative exploration. All participants in this study acknowledged that foundational information, obtained either through formal education, company resources, and/or individual research, was drawn upon to make design decisions. However, for DfE-oriented designers this included either organizational memberships (i.e., LEED Certification) or extensive knowledge of DfE organizational criteria (i.e., GOTS). As a result, these designers demonstrated a larger scope of information and knowledge about human health and environmental issues prior to engaging in the development and conceptualization of interior textile products.

Another notable difference in DfE-oriented design as compared to conventional design was evident in participants' accounts of creative exploration, particularly in regard to choice of materials and production methods. Unlike other designers who may explore and/or select materials and production methods based solely upon creative or performance considerations, DfE-oriented designers engage in creative exploration that is balanced by considerations for the impact of materials and production methods on human health and the environment. This, in turn, may limit their choice for material and production method, framing their scope of exploration. DfE-oriented designers in this study made reference to selecting raw material based on environmental criteria employed by organizations, such as GOTS. This is consistent with research that requires environmental assessments throughout the design process, including material options (Gam et al., 2009).

The final research question was, in what ways do designers of interior textile products consider the impact of the design process on human health and the environment? Content analysis revealed that all participants in this study demonstrated knowledge of issues pertaining to the human health and environmental impact of interior textiles at various stages of the product life cycle. These findings differ from conclusions drawn in Handfield et al. as designers relied on

environmental experts for information and demonstrated very little knowledge of human health and environmental issues as they related to their process (2001). However, consistent to prior research it was found that participants did not discuss all stages of the life cycle, nor did any one participant consider potential impacts associated with all stages of the product life cycle throughout their design processes. In addition, the application stage of the life cycle was not mentioned in relation to human health and environmental impacts, even though it was isolated as important to the interior textile products life cycle in the Design Tex environmental design criteria (Environmental Design, 2013).

Research on life cycle assessments throughout the design process has been published across a multitude of disciplines and studied within professional settings (Ramani et al., 2010). However, to date, this research has not addressed the extent to which industry professionals consider the life cycle of the products they are designing and producing, without the use of a specific measurement tool (i.e., checklist, environmental audit). One key finding in this study is that the consideration of impacts throughout the life cycle was present, but limited, owing to industry standards and regulation; demand for DfE-products, availability of products and production methods; and company size and resources. In addition, product performance and quality were, at times, perceived to be more important to achieve than were reduced impacts to human health and the environment. This was consistent with the findings of Handfield et al., in that the environmental impact of raw materials was viewed as less important than cost and availability (2001).

Even though the human health and environmental impacts of interior textile design and development appeared to be important to all participants, it also was apparent that all designers worked within the limitations of their companies and the industry at large. Content analysis

suggested that the attention participants gave to the various stages of the product life cycle was influenced by the size of the company represented (i.e. amount of employees, resources). This was demonstrated by participants from larger companies that were more likely to have separate departments to investigate particular points in the life cycle, such as raw material vetting, and then provide DfE material recommendations to the designer, thus creating less of a need for the designer to understand the details of raw material sourcing. Another instance when size of the company appeared to be a factor in human health and environmental considerations pertained to smaller DfE-oriented companies with limited financial resources and product demand. Because these smaller DfE-oriented companies were producing less material, and therefore could not meet the higher minimum required by some mills, they had fewer choices in regard to mill and sourcing partnerships and less opportunity to engage in research and development. Also, smaller DfE-oriented companies lacked the ability to implement a complex return program and therefore left decisions at the later stages of the life cycle (i.e., end of use) solely in the hands of the consumer. In contrast, larger DfE-oriented companies were more likely to implement programs addressing issues in the later stages of the life cycle (i.e., end of use) which were found to be more consistent with the Design Tex design criteria. As a result, designers from these smaller companies tended to focus on human health and environmental impacts associated with the first stages of the life cycle (i.e., raw material sourcing), whereas designers from larger companies were more likely to focus on early and later stages of the life cycle (i.e., consumer care and end of use).

Implications

The findings from this study provide both practical and theoretical implications regarding the design processes undertaken to develop interior textile products as well as DfE-oriented

approaches to design. First, findings suggest that designers of interior textiles embrace a holistic approach to the design and development of products that places special emphasis on foundational knowledge and inspiration as well as on product trends and raw material sourcing. Second, this work provides some support for earlier models of the design process, although business practices call for an extended and more in depth process, rather than overlapping steps in a three or four step process.

The findings from this study provide insights for both conventional and DfE-designers of interior textile products. Most notably, that information gathering and sharing, especially between small and large companies could encourage consideration of human health and environmental issues within the design process. Information sharing with consumers also is important, as it can result in increased demand making it easier for designers to implement DfE-oriented approaches, as consumers become more aware of human health and environmental issues. In addition, participants called for enhanced 3rd party standards with increased transparency and enforced accountability to improve the current human health and environmental impacts of the textile industry.

The implication for design process research is that the different area of focus for designers and developers of interior textile products may be associated with how interior textiles perform in the home. This difference in product use may, in part, explain distinctions in the design processes employed for apparel and interior textiles, specifically in regard to how information pertaining to consumer needs, raw materials, and industry performance standards is used to inform the processes. The implication for DfE-oriented approaches to design research is that there are variations in these design processes due to the influence of business practices, calling for more research in this setting. This study highlights the way designers engage in the

design and development of interior textile products and demonstrates that the processes cannot be separated from the industry within which they exist. This is particularly apparent when examining the field of DfE-oriented approaches to design as industry, consumer and technological limitations provide hurdles for the designers who attempt to reduce the impacts to human health and the environment. As a result, designers react to the world in which they work and through a deeper understanding of their situations, better avenues for research to decrease human health and environmental impacts may become available.

Limitations

Due to the exploratory nature of this study, there are a few limitations to the present work that also need to be addressed. First, only twelve designers participated in this study. This relatively small number of participants may be attributed to the specific segment of the interior textile industry being investigated. Another limitation was that industry professionals may be less likely than other populations to participate in academic research due to time constraints and a lack of willingness to share company information. Finally, as is the case with all qualitative research, the data gathered for this study represents participants' perspectives on design processes rather than factual data on issues, such as the human health and environmental impacts of textile design and development. For example, one designer claimed that products made from organic natural fibers will biodegrade without causing environmental harm, this claim cannot be substantiated without specific product research.

Future Research

The findings from the present study provide several suggestions for future research. Future research is necessary for the advancement of practical solutions to reduce the textile industry's impact to human health and the environment. This study provides a basis for future

research in the areas of interior textile design process, DfE-oriented approaches to the design and development of interior textile products, and the relationship between the design process and life cycle of interior textile products as it relates to the impact on human health and the environment. This research could include examinations of specific aspects or themes related to the design process, such as a designer's previous experience and inspiration. Such research would contribute to the topic and offer a deeper understanding of the design processes utilized for interior textile products and in professional settings. Also, the testing of specific materials and products throughout the design process could be beneficial to life cycle research by providing a closer examination of the relationship between the design stage and later stages in the life cycle. Researchers also might explore differences in the theoretical and practical application of DfE-oriented design processes in a business versus a classroom setting. Such a study could help students to incorporate DfE approaches in their design processes, and thus, better prepare students for work in the textile industry. In addition, with continual changes in the textile industry in regard to consumer demand and technology, designers may have the opportunity to implement more effective DfE-oriented strategies, which over time, will present a need for research on the developments in this area.

REFERENCES

- Abreu, M., Castro, F., Soares, F., & Silva Filho, J. (2012). A comparative understanding of corporate social responsibility of textile firms in Brazil and China. *Journal of Cleaner Production*, 20(1), 119-126. doi:10.1016/j.jclepro.2011.08.010
- Aktas, C. B., & Bilec, M. M. (2011). Impact of lifetime on US residential building LCA results. *International Journal of Life Cycle Assessment*, 17(3), 337-349. doi: 10.1007/s11367-011-0363-x
- Albinsson, P. A., & Perera, B. Y. (2009). From trash to treasure and beyond: The meaning of voluntary disposition. *Journal of Consumer Behaviour*, 8(6), 340-353.
- Araji, M. T., & Shakour, S. A. (2013). Realizing the environmental impact of soft materials: Criteria for utilization and design specification. *Materials & Design*, 43, 560-571.
- Bianchi, C., & Birtwistle, G. (2010). Sell, give away, or donate: An exploratory study of fashion clothing disposal behaviour in two countries. *The International Review of Retail, Distribution and Consumer Research*, 20(3), 353-368.
- Birtwistle, G., & Moore C. M. (2007). Fashion clothing – where does it all end up? *International Journal of Retail & Distribution Management*, 35(3), 210-216.
- Brown, M. S., & Wilmanns, E. (1997). Quick and dirty environmental analyses for garments: What do we need to know? *The Journal of Sustainable Product Design*, 1(1), 28-35.
- Bye, E. (2010). A direction for clothing and textile design research. *Clothing and Textiles Research Journal*, 28(3), 205-217. doi: 10.1777/0887302X10371505
- Cachon, G. P., & Swinney, R. (2011). The value of fast fashion: Quick response, enhanced design, and strategic consumer behavior. *Management Science*, 57(4), 778-795. doi:

- Caniato, F., Caridi, M., Crippa, L., & Moretto, A. (2012). Environmental sustainability in fashion supply chains: An exploratory case based research. *International Journal of Production Economics*, 135(2), 659-670.
- Chen, H-L., & Burns, L. D. (2006). Environmental analysis of textile products. *Clothing and Textiles Research Journal*, 24(3), 248-261. doi: 10.1177/0887302X06293065
- Chiu, M. C., & Chu, C. H. (2012). Review of sustainable product design from life cycle perspectives. *International Journal of Precision Engineering and Manufacturing*, 13(7), 1259-1272. doi: 10.1007/s12541-012-0169-1
- Chivas C., Guillaume E., Sainrat A., & Barbosa, V. (2009). Assessment of risks and benefits in the use of flame retardants in upholstered furniture in continental Europe. *Fire Safety Journal*, 44(5), 801–807.
- Claudio, L. (2007). Waste couture: Environmental impacts of the clothing industry. *Environmental Health Perspectives*, 115(9), A448-A454.
- Cobbing, M., & Ruffinengo, E. (2013). *Textiles: Stop the chemical overdose*. Women in Europe for a Common Future. Retrieved from:
<http://www.wecf.eu/download/2013/ResizedReportWECFTextiles.pdf>
- Coggon, D. (1996). Air pollution in homes. *BMJ: British Medical Journal*, 312(7042), 1316.
- Connell, K. Y. H. (2010). Internal and external barriers to eco-conscious apparel acquisition. *International Journal of Consumer Studies*, 34(3), 279-286.
- Daisey, J. M., Angell, W. J., & Apte, M. G. (2003). Indoor air quality, ventilation and health symptoms in schools: an analysis of existing information. *Indoor Air*, 13, 53–64

- Design. (2011). In *Merriam-Webster online dictionary*. Retrieved from <http://www.merriam-webster.com/dictionary/design>
- Environmental Design. (2013). In *Designtex*. Retrieved from http://www.designtex.com/environmental_design_Product.aspx?f=35632
- Franklin-Associates. (1993). *Resource and environmental profile analysis of a manufactured apparel product. Life cycle analysis (LCA): Women's knit polyester blouse*. Retrieved from <http://www.fibersource.com/f-tutor/lca-page.htm>
- Fuad-Luke, A. (2009). *Design activism: Beautiful strangeness for a sustainable world*. London: Earthscan.
- Gagnon, B., Leduc, R., & Savard, L. (2012). From a conventional to a sustainable engineering design process: Different shades of sustainability. *Journal of Engineering Design*, 23(1), 49-74. doi:10.1080/09544828.2010.516246
- Gam, H. J., Cao, H., Farr, C., & Heine, L. (2009). C2CDA: A sustainable apparel and design production model. *International Journal of Clothing Science and Technology*, 21(4), 166-179.
- Gam, H. J., & Banning, J. (2011). Addressing sustainable apparel design challenges with problem-based learning. *Clothing and Textiles Research Journal*, 29(3), 202-215.
- Gam, H. J., Cao, H., Bennett, J., Helmkamp, C., & Farr, C. (2011). Application of design for disassembly in men's jacket: A study on sustainable apparel design. *International Journal of Clothing Science and Technology*, 23(2), 83-94.
- Giudice, F., La Rosa, G., & Risitano, A. (2005). Materials selection in the Life-Cycle Design process: A method to integrate mechanical and environmental performances in optimal choice. *Materials and Design*, 26(1), 9-20. doi: 10.1016/j.matdes.2004.04.006

- Glesne, C. (2011). *Becoming qualitative researchers: An introduction* (4th ed.). Boston: Pearson.
- Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago: Aldie.
- Goldbach, M., Seuring, S., & Back, S. (2003). Co-ordinating sustainable cotton chains for the mass market. *Greener Management International*, 43, 65-78.
- Gray, C., & Malins, J. (2004). *Visualizing research: A guide to the research process in art and design*. Aldershot, Hants, England: Ashgate.
- Guetzkow, H. (1950). Unitizing and categorizing problems in coding qualitative data. *Journal of Clinical Psychology*, 6(10), 47-58.
- Handfield, R. B., Melnyk, S. A., Calantone, R. J., & Curkovic, S. (2001). Integrating environmental concern into the design process: The gap between theory and practice. *IEEE Transactions on Engineering Management*, 48(2), 189-208.
- Høgevold, N. M., & Svensson, G. (2012). A business sustainability model: A European case study. *Journal of Business & Industrial Marketing*, 27(2), 142-151.
- Hopkins, L., Allen, D. T., & Brown, M. (1994). Quantifying and reducing environmental impacts resulting from transportation of a manufactured garment. *Pollution Prevention Review*, 4(4), 491-500.
- Hu, Y. (2012). A study on the sustainable fashion design in the process of use. *International Journal of Arts and Commerce*, 1(4), 54-59.
- Ip, K., Miller, A., & Ellis, J. (2003). Criteria and measurement of indoor air quality in sustainable buildings. In D. G. Greenwood (Ed.), *19th Annual ARCOM Conference: Vol. 1. Association of Researchers in Construction Management* (pp. 91-100). Brighton, UK: University of Brighton.

- Jaakkola, J. K., Øie, L., Nafstad, P., Botten, G., Sammelsen, S., & Magnus, P. (1999). Interior surface materials in the home and the development of bronchial obstruction in young children in Oslo, Norway. *American Journal of Public Health*, 89(2), 188-192.
- Kadolph, S. J. (2010). *Textiles*. (11th Edition). Upper Saddle River, N.J.: Pearson Prentice Hall.
- Kim, B. (2010, November). Green design-Studies about fashion handbag. In *Computer-Aided Industrial Design & Conceptual Design (CAIDCD) Vol.2, 2010 IEEE 11th International Conference on* (pp. 815-819). doi: 10.1109/CAIDCD.2010.5681896
- Knight, P., & Jenkins, J. O. (2009). Adopting and applying eco-design techniques: A practitioners perspective. *Journal of Cleaner Production*, 17(5), 549-558. doi: 10.1016/j.jclepro.2008.10.002
- Kogg, B. (2003). Greening a cotton-textile supply chain: A case study of the transition towards organic production without a powerful focal company. *Greener Management International*, 43, 53-64.
- Laamanen, T-K., & Seitamaa-Hakkarainen, P. (2008). Sources of inspiration and mental image in textile design process. *Art, Design & Communication in Higher Education*, 7(2), doi: 10.1386/adche.7.2.105/7
- LaBat, K. L., & Sokolowski, S. L. (1999). A three stage design process applied to an industry-university textile product design project. *Clothing and Textile Research Journal*, 17(1), 11-20. doi: 10.1177/0887302X9901700102
- Laitala, K., Boks, C., & Klepp, I. G. (2011). Potential for environmental improvement in laundering. *International Journal of Consumer Studies*, 35(2), 254-264.
doi:10.1111/j.1470-6431.2010.00968.x

- Laitala, K., & Boks, C. (2012). Sustainable clothing design: Use matters. *Journal of Design Research, 10*(1/2), 121-139.
- Lamb, J. M., & Kallal, M. J. (1992). A conceptual framework for apparel design. *Clothing and Textiles Research Journal, 10*(2), 42-47.
- Lawson, B. (1997). *How designers think: The design process demystified* (Rev. 3rd ed.). Oxford: Architectural Press.
- Lenox, M. J., & Nash, J. (2003). Industry self-regulation and adverse selection: A comparison across four trade association programs. *Business Strategy and the Environment, 12*(6), 1-14. doi: 10.1002/bse380.
- Lindahl, M. (2001). Environmental effect analysis-how does the method stand in relation to lessons learned from the use of other design for environment methods. In *Environmentally Conscious Design and Inverse Manufacturing, 2001. Proceedings EcoDesign 2001: Second International Symposium on* (pp. 864-869).
- Mace, M. A. (1997). Toward an understanding of creativity through a qualitative appraisal of contemporary art making. *Creativity Research Journal, 10*(2-3), 265-278.
- Mackenzie, D. (1991). *Design for the environment*. New York: Rizzoli.
- Margolin, V. (2007). Design, the future and the human spirit. *Design Issues, 23*(3), 4-15.
- McDonough, W., & Braungart, M. (2002). *Cradle to cradle: Remaking the way we make things*. New York: North Point.
- Muthu, S., Li, Y. Y., Hu, J. Y., & Mok, P. Y. (2012). Quantification of environmental impact and ecological sustainability for textile fibres. *Ecological Indicators, 13*(1), 66-74. doi:10.1016/j.ecolind.2011.05.008

- Meyer, A., & Hohmann, P. (2000). Other thoughts; other results? Remei's bioRe organic cotton on its way to the mass market. *Greener Management International*, 31, 59-70.
- May-Plumlee, T., & Little, T. J. (1998). No-interval coherently phased product development model for apparel. *International Journal of Clothing Science and Technology*, 10(5), 342-364.
- May-Plumlee, T., & Little, T. J. (2006). Proactive product development integrating consumer requirements. *International Journal of Clothing Science and Technology*, 18(1), 53-66.
- Nieminen E., Linke M., Tobler M., & Beke B. V. (2007). EU Cost Action 628: Life cycle assessment (LCA) of textile products, eco-efficiency and definition of best available technology (BAT) of textile processing. *Journal of Cleaner Production*, 15(13), 1259-1270. doi:10.1016/j.jclepro.2006.07.011
- Niinimäki, K., & Hassi, L. (2011). Emerging design strategies in sustainable production and consumption of textiles and clothing. *Journal of Cleaner Production*, 19(16), 1883-1846. doi: 10.1016/j.jclepro.2011.04.020
- Pammi, S., Geetha, D., Danford, M., & Charles, K. (2012). Creating a global vision for sustainable fashion. *Pakistan Textile Journal*. 46-54.
- Parsons, J. L., & Campbell, J. R., (2004). Digital apparel design process: Placing a new technology into a framework for the creative design process. *Clothing and Textiles*, 22(1/2), 88-98, doi: 10.1177/0887302x0402200111
- Platzer, M. D. (2012). *U.S. textile manufacturing and the Trans-Pacific Partnership negotiations* (Report No. 942772). Retrieved from <http://www.fas.org/sgp/crs/row/R42772.pdf>

- Preisser, A. M., Budnik, L. T., & Baur, X. (2012). Health effects due to fumigated freight containers and goods: How to detect, how to act. *International maritime health*, 63(3), 133-139.
- Rastogi, N. (2009). The eco-perils of cheap décor: Is fake wood furniture bad for the environment? In Slate.com Retrieved from http://www.slate.com/articles/health_and_science/the_green_lantern/2009/09/the_ecoperils_of_cheap_decor.html
- Ramani, K., Ramanujan, D., Bernstein, W. Z., Zhao, F., Sutherland, J., & Handwerker, C. (2010). Integrated sustainable life cycle design: A review. *Journal of Mechanical Design*, 132, 1-15.
- Ryan, C., & Riggs, W. E. (1996). Redefining the product life cycle: The five-element product wave. *Business Horizons*, 39(5), 33.
- Sathe, V., & Crooke, M. (2010). Sustainable industry creation. *Journal of Corporate Citizenship*, 2010(37), 69-88.
- Saxce, M., Pesnel, S., & Perwuelz, A. (2012). LCA of bed sheets-some relevant parameters for lifetime assessment. *Journal of Cleaner Production*, 37, 221-228. doi: [dx.doi.org/10.1016/j.jclepro.2012.07.012](https://doi.org/10.1016/j.jclepro.2012.07.012)
- Shank, G. D. (2002). *Qualitative research: A personal skills approach*. Upper Saddle River, NJ: Merrill Prentice Hall.
- Stegall, N. (2006). Designing for sustainability: A philosophy for ecologically intentional design. *Design Issues*, 22(2), 56-63.
- Steinbring, Y., & Rucker, M. (2003). Utilization of post-consumer textiles and clothing. *Journal of Family and Consumer Sciences*, 95(2), 33-37.

- Strauss, A., & Corbin, J. (1998). *Basics of Qualitative Research* (2nd ed.). Thousand Oaks, CA: Sage Publications.
- Tokatli, N. (2008). Global sourcing: Insights from the global clothing industry—the case of Zara, a fast fashion retailer. *Journal of Economic Geography*, 8(1), 21-38. doi: 10.1093/jeg/lbm035
- Thiry, M. C. (2005). Every shirt has a story. *AATCC Review*, 3(5), 7-12.
- Tremblay, K. R., Peng, L-W., Kreul-Froseth, S. A., & Dunbar, B. H. (1999). Perceived effects of carpet on indoor air quality. *Housing and Society*, 23(1), 16-25.
- Uhdea, E. & Salthammer, T. (2007). Impact of reaction products from building materials and furnishings on indoor air quality—A review of recent advances in indoor chemistry. *Atmospheric Environment*, 41(15), 3111–3128.
- United States Environmental Protection Agency. (2013). *Fast facts: U.S. transportation sector green house gas emissions 1990-2011*. Office of Transportation and Air Quality, EPA-420-F-13-033a. Retrieved from <http://www.epa.gov/otaq/climate/documents/420f13033a.pdf>
- Wallander, M. (2011). The lifecycle of a t-shirt. *Huffington Post*, Retrieved from http://www.huffingtonpost.com/mattias-wallander/the-lifecycle-of-a-tshirt_b_887133.html
- Watkins, S. M. (1995). *Clothing; The portable environment* (2nd ed.). Ames, IA: Iowa State University Press.
- Whiteley, N. (1987). Toward a throw-away culture. Consumerism, ‘style obsolescence’ and cultural theory in the 1950s and 1960s. *Oxford Art Journal*, 10(2), 3-27.
- Woolridge, A. C., Ward, G. D., Phillips, P. S., Collins, M., & Gandy, M. (2006). Life cycle

assessment for reuse/recycling of donated waste textiles compared to use of virgin material: An UK energy saving perspective. *Resources, Conservation and Recycling*, 46(1), 94–103.

Wright, H. E., Zhang, Q., & Mihelcic, J. R. (2008). Integration economic input-output life cycle assessment with risk assessment for a screening-level analysis. *International Journal of Life Cycle Assessment*, 13(5), 412-420. doi: 10.1007/s11367-008-0006-z

Yang, Q., Yu, S., & Sekhari, A. (2011). A modular eco-design method for life cycle engineering based on redesign risk control. *International Journal of Advanced Manufacturing Technology*, 56(9), 1215-1233. doi: 10.1007/s/00170-011-3246-1

APPENDIX A.

Interview Questions

BACKGROUND

- Please describe your role and responsibilities at the company
- What type of design projects are you presently involved in?

DESIGN PROCESS

To better understand your design process let's dissect one of the projects you just described

- Would you please describe the general steps you take from start to finish to design this product
- How many people were involved in the design of this product?
- How long did the design process take?
- What tools/aids did you use in designing this product?
- Do you decide where/how your product will be manufactured? Are there criteria for choosing a manufacturer?
- Do you design/choose materials for packaging and transport of product? What are they?
- What finishes do you recommend for the best product performance?
- How long do you anticipate (plan) that your products will perform to the consumer's satisfaction?
- What do you recommend the consumer do with the product post use?
- How do you/your company evaluate the success of your product?

SUSTAINABILITY

- How do you define the term sustainability as it relates to textiles?

- Does your company have a formal definition of sustainability, if so what is the definition?
- What sustainable practices are incorporated at your company related to product design and development?
- What sustainable practices do you feel are the most effective?
- What tools/aids/incentives are used to facilitate the consideration of these sustainability concerns in the design process? (i.e. life cycle assessment, sustainability policies)
- What aspects of the design process do you feel are most important in incorporating sustainability issues?
- Does your company have future plans to increase sustainability efforts within your department?

Table A1. Participant and Company Profile

Participant No.	Title	Years in interior textile industry	Business type	Product types	DfE Oriented	Company Size (number of employees)
Participant 1	President/Designer	1-10	Wholesale	Residential Upholstery	Yes	Less than 10
Participant 2	Artist	1-10	Art, Furniture, Manufacturer	Furniture	No	Less than 10
Participant 3	Owner/Designer	10-20	Wholesale	General textile	Yes	Less than 10
Participant 4	Creative Director	20-30	Wholesale	Contract textile	No	over 100
Participant 5	Owner/Creative Director	30-40	Wholesale, Retail, Custom	General textile	Yes	Less than 10
Participant 6	Design Manager	1-10	Wholesale, Manufacturer	Contract textile	Yes	50-75
Participant 7	Owner/Designer	10-20	Wholesale, Custom, Printer	General textile	No	Less than 10
Participant 8	Product Development Assistant	1-10	Wholesale	Contract textile, Furniture	No	over 100
Participant 9	Associate Print Director	10-20	Wholesale, Converter	Contract textile	No	over 100
Participant 10	Product Development Manager	1-10	Retail	Bedding, Tableware, Rugs	No	50-75
Participant 11	Vice President Research and Development	20-30	Wholesale	Contract textile	Yes	50-75
Participant 12	Senior Textile Designer	1-10	Wholesale	Contract textile	Yes	50-75