THESIS

COLLABORATIVE PRODUCT DEVELOPMENT: EXAMINING THE DEVELOPMENT OF A NURSING SPORTS BRA

Submitted by

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ABSTRACT

COLLABORATIVE APPAREL PRODUCT DEVELOPMENT: EXAMINING THE DEVELOPMENT OF A NURSING SPORTS BRA

Introduction

The new product development process has been the focus of much attention in academia and industry for good reason; accurate product development constitutes the success of manufacturers. Up until now, the role of product development in the apparel industry has been one of predicting the needs of the consumer and responding with novel and well executed products with little to no consumer involvement (Hines & Quinn, 2007). However, the most successful innovative product development processes require a great understanding of continually changing needs of the consumer. Co-Design is a developing avenue that can not only provide information to the apparel development process, but could dramatically influence how apparel and other products are developed (Sanders & Stappers, 2008). In the field of apparel design, no models currently exist that integrate co-design into the entire product development process. Such a model would provide a foundation for integrating consumer needs into a systematic guide and aide in indentifying other research opportunities.

This research encompassed a two-fold purpose. The first purpose of this research was to develop a framework that highlighted collaboration between inter-departmental teams (i.e., Internal Collaborators) and end-users (i.e., External Collaborators) in the apparel product development process. The second aim of the research was to test the Collaborative Apparel Product Development (CAPD) Model through an in-depth case study, and identify key factors to success within the process by studying the collaborators involved in the project.

The CAPD Model integrates two existing models that are widely used in the area of apparel product development into a singular framework. The existing models, which are adopted, include the FEA Consumer Needs Model (Lamb and Kallal, 1992) and the Three Stage Design Process (LaBat and Sokolowski, 1999). The proposed model consisted of teams of collaborators, which included Internal Collaborators (IC) and External Collaborators (EC), and a team leader. The collaboration team is based upon the FEA Consumer Needs Model. At the heart of the collaboration team, is the FEA Model. During the collaboration process, each collaborator relied on each other in a closed loop circuit, and constantly addressing the FEA model at each decision point. This collaborative team was applied in all three stages of design. Within each stage of the product development cycle, immediate feedback was available through ICs and ECs, which reduced backtracking between separate stages. The first stage of the model of 'problem definition and research' was expanded to use consumers and overall managers as means to obtain the necessary approval for product advancement. The second stage of 'creative exploration' very seamlessly incorporated ICs and ECs ideas and propositions.

Market acceptance testing and product support, in the final stage of ‘implementation’ was suitable.

Model Testing and Revision

The case study follows the process of the model through development of a sports bra designed for nursing women. The researchers collected qualitative and quantitative data from five ICs and five ECs to evaluate the effectiveness of the model. The sponsor company chosen for this study was a small maternity apparel manufacturer, located in the Midwest region of the U.S. This particular company was selected because their product development process was not well established and the company indicated challenges in efficiency of product development and soliciting consumer feedback. External Collaborators were recruited through the sponsor company blog, newsletter, and Facebook page. Stage one included a survey and focus group where both IC and EC attended. From the focus group and survey findings, a prototype was developed which addressed user needs from stage one and tested in stage two through wear trials, and stage three concluded the process with an exit survey gathering final thoughts on the product and the process. Particular user needs that were considered include, additional support, ease of nursing, breathability of fabric, and design lines. The wear trials of the prototype bra, developed based on the identified IC user needs in stage one, found that the prototype performed adequately in regard to support, comfort, aesthetics, movement, and fabric breathability. The prototype did not perform well in fit, donning/doffing, and ease of nursing. In stage three, results of the wear trials (i.e. design modifications and future recommendations) were provided to the sponsor company.

The results of the model indicated IC perceived the model as increasing efficiency, and increased perception of addressing the target market's needs. However, ICs opinion of continued collaboration decreased by the end of the research process. Continued collaboration was rated as being more important by ECs ($\bar{x}$ = 6.00) than ICs. ($\bar{x}$ = 5.80) Throughout the process, it was found that social networking could be a useful tool in increasing efficiency and communication between IC and EC. The CAPD Model was revised to include internet tools at each stage of the design process. In an effort to balance each stage of the process, stage two was split into two separate stages so the resulting model is a four stage design process.

Conclusion and Discussion

The results of this project identified positive impacts of the CAPD Model on the product development process of the sponsor company. Over the course of this collaborative design process, the sponsor company achieved better efficiency, and better understanding of the target consumer. By using the CAPD Model, the sponsor company was able to identify modifications to the nursing sports bra prototype. Design modifications, which are necessary before production ramp up, were identified through the CAPD process and assist in decreased risk of manufacturing.

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CHAPTER ONE

INTRODUCTION

A great deal of literature has been based around product development and product innovation. Across many disciplines, product development has been discussed and tailored to meet the needs of the specific industry where it is to be utilized (LaBat & Sokolowski, 1999). However, the markets for apparel design are changing and collaboration and consumer involvement in design are emerging as trends in the new product development process (Binder, Brandt, & Gregory, 2008; Lee, 2008).

The new product development process has been the focus of much attention in academia and industry for good reason; accurate product development constitutes the success of manufacturers (e.g. May-Plumlee & Little, 2006; Schilling & Hill, 1998; Hultink & Robben, 1995). Between 1982 and 1997, the success rate of new products introduced to the market had stabilized at 59 percent with no concomitant increase since (Griffin, 1997). Furthermore, companies who are showing the best success rates of product acceptance are using multiple product development strategies simultaneously (Griffin, 1997). These trends have prompted a new surge of research on how to optimize the new product development processes (Shilling & Hill, 1998).

Up until now, the role of product development in the apparel industry has been one of predicting the needs of the consumer and responding with novel and well executed products

with little to no consumer involvement (Hines & Quinn, 2007; May-Plumlee & Little, 2006). However, the most successful innovative product development processes require great understanding of continually changing needs of the consumer (Hines & Quinn, 2007; Ng & Wang, 2007). Consumer input has been scant and the market-driven era of consumer need prediction is finally giving way to the people-driven era of consumer input (Sanders & Stappers, 2008).

User-centered product designs are a developing avenue that cannot only provide information to the apparel development process, but could dramatically influence how apparel and other products are developed (May-Plumlee & Little, 2006; Sanders & Stappers, 2008). No models currently exist that integrate consumer data into the product development process. Such a model would provide a foundation for integrating consumer needs into a systematic guide and aide in indentifying other research opportunities. There is a need to study and develop procedures that can help a company or project team gain a profound knowledge of customer requirements and satisfaction, and develop products with innovative features (Shen, Tan, & Xie, 2000). Researchers have examined consumer involvement in product development in general, and the models used to extract consumer needs. Consumer involvement has not been directly linked to apparel product development. Making the link is a critical step in developing successful new apparel products and effectively incorporating new technologies (May-Plumlee & Little, 2006).

Before this discussion proceeds, clear definitions of product development/product innovation, are needed. Product development can be defined as a set of activities beginning with perception of target market and ending with delivering a product to the market (Ulrich & Eppinger, 2003). Additionally, product innovation is the process of new discovery to eventual

product (Trott, 2008). For both of these definitions, it is important to add that supply chain management is an integral function for product deployment, and is defined as: All activities associated with the flow of products and services from initial design stage through sourcing and manufacturing, and ends at the end user (Hines & Quinn, 2007). For the argument of this research, a synthesis of all three definitions will give way to the working definition for this research: Product development and innovation is a set of activities starting from initial market discovery, leading to eventual product manufacture, and ending with acceptance of the end consumer.

Definitions of collaborative design and clarification of the use of the terms internal and external collaborator are also needed to continue this discussion. Co-design, collaborative design, and participatory design are used interchangeably in this research. The term co-design is based on the idea that every person has a different opinion and should collaborate in the design process (Lee, 2008). Co-design also refers to any act of collective creativity, shared by two or more people (Sanders & Stappers, 2008). Co-design pertains to the collaboration of professionally trained designers, and extends so far as to include collaboration between end users and professional designers. In some research, co-design does not include consumer involvement, however for this research the term co-design is meant to include designer-designer and consumer-designer relationships. The term internal collaborator (IC) refers to employees within the manufacturing company who work closely on inter-departmental teams. External collaborators (EC) are active participants within a specific target market and are end-users of the product being developed (Lee, 2008).

PURPOSE

This research encompasses a two-fold purpose. The first purpose of this research is to develop a framework that highlights collaboration between inter-departmental teams (i.e., Internal Collaborators) and end-users (i.e., External Collaborators) in the apparel product development process. The second purpose of this research is to use the new model as the theoretical framework for the present research project. The Collaborative Apparel Product Development (CAPD) Model integrates two existing models that are widely conceived in the area of apparel product development into a singular framework. The existing models that are adopted include the FEA Consumer Needs Model (Lamb and Kallal, 1992) and the Three Stage Design Process (LaBat and Sokolowski, 1999).

The proposed model is tested in an embedded single-case study design. The case study follows the process of the model through development of a sports bra designed for nursing women. The researcher collected qualitative and quantitative data to evaluate the effectiveness of the CAPD model.

CASE STUDY RESEARCH QUESTIONS

Case studies often employ two levels of questions to direct the case study and the actual line of inquiry (Yin, 2009). Presented below are cross-case questions, which were addressed after data from the case study was complete. Questions that address the case study are present in chapter four.

To answer the objective of this research project, namely how to implement a framework supporting collaboration between ICs and ECs during the product development process, it was necessary to analyze the interface between the ICs and the product development process.

Analysis of the interface between the ECs and the product development process provided research about what parameters affect the efficiency of the collaborative process. Also by looking at the interface between ECs and the product development process, research unveiled how the collaborators could be best utilized within the apparel product development process.

For this study, the following research questions were identified:

Q1: What key factors may be identified and related to the efficient execution of collaborative product development projects?

Q1a: What challenges do companies experience when they adopt the collaborative apparel product development (CAPD) process?

Q2b: What advantages do companies experience when they adopt the collaborative apparel product development (CAPD) process?

Q2: Has the CAPD Model enabled successful product development in relation to increasing perceived efficiency in the product development process?

Q2a: What tools would aid in the management of CAPD to enhance the proposed framework?

Q2b: How can interactions between internal and external collaborators be efficiently managed in order to support successful CAPD projects?

OBJECTIVES

To answer the previous research questions, the following objectives were identified:

1. The main objective of this research is to test the CAPD Model within an embedded case study design.
2. Facilitate efficient execution of collaborative product development projects in the apparel industry by defining key factors to successful collaborative design.
3. To make the new knowledge developed during this research available for the research community, industry, and growing body of literature to act as a guideline when establishing future product development projects.

ASSUMPTIONS

During the data collection stage of this study, the following assumptions were made:

1. All participants have an understanding of the target market for which the product is being produced and are regular consumers of the product.
2. The company is experiencing growth in their apparel market and is producing new products.
3. Participants will vary in their level of knowledge of the product development process.
4. All participants answered truthfully regarding their experiences.

SCOPE

The following criteria were used for the selection of all the participants in the study:

1. All internal collaborator participants are employed by the sponsor company, and have a minimum of one year professional experience in the apparel design field.
2. All internal collaborator participants have an understanding of the sponsor companies target market.
3. No external collaborator participants are employed by the sponsor company.
4. The sponsor company conducts business in an urban area with populations over fifty thousand.
5. The sponsor company produces over $200,000 gross revenue annually.

CONTRIBUTION TO THE APPAREL & MERCHANDISING FIELD

Product managers who are looking to integrate consumers into the design process or development teams who are seeking a way to collaborate on new product development may find this research beneficial. The framework and methods explored in this study will stand as a resource for many disciplines of product development within academia, the current body of literature, and the product development industry. This exploration has contributed to the

growing body of research on benefits of collaborative design and consumer involvement in product design.

LIMITATIONS

The researcher recognized the following as limitations to the study:

1. The sample participating in the study is not completely representative of the entire population of companies producing apparel or of collaborators.
2. All participants in the study will be volunteers. That is, a sample of volunteers who are motivated to participate may not be representative of the general population.
3. The researcher acknowledges that she may have brought personal biases and knowledge to this study because of her experiences as an apparel product developer. This knowledge was helpful in understanding professional terms and process of apparel product development. However, the bias was put aside as different designers in different situations will be included in the sample.

DEFINITIONS & TERMS

Aesthetic	Aesthetics in relation to dress pertain to the relationship of dress and the human ideal of beauty (Lamb & Kallal, 1992).
Athletic Apparel/Activewear	Any clothing designed specifically for sporting or recreational activity (The American Heritage Dictionary of the English Language, 2009).
Benchmark Product	The process of designing new innovative products or upgrades to current ones. This process can sometimes involve reverse engineering which is taking apart competitors products to find strengths and weaknesses (Ulrich & Eppinger, 2003).
Efficient	Efficient may be defined as acting with a minimum of waste, expense, or unnecessary effort (The American Heritage Dictionary of the English Language, 2009).
Expressive	In relation to dress, expression is the communicative and symbolic values of dress (Lamb & Kallal, 1992).

FEA Consumer Needs Model	The FEA defines three considerations in product design: Function, Expression, and Aesthetic. The non-linear FEA model fits into the linear framework of a six stage design process. Lamb and Kallal define problem identification, preliminary ideas, design refinement, prototype development, evaluation, and implementation as the six stages for apparel design. The FEA model is placed in the analysis and evaluation stages of problem identification and evaluation (Lamb & Kallal, 1992).
Framework	A simplified description of a complex entity of a process and a set of assumptions, concepts, values, and practices that constitute a way of viewing reality (The American Heritage Dictionary of the English Language, 2009).
Functional	Functional considerations of dress pertain to its utility for protection, thermal comfort, fit, and ease of movement (Lamb & Kallal, 1992).
Production Ramp-Up	The period between completion of development and full capacity utilization is known as production ramp-up (Terwiesch & Bohn, 2001).
Supply Chain Management	All activities associated with the flow of products and services from initial design stage through sourcing and manufacturing, and ends at the end user (Hines & Quinn, 2007).

CHAPTER TWO

REVIEW OF LITERATURE

The review of literature for this research begins with examining emergent innovation trends in new product development. The review also speaks to the role and affect of consumers in collaborative design. This review also looks at the role and influence of collaborative design in the new product development process. Including impacts of social networking, the benefits and limitations of collaborative involvement in the product development process are also addressed. Finally, product development theories and frameworks are examined in this chapter and applied in chapter three of this research to the proposed theoretical framework.

Multiple academic databases including: Academic Search Premier, Business Source Premier, EBSCO, and Google Scholar were used to locate articles pertaining to product development. Search terms included *co-design, collaborative design, collaboration, customer involvement, design participation, design process, design research trends, new product development, participatory design, and product development.* The indexes of specific journals were also scanned for relevant articles. The indexes examined were of *Co-Design, Clothing and Textiles Research Journal* (from 2007-2009) and *Textiles Research Journal* (from 2005-2009) as the journal titles are not indexed through the previously mentioned databases. Finally, the reference listings of the articles offered great leads in the identification of additional articles.

THE CURRENT PRODUCT INNOVATION PROCESS IS ON THE MOVE

As discussed previously, product development can be defined many ways, however for the argument of this research, the working definition of product development is a systematic set of activities starting from initial market discovery, leading to eventual product manufacture, and ending with acceptance of end consumer.

Figure 2.1
A generic six-stage product development process (Ulrich and Eppinger, 2008)

Because industry typically adapts a generic product development model to fit their needs for each individual project, no singular product development model exists. Ulrich and Eppinger (2008) discuss the fact that although different companies' product development process are not uniform, the process of developing products often follows at least some of the steps seen in Figure 2.1. According to Unger and Eppinger (2006), the purpose of a product development process is to provide a structure to manage uncertainties and risks associated to each project. Segmenting the process into smaller sections allows for better risk management.

The current new product development process used today by the apparel industry is in transition as evident from scholarly literature as well as industrial experience. Today companies are reinventing their development processes to become faster, leaner, and more effective while simultaneously improving smaller components within the segmented stages of the process (Cooper, 2008; Hines & Quinn, 2007). The systems now are fluid and flexible acting more as guidelines than strict plans, and, companies who are showing the best success rates of product acceptance are using multiple strategies simultaneously (Cooper, 2008; Griffin, 1997).

The Product Development Management Association has commissioned research studies to determine what new product development processes are used successfully by manufactures (Griffin, 1997). The study reported that the percentage of companies who operate with no formal product development process in place, or are using an informal process was 38.5 percent in 1997 (Griffin, 1997). Research has demonstrated that using some form of a systematic product development process improves the probability of product development success (Cooper, 2008; Griffin, 1997). The survey also determined that more than half of the respondents are using a form of a stage gate-process for new product development (Griffin, 1997). A stage-gate process depicted in Figure 2.2 is a widely employed product development strategy that moves systematically and divides the process into distinct stages separated by management decisions called gates (Trott, 2008).

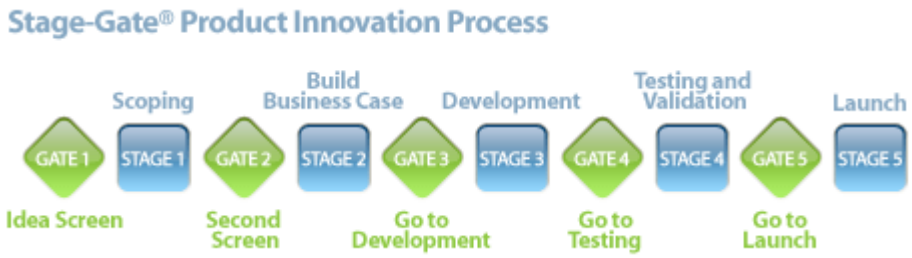


Figure 2.2
Stage-Gate Process (courtesy of www.stage-gate.com, 2009)

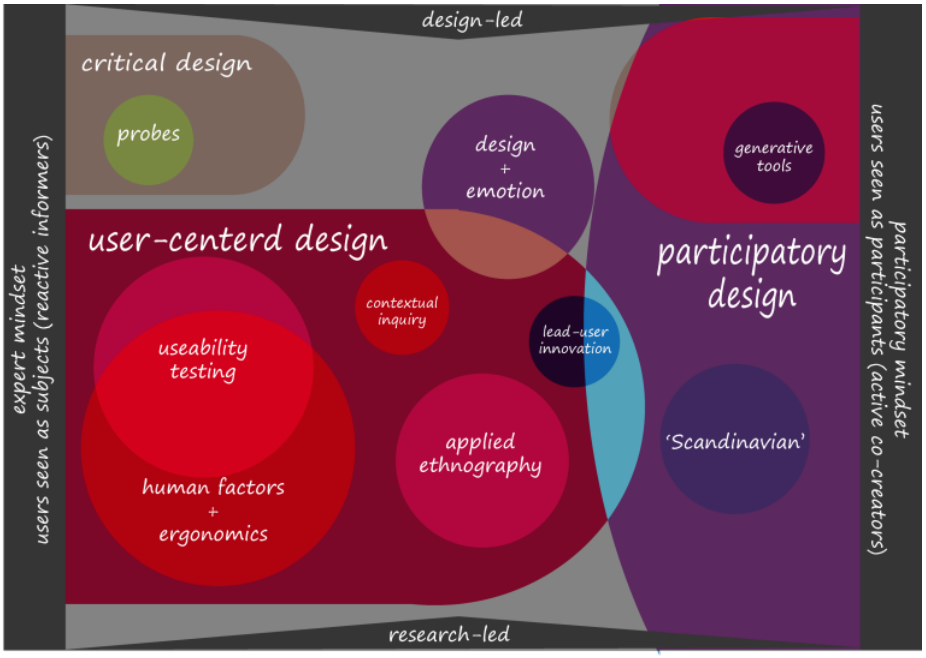
The product innovation processes being implemented more recently have moved from functional and sequential approaches to multi-functional, parallel approaches. A parallel approach allows for more efficiency in the product development process. Certain stages can be managed simultaneously in order to reduce the product development time cycle (Schilling & Hill, 1998). The product innovation process in general is changing to a leaner, quicker, and more effective process. Companies who are achieving success with product development process have adapted the models to fit their particular needs, and are using multiple models in a non-

linear fashion. Researchers note that the processes implemented within a company should be frequently updated and revised to fit the current market trends (Griffin, 1997). Robert Cooper, the founder of the Stage-Gate process, even goes so far as to recommend evaluation of the working process every five years (Cooper, 2008).

CURRENT NEW PRODUCT DEVELOPMENT TRENDS IDENTIFIED

The product development trends from the late 1970s to late 1990s were more evolutionary than revolutionary, according to Griffin (1997). This may be due in part to the complexity of the product innovation systems. The process is easier to update and modify than institute a completely new program (Griffin, 1997).

Because there is little information regarding the apparel development process specifically, it may be generalized that the trends occurring elsewhere in product development are also occurring in apparel design. Figure 2.3, illustrates the emerging trends in design research. The emerging trends in design research include critical design, design and emotion, user-centered design, and participatory design (Sanders, 2006). The overlapping circles look at how research is being conducted within the major trends. The focus of this research is the area where user-centered design and participatory design overlap. Because this topic is getting much attention in academia and the apparel industry, special interest will be taken looking at and melding the facets of participatory design and user-centered design. For the purpose of this research, the terms collaborative design, participatory design, co-design and user-centered design are used simultaneously to represent direct consumer interactions.



Emerging Trends in Design Research (Sanders, 2006)

Figure 2.3
Emerging Trends in Design Research (Sanders, 2006)

Four trends, which speak to co-design and user-centered design, were identified by review of the current literature. They include moving into a people-driven era, long-term product creation, creating transparency in the process, and front end advancements. The trends defined below are by no means inclusive, but have appeared in the last five years as the newest and largest trends for collaborative design across multiple publications.

People-Driven Era

The observation has been noted that the market driven era is giving way to a people-driven era (Sanders, 2006). Manufacturing companies are becoming more open to product development approaches that define product based on what people need, and creating experiences for the consumer rather than simply designing products (Sanders & Stappers, 2008; Raymond, 2007). User-centered design is research-led design which aims to collect, analyze, and

interpret data to develop specifications to guide design development (Sanders, 2006).Consumers are focusing on the experiential rather than on the physical or material aspects of products (Cooper, 2008; Ng & Wang, 2007; Sanders, 2006). This movement to a people-driven era is aimed at discovering new ways to understand and empathize with the needs of the consumers (Sanders, 2006).

Creating for the Long-Term

The push for inexpensive products with short life-spans is a trend, which is fading out. Consumers are starting to be more careful about the product choices they make in achieving a balance between needs and desires of consumption. Consumers are gravitating towards simpler, no-frills products and considering spending more money on more universal products that will last longer (Hines, Calder, & Abraham, 2009). Increasing product longevity can be built into the design process by thinking about what will happen during the lifecycle of the product and accounting for that in the design phase (Dickson, Loker, & Eckman, 2009; van Nes & Cramer, 2005). The main challenge in designing for longevity lies in achieving enduring consumer satisfaction with the product through creating creative experiences, rather than only meeting the momentary desires of today (Sanders & Stappers, 2008; van Nes & Cramer, 2005). People-centered innovation takes a long view in time across a large space (Sanders, 2006).

Transparency

Transparency in product development is also emerging as a multi-faceted new trend in new product development. Transparency in product development can range from clearly stated consumer wants, to thorough understanding of products, all of which contribute to a clear understanding of the systems of new product innovation. Consumers are voluntarily offering personal information to manufacturers; whereas this type of voluntary information had

previously been inaccessible to designers and manufacturers (Hines et al., 2009). For example entire target markets are voicing their opinions about what they enjoy about products or wish was available in the market through forums, blogs, and social networking websites What is more, consumers are deliberately choosing to make various details of their personal life public via blogs, photo/video sharing, and social networking websites (Hines et al., 2009).

Open innovation is also creating transparency in new product development and the new product development processes are adapting to handle the flow of ideas (Cooper, 2008). Open innovation is an ideal that assumes companies can and should use internal ideas as well as external ideas to advance their product (Chesbrough, 2006). In addition to consumers voluntarily sharing their product experiences, the consumer is expecting more information in return from the supplier and greater transparency about the products they are to purchase (Dickson, Loker, & Eckman, 2009; Hines et al., 2009). Transparency in design can also lead to increased ease in usability to create better understanding of the products (van Nes & Cramer, 2005). However, it is noted that too much transparency can give away valuable trade secrets, so a balance is to be achieved with transparency (Hines & Quinn, 2007).

Front End Advancement

Where companies are finding the most room for flexibility is in the first few stages of the new product development process. Many researchers have examined the first few stages and identified this area as possible room for process improvement (Cooper, 2008; Koen et al., 2001). These early stages in product development are commonly known as the fuzzy front end, which is the messy 'getting started' ideation phase (see Figure 2.4). It is at this point that many ideas are generated and funneled down to potentially successful design concepts (Sanders & Stappers, 2008; Koen et al., 2001). Design in the clothing and textile field is moving increasingly

toward hybrid trends that integrate models, which address consumer aesthetics into the fuzzy front end of design (Ng & Wang, 2007).

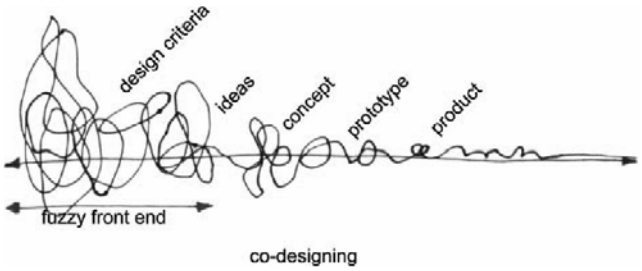


Figure 2.4
Fuzzy Front End (Sanders & Stappers, 2008)

In summary, it has been found through an examination of current literature, that the contemporary product development process is in transition to become a faster and more effective process, while simultaneously improving smaller components of the process. The new frameworks are more flexible and act more as guidelines rather than strict linear plans.

Four themes within the user-centered design and participatory design of current trends in design research have emerged as: (a) product development is entering a people-driven era where manufacturing companies are becoming sensitive to the needs of the consumer and letting the consumers drive the markets; (b) product creation is now looking at long-term product development, and products with short life-spans are being phased out; (c) the consumers within the design processes are becoming more transparent with personal information, and the design process itself is becoming more transparent to consumers; and (d) multifunctional processes are emerging and being incorporated into the front end of product design.

ROLE OF THE CONSUMER IN COLLABORATIVE DESIGN

Depending on the company and product, consumer involvement can be at varying stages, but many agree invaluable insights can be obtained from external consumer involvement (Nambisan, 2002; von Hippel, 1988). The consumer, as a vessel of external ideas, is valuable to the inter-departments of manufacturers because of the constant flow of new ideas from the end-users. Nambisan (2002) has defined three stages of which costumers may be involved. The stages are: (a) customer as a resource, (b) customer as a co-creator, and (c) customer as the use for product testing and support. Most of the research conducted utilizes the consumer as a resource in the front end of product development (Sanders, 2006). Few research studies have looked at the actual implementation of customers as co-creators, although much research has considered this possibility (Nambisan, 2002). The level at which the consumer can become a co-creator depends on the level of expertise and creativity of the end-user (Sanders and Stappers, 2008). Consumers who have a deeper understanding of the projects may provide more rich feedback and ideas. Using consumers for testing and support at the end of the process is found in programs where consumers are encouraged to personalize products (Hines et al., 2009). This phenomenon is known as lead-user innovation, and for the purpose of this research is not addressed, however would be a very interesting study in the advancement of the current research.

Affect of the Consumer in Collaborative Design

The affect consumers are having on the design process is quite substantial. Consumers are affecting the apparel product development process by changing the way market research is collected. The clothing and textile industry has typically used market research as a means for understanding consumer needs. The use of market research focuses on identifying opportunities

for product innovation and understanding the evaluative criteria used by the consumer in reaching a purchase decision (May-Plumlee & Little, 2006). For apparel design, research the classical process for the front end of product development is to research fashion and color forecasting and market research by review of trade publications and popular press. From these sources, the manufacturer discerns trends in color, style, and fabrication (May-Plumlee & Little, 2006).

This method of data gathering does not remove uncertainty from the process because consumers have minimal input and ambiguity arises in design decisions (May-Plumlee & Little, 2006). Emotion cannot be obtained from third party analysis (Jordan & Persson, 2007). These traditionally no-frills sources for apparel market research are now being expanded to include consumer emotion (Jordan & Persson, 2007). Consumer insight may not only reduce uncertainty, but has the potential to reduce costly errors discovered late in the process of creating a product that is not on target with consumer requirements (von Hipple, 2001).

Many consumers are increasingly interested in participating in the creation of their products and services (Hines et al., 2009). For the consumer, the choice of product is reflective of their sense of identity. The ability to personalize products or try out products on location will become increasingly important (Hines et al., 2009). The benefits of utilizing consumers in the apparel product development process are: access to personal information that may have been otherwise costly to obtain, removal of any uncertainty with product concepts, and of course, using consumers as a resource could create more on-point products.

Some of the implications of using consumers in the product development process are, consumers may not know what they want before they are able to see physical prototypes and consequently, they may not be able to verbalize their needs

(von Hipple, 1988). The trial-and-error method of creating visual prototypes may lead to an iterative process of design, which could extended product life cycle time (Cooper, 2008).

Ultimately, the success of a product is determined by the consumer (von Hippel, 2001; Shen et al., 2000). Although, consumer involvement may have the potential to elongate the product time cycle, it also has the potential to develop more successful products (Nambisan, 2002). What is unknown and debated is how much the customer should be involved in the process. Some researchers have argued that customers need to play a key role in the development of new ideas and feedback; however, others argue that involving customers in idea generation will hinder technological advancement (Sanders, 2008; Nambisan, 2002).

The user-centered design trend is important to the overall purpose of this research because consumer input is valuable for successful product development. By looking at the role of the consumer and the effect they are having on the market, a need to understand how to utilize the consumer becomes evident. Accordingly, collaborative design is emerging as the preferred system by which companies are approaching utilizing the end-user in new product development. The varying levels of user-centered design and design collaboration are strategies being explored as ways of creating products that are more successful.

Affect of Social Networking on Collaborative Design

As previously mentioned, consumers are increasingly offering personal information to the public realm. The vehicle of choice has been social networking sites such as Facebook, Twitter, and MySpace. Figure 2.5 graphically represents the multitude of social networking websites by various themes/communities. Reports from Social Media Week, an annual conference is held in nine international cities with aims of uniting thousands of people to advance the understanding of social media's roles in society. This indicates that 1 in 13 of all

people globally is an internet user, and 17% of internet users are accessing the web on their mobile devices (Social Media Week, 2011). In marketing, social engagement, dialogue, interactivity and informal conversations are replacing traditional marketing concepts such as push messaging, broadcasting and direct mail (Social Media Week, 2011). An overwhelming 70% of consumers trust peer to peer product recommendations from online as opposed to 7% of consumers trusting direct advertising (Smith, 2011). With the internet, consumers are easily able to read reviews and gather opinions from peers. Facebook is becoming more commercial, being used as much for personal networking as for business, even incorporating shopping from the site. While Facebook is by far the most flourishing online community in Western society, other social utilities, such as Renren.com in China and Orkut and hi5 in India, also provide the countries' web-users similar social networking platforms that facilitate the free exchange of ideas and opinions with others (Smith, 2011).

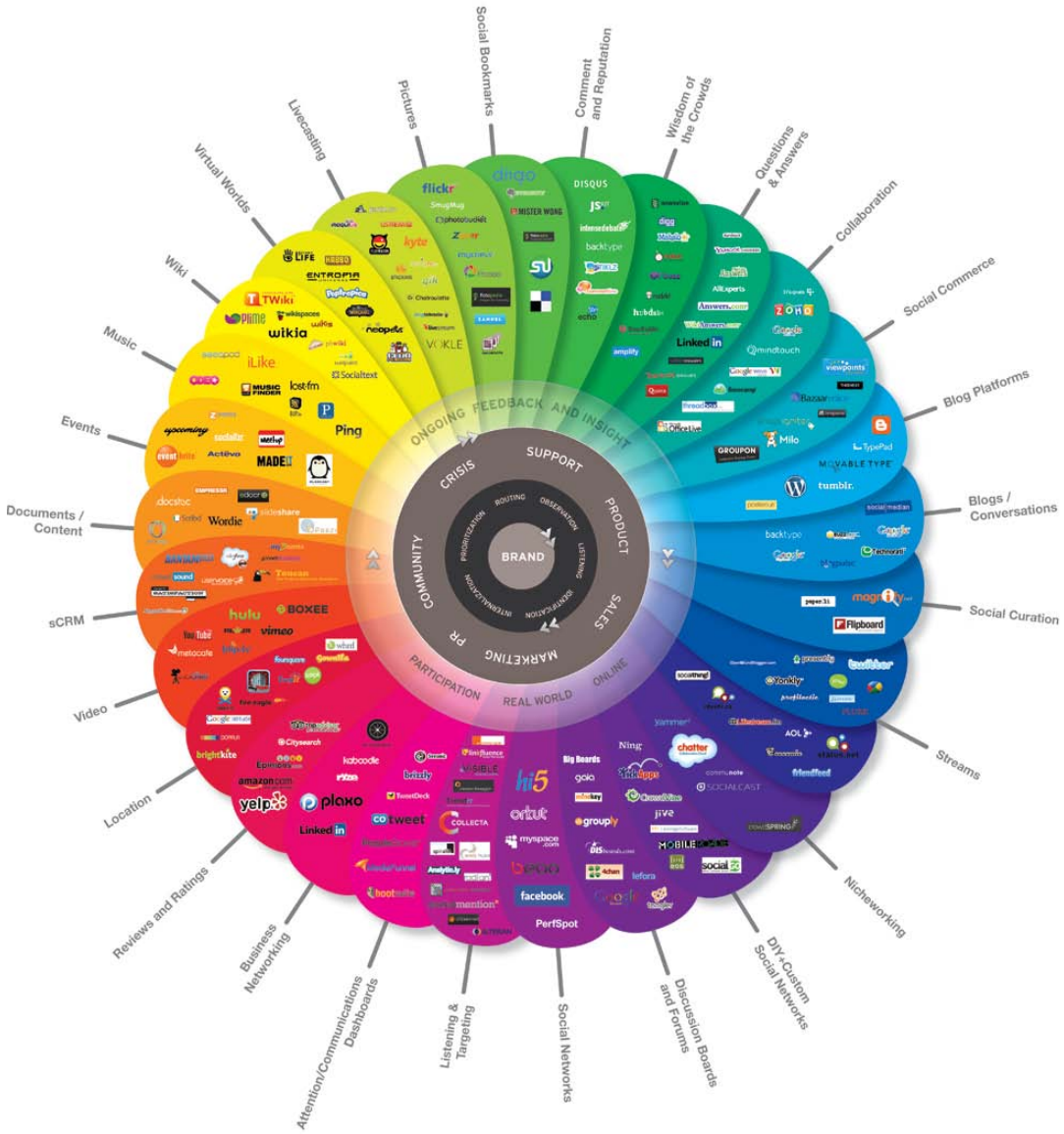


Figure 2.5
The Conversation Prism by Brian Solis and graphic designer JESS3
(www.conversationprisim.com, 2011)

The key characteristic of social media that differentiates this trend from traditional media is the "word of mouth" component. Researchers consider social media to be a hybrid of the traditional promotional mix that combines tools like advertising, public relations, and sales promotions with a 'highly magnified' communication on a new platform (Mangold & Faulds,

2009; Wu, 2010). The advantages of using social networking include immediate access by and to consumers, and more trust by the consumer whereas, traditional media only allowed for controlled dissemination of information to consumers (Mangold & Faulds, 2009). However, social media is second-hand word of mouth information about products, and manufacturers have less control over content and timing. As easy as satisfied consumers can rave about products online, unsatisfied consumers can voice their dissatisfactions with a broad reach (Mangold & Faulds, 2009).

Mangold and Faulds (2009) offer nine suggestions to companies who are looking for ways to utilize social networking in order to engage with their consumers: 1) use blog spots and social networking sites to create communities of like-minded people centered on a brand; 2) create a platform for feedback to engage consumers; 3) use the internet and it's contributions to supplement traditional forms of marketing; 4) create transparency on the company website to inform the consumer; 5) the authors also suggest to 'be outrageous' and create a little controversy/drama for the consumer to talk about; 6) provide exclusivity and make the consumers feel special through deals and limited opportunities; 7) design products with talking points in mind which can engage the emotions of the consumer to stimulate conversations; 8) support causes important to the consumer so the consumer can relate and be emotional linked to the cause and the brand; and 9) create memorable stories that the consumer may talk about and repeat to other members of the market.

Social networking websites engage and energize their consumers in co-creating products and build a dynamic online community (Wu, 2010). The internet is a powerful tool, which can be used as an integrated platform for engaging consumers in multiple ways for different purposes (Sawhney, Verona, & Prandelli, 2005). If used synergistically and simultaneously, different collaboration methods through social networking can be employed as

part of an integrated innovation strategy to gather consumer dialogue (Sawhney, Verona, & Prandelli, 2005).

ROLE OF CO-DESIGN ON THE NEW PRODUCT DEVELOPMENT PROCESS

Collaborative design examines how to engage multiple voices for an ongoing creative development project. The practice of collective creativity has existed for nearly 40 years under the name of participatory design (Binder et al., 2008, Sanders & Stappers, 2008). The participatory design movement began in Scandinavia with a request to the research community to include non-designers in design collaborations (Binder et al., 2008; Sanders & Stappers, 2008). Most common proponents of co-design originate from business or marketing practices, not from design practice (Fraser, 2009; Sanders & Stappers, 2008).

As is illustrated in Figure 2.6, co-design shifts the power from the internal collaborators (IC) of designers and managers, and gives power to external collaborators (ECs) which are potential customers and end-users (Lee, 2008; Sanders & Stappers, 2008). Designers are becoming moderators for consumers, rather than experts in design ideation (Sanders, 2006; Sanders & Stappers, 2008). In order for participatory design to be successful, one must believe that *all* people are creative, and have valuable input (Bjorgvinsson, 2008; Sanders & Stappers, 2008). Co-design has had opposition over the past 40 years because some people may view collaborative design as disrupting the current chain of command in the product development process.

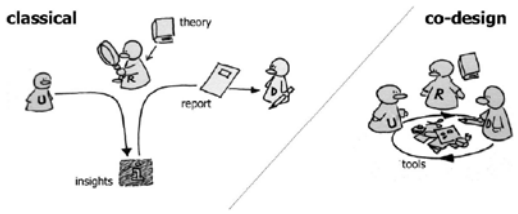


Figure 2.6
Classical design to Co-design (Sanders and Stappers, 2008)

Collaborative design can range from strategic alliances (Schilling & Hill, 1998), to team development (Schilling & Hill, 1998; Trott, 2008), to end- user involvement (Sanders, 2006). Although strategic alliance is not necessarily the focus of this research study, strategic alliance may be implicitly utilized within the internal collaborations. The assets gained by strategic alliance could be experience, knowledge, outsourcing, and sourcing. The *go-it-alone* approaches of individual firms are giving way to multiple companies looking for mutually beneficial alignments (Trott, 2008). *M*ulti-functional teams have now been instituted broadly for developing new products (Griffin, 1997). Teams are a strong outlet for interdepartmental communication and ideation (Schilling & Hill, 1998; Trott, 2008). Collaborative design using external consumer involvement includes those who will be affected by design in the process (Sanders, 2006).

Affect of Co-Design on the New Product Development Process

As defined previously in the trends portion, the way ECs are thinking about purchase decisions is also shifting. Consumers are moving away from purchasing products that offer short-term satisfaction and are starting to purchase products that will provide long-term fulfillment (Maxwell, Sheate, & van der Vorst, 2006). People are looking for a balance between passive consumption and thoughtful creative experiences (Bjorgvinsson, 2008; Sanders & Stappers, 2008). Co-design allows for, and encourages product development to look across

multiple disciplines and create thoughtful products that will withstand time. Through collaboration between internal and external teams, co-design is able to focus not only on the product, but the experience the product encompasses (Sanders, 2006). It is thought by some researchers that the resurgence of participatory design has been encouraged by this trend (Sanders & Stappers, 2008). In the recent history, co-design was not as important because the previous trend of short-term products did not need to be as on-point with the consumer as long-standing products (Sanders & Stappers, 2008).

Some research is underway to start defining what key factors are needed for successful collaborative design. The key factors contributing to successful collaborative product development were defined by researchers in the UK who surveyed 106 manufacturing firms (Littler, Leverick, & Bruce, 1995). Several questions were addressed including the effect of collaboration on product development, the risks of collaborative product development, and factors affecting the outcome of collaborative product development. It was concluded for this specific survey that: 1) frequent consultation between partners is needed, 2) the collaboration relationship needs to be perceived as important by all parties, 3) a collaboration leader needs to be defined, 4) benefits are perceived as evenly distributed, 5) collaborating partners need to contribute equally and on schedule, and 6) a substantial degree of trust between collaborating partners needs to be established (Littler et al., 1995).

The positive effects of collaborative design include decreasing uncertainty in development by acting as a means to better consumer understanding, which could lead to improved product success. Researchers have found negative implications of collaborative design to include people who are not educated in design are now designing which could damage the reputation of the field (Sanders, 2006). Researchers argue that involving customers in idea

generation will lead to uninspired and unimaginative products (Nambisan, 2002). Researchers are also concerned that the line between product and service are no longer clear (Bjorgvinsson, 2008), and the boundaries between different design disciplines are blurring (Sanders, 2006).

Incorporating external consumer collaboration is a strong approach to developing workable and innovative solutions that bring end-users into the design process to identify real customer needs (e.g. Binder et al., 2008; Ng & Wang, 2007; Shen et al., 2000). A substantial amount of literature has been published about the end-user involvement trend within product innovation (e.g. Nambisan, 2002; Ng & Wang, 2007). The collaborative design trend is important to the overall purpose of this research because co-design offers a process, although not clearly systematic, which could help identify important user requirements in incorporating the voice of the consumer into apparel product innovation. Two models, LaBat and Sokolowski's Three Stage Process (1999), and Lamb and Kallal's FEA Consumer Needs Model (1992) show opportunity for development to include external collaboration and foster internal collaboration. These two frameworks are discussed in detail in the theoretical framework subsection below.

DISCUSSION OF THEORY

This section describes in-depth theory within the product development and apparel design fields essential to the research project. Since this research looks into how to collaborate and analyze the relationship between the consumer and the product development process, it is also of interest to introduce the reader to theory about consumer needs in functional apparel through Lamb and Kallal (1996) FEA Consumer Needs Model and the interface between co-design and the product development process. This is done after LaBat and Sokolowski's (1999) Three Stage Design Process has been presented.

Three Stage Design Process

LaBat and Sokolowski's Three Stage Design Process (1999) is a linear product development framework based off multiple models from different fields. The Three Stage Design Process reaches across multiple disciplines to reveal three common stages of product development. Architectural design, engineering design, product design, and clothing design models were examined for similarities. The models in apparel and textiles examined for development of this framework include Koberg & Bagnall (1981), as adopted by Watkins (1988), and Lamb and Kallal's FEA Consumer Needs Model (1992), among others. A chronological structure is used to track steps of the process along the way.

The three stages of the design process include: (1) problem definition and research, (2) creative exploration, and (3) implementation (Figure 2.7). The problem definition and research stage includes definition of the problem/project by a client and design criteria established for the particular process. Concurrently, research is conducted which addresses user needs and market analysis. The second stage of creative exploration includes an expansive overview of all preliminary ideas. After a thorough examination of all ideas, design refinement is initiated and outlined by user constraints and production constraints. After the ideas are refined, prototyping gets underway and first prototypes are created through a fusion of design criteria and constraints. Prototypes are then evaluated by the designer and by the client. The final stage of implementation is where production refinement occurs. Specific questions about cost, time, and methods of production are addressed in addition to addressing sales potential. If minor changes to the prototypes are necessary, they may be implemented before production ramp-up, or the period between the end of development and full capacity production of the product at the

factory (Terwiesch & Bohn, 2001). Further improvement and refinements are suggested to the client for future development.

Figure 2.7
Three Stage Design Process (LaBat and Sokolowski, 1999)

The compressed nature of this model allows for flexibility within the design process. By not systematically defining every step of the design process, but showing large stages, cyclical sub-processes may occur in each stage. A traditional linear approach to product development may complicate development progress because if any problem is to occur during development they must cycle back to a previous development stage and make necessary changes to the product (Cooper, 2008). Going between stages is not an efficient process, however if cyclical sub-processes within each stage occur, the product development process may become more efficient.

The Three Stage Design Process has been used for textile and clothing design prior to application of this research. Varying forms of this conceptual framework have been adopted and analyzed in a handful of other functional design publications, including designing for the people with physical disabilities (Carroll, 2001), and knitwear development process (Pitimaneeyakul, LaBat, & DeLong, 2005). It is noted that, designers and clients find assurance in a design process, that if it follows a clear process, it will inevitably lead to good design (LaBat & Sokolowski, 1999).

FEA Consumer Needs Model

The FEA Consumer Needs Model (1992) is widely recognized in textile and clothing research. The FEA model and framework are also based off previous functional design models and theories by Koberg & Bagnall (1981) and Watkins (1988). The FEA defines three considerations in product design: Function, Expression, and Aesthetic. The three components are defined to show how culture is the barrier before acceptance by the target market. In order for a target market to accept the design, the product has to comply with the target consumers' cultural beliefs, sociological ideals, and personal values (Lamb & Kallal, 1992). If the product does not comply with one or more of the culture's beliefs, then the cultural aspect acts as a barrier and results in an unsuccessful product design.

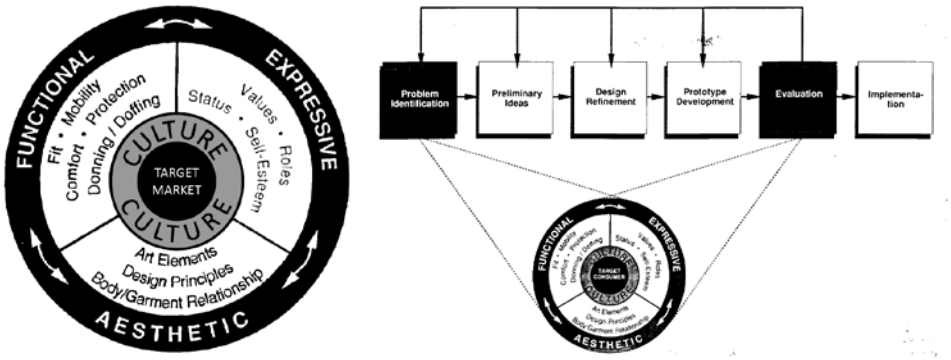


Figure 2.8
FEA Consumer Needs Model (Lamb and Kallal, 1992)

The main theme of this model is the idea that one aspect, whether it is function, expression, or aesthetics, cannot stand alone in successful design, but rather two or all three aspects need to be involved to create a product that is widely accepted by the market (Lamb & Kallal, 1992).

The original non-linear FEA model (Figure 2.8) fits into the linear framework of a six stage design process. Lamb and Kallal define problem identification, preliminary ideas, design

refinement, prototype development, evaluation, and implementation as the six stages for apparel design. The FEA model is placed in the analysis and evaluation stages of problem identification and evaluation. This model has been cited extensively in apparel product production from projects ranging from development of course syllabus (Kim and Farrell-Beck, 2003) to case studies for development of sailing apparel (Bye and Hakala, 2005) and re-designing hospital gowns (Cho, 2006).

LaBat and Sokolowski evaluated pieces of Lamb and Kallal's FEA Consumer Needs Model (1992) in their framework although; the Three Stage Design Process (1999) and the FEA Consumer Needs Model (1992) are established off similar frameworks. The two models address different aspects of the product development process at different times. The Three Stage Design Process (1999) looks at the development process from start to finish, while the FEA Consumer Needs Model (1992), if used independently from their process, addresses specific concerns of the target market within a linear process.

The FEA Consumer Needs Model (1992) and LaBat and Sokolowski's Three Stage Design Process (1999) are strong models for apparel design. It has been found, that few models and frameworks actually incorporate consumer needs into the development process. It appears that the FEA Consumer Needs Model (1992) and LaBat and Sokolowski's Three Stage Design Process (1999) may lend themselves to expansion to include collaborative theory.

CHAPTER THREE

THEORETICAL FRAMEWORK

The objective of this research, as previously stated in chapter one, is to develop a framework that highlights collaboration between internal collaborators (IC) and external collaborators (EC) in the apparel product development process. This new model is tested with an embedded single case design and used as the theoretical framework for the present research project. The Collaborative Apparel Product Development (CAPD) Model integrates two existing models that are widely conceived in the area of apparel product development into a framework. The existing models adopted include the FEA Consumer Needs Model (Lamb and Kallal, 1992) and the Three Stage Design Process (LaBat and Sokolowski, 1999). Presented below is the original frame work as proposed prior to testing the CAPD Model.

PROPOSED FRAMEWORK - *CAPD MODEL*

The rational for developing a new model for apparel product development using existing framework was to modernize and create a more efficient system. The FEA Consumer Needs Model (Lamb and Kallal, 1992) and the Three Stage Design Process (LaBat and Sokolowski, 1999) were developed over ten years ago. Since the publishing of these models, advancements in technology and supply systems have opened up new avenues for development. Both models, albeit widely conceived in the area of apparel products, have never been used together to

develop a singular construct. To execute both models efficiently in one system, a new model is necessary.

Forum for Collaboration

The product development process has an effect on every aspect of development. Therefore, when developing a new product, consideration needs to be given to how the product will be accepted. It is essential to support collaboration between ICs and ECs at each phase of development in order to decrease uncertainty in product acceptance and diffusion. The question is *how* to support collaboration and *how* to integrate ICs and ECs in each step of the apparel product development process.

To begin, the members of the collaboration team need to be identified. A typical collaboration team should be comprised of no less than one IC, one EC, and one project leader (Littler et al., 1995). Wynstra, van Weele, & Weggemann (2001) posit that the output of the participants is better information between departments and ability to influence certain decisions if the development teams involve multiple representatives.

Internal collaborators may be employees of the organization from various departments that include design, development, logistics, management, sales/marketing, and so on. It is essential that the right person from the right department is involved in the right product development phase (Wynstra et al., 2001). That is, in purchasing and strategic decisions, it is essential to involve overall managers in the first product development stage (Wynstra et. al, 2001). In the phase of creative exploration, where ideations for new products are discussed, it would be appropriate to include managers from specific departments. In the final phase of implementation, it would be appropriate to include managers of logistics and shipping.

External collaborators, on the other hand, are less objective. External collaborators are consumers that have strong participation in the target market for which the product is to be developed. For the purpose of the development of this model, it was the objective to retain the same ECs throughout the process with the idea at each stage of the development process, their knowledge would become richer and their output would be more valuable (Nambisan, 2002).

If the product development team is new to collaborative design, it may be useful to conduct a focus group during the first phase of this model to gather a wide range of collaborative insights (Griffin & Hauser, 1993). A focus group is an interview technique with a small group of people on a topic of interest (Patton, 1987). The focus group provided a good opportunity to recruit participants as ECs. This process of recruitment may be beneficial, not only if the manufacturing company new to collaboration, but if the company is looking to manufacture for a new target market, expand to a new product category, or try a new technology. If the organization is not embarking on something new, they may wish to keep previous ECs over a period and over a scope of projects.

Based on the findings from Littler et al. (1995), an essential addition to this collaboration team is a clear project leader. This leader may be from any one of the departments, depending on the nature of the product under development. As depicted in Figure 3.1, any number of ICs and ECs may be involved, but only one project leader is needed.

Figure 3.1
Proposed method of composing teams

The collaboration team is expected in the proposed model to experience a series of stages while working together through the collaboration process (Andersson, 2007). The first stage is the composition of the team and specification of requirements. The second stage is where collaboration activities ensue and product development decisions are implemented. Parameters that affect the apparel product development process were actualized and acted upon for more efficient development in the third stage. Table 3.1 provides a summary of the stages of collaboration within teams.

Table 3.1
Stages of collaboration within teams

STAGE	STAGES OF COLLABORATION WITHIN TEAMS
Stage One	Team composition; Specification of requirements
Stage Two	Collaboration activities; Decision making; Prototype evaluations
Stage Three	Parameters defined; Action on parameters

Application of FEA Consumer Needs Model

The collaboration team is based upon the FEA Consumer Needs Model. At the heart of the collaboration team, is the FEA Consumer Needs Model. During the collaboration process,

each collaborator relies on each other in a closed loop circuit, and constantly addressing the FEA model at each decision point (Figure 3.2). It was theorized in the proposed model that the FEA model might be extruded from the original six-step framework proposed by Lamb and Kallal (1992), and used independently to understand consumer needs. The 'target consumer' portion of the model may become more flexible to include EC input, and be switched out with a new set of consumer requirements for each design project. The non-linear FEA model lends itself to be more flexible with the changing trends of product innovation. During the collaboration process, each collaborator should constantly be asking if they meet the needs of the FEA model and the end user. The benefit of having ECs on the team was that the ICs have access to immediate feedback from a representative of the 'target consumer,' and potentially the exact end-user. The FEA Model was strong in respect to including consumer needs within product design for apparel.

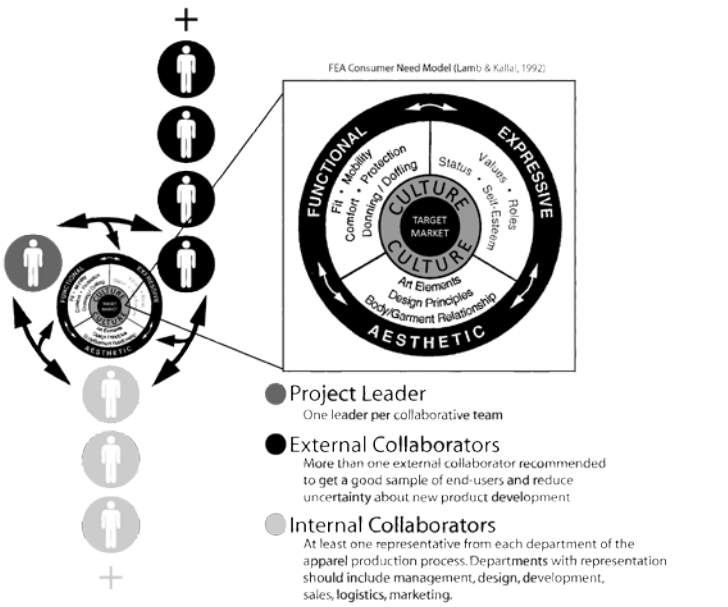


Figure 3.2
Lamb and Kallal's FEA Consumer Needs Model (1992) incorporated into the collaboration teams.

Application to Three Stage Design Process

This collaborative team, as it was proposed, was applied in all three stages of LaBat and Sokolowski's Three Stage Design Process (1999), presented previously, and illustrated in Figure 3.3. Within each stage of the product, development cycle immediate feedback was available through ICs and ECs, which reduced backtracking between separate stages. The pattern that emerged was build, test, obtain feedback, and revise (Cooper, 2008).

It was also proposed that all three stages of the Three Stage Design Process would be open to incorporating collaborative efforts. The first stage of the model of problem definition and research was expanded to use consumers and overall managers as means to obtain the necessary approval for product advancement. The second stage of creative exploration very seamlessly incorporated ICs and ECs ideas and propositions. The final stage of implementation was appropriate to use the ECs for market acceptance testing and product support.

LaBat and Sokolowski's Three Stage Design Process was proposed to be flexible and easily incorporate ICs and ECs at all three stages of design. This proposed framework was a description of a way of working in the phases of the Three Stage Design Process (1999) to be able to integrate ICs and ECs throughout the product development process.

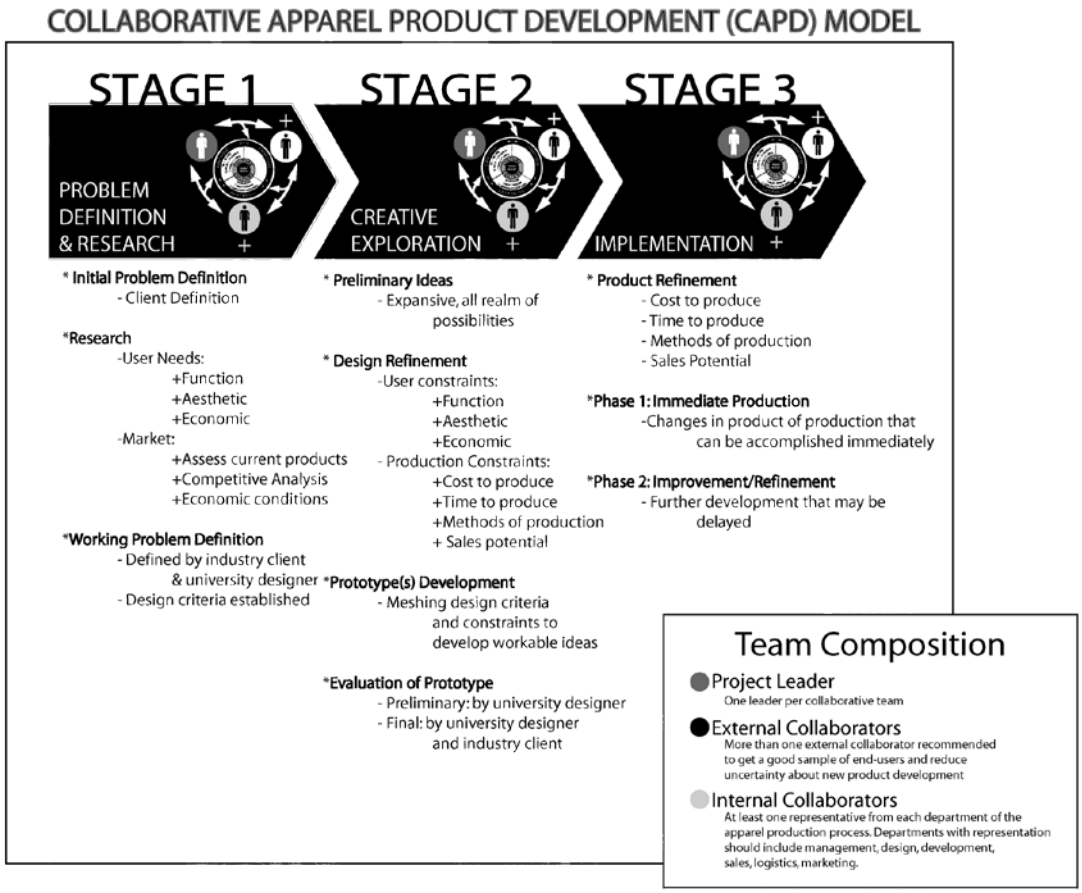


Figure 3.3
Collaborative team integration into all three phases of the Three Stage Design Process (LaBat and Sokolowski, 1999)

All the pieces of the model are now summarized in a total proposed framework supporting the collaboration between the FEA collaboration team and the Three Stage Design Process, which is represented in Figure 3.4. To make it easier to implement this framework in a functioning apparel company, a description is summarized over the three phases in the product development process with propositions of who to involve, examples on how to collaborate, and what to focus on in the different stages.

Stage 1 – Problem Definition and Research:

In this stage, it was proposed that top strategic managers are involved, since questions discussed in the early phase are on a tactical level. The ICs included product development, design, and sales managers. Only key department managers were necessary at this point. This was the stage where the most ECs were needed. The preferred way of collaboration in this phase was regular meetings between ICs, and strategic planning sessions between ICs and ECs. The focus in this stage was proposed to critically define the problem, or product, and conduct research pertaining to the problem. Research included strengths, weaknesses, opportunities, and threats involved in the project (SWOT) analysis and competitive analysis research including price-point comparison, product offering comparison, and consumer purchasing trends. Internal collaborators defined production constraints including cost, time of production, methods of production and sales potential. It was also proposed that it was essential to focus on strategic product development solutions and design criteria that may have an impact on the apparel product development process. It was proposed that ECs were utilized to extrude opinions on market voids, product aesthetics, product improvements, and specific technical questions on functional use.

Stage 2 – Creative Exploration:

In this stage, it was proposed that ICs were broadened to include other department managers including marketing, sales, and logistics. It was also proposed that the most impactful ECs from stage one be asked to remain on the FEA collaboration team. It was the objective to retain the same ECs throughout the process with the idea at each stage of the development process, their knowledge became richer and their output was more valuable (Nambisan, 2002). Forums for collaboration for this stage are were proposed to be informal brainstorming sessions

where expansive preliminary ideas could be exposed. By the mid-point of stage two, it was proposed that design criteria and constraints be developed into workable ideas and prototype development would begin. At this point in stage two, it was theorized that ICs needed to meet frequently on a day-to-day basis, not just interactions at formal meetings. By the end of stage two, it was proposed the ICs and ECs would have an opportunity to evaluate the prototype. It was suggested that ECs be utilized as fit models and in wear trials for most insightful understanding of prototype performance.

Stage 3 – Implementation:

In the final stage, product and logistics refinement are crucial between ICs. It was proposed that the small group of FEA collaborators decided if minor changes were necessary before going into production. During production ramp-up, ICs would focus on keeping the development process on schedule. After production, ECs could be broadened and utilized to test market acceptance of product, and continue the refinement process for further development. It is also important to follow- up with collaborators involved in this project for future refinement of the project.

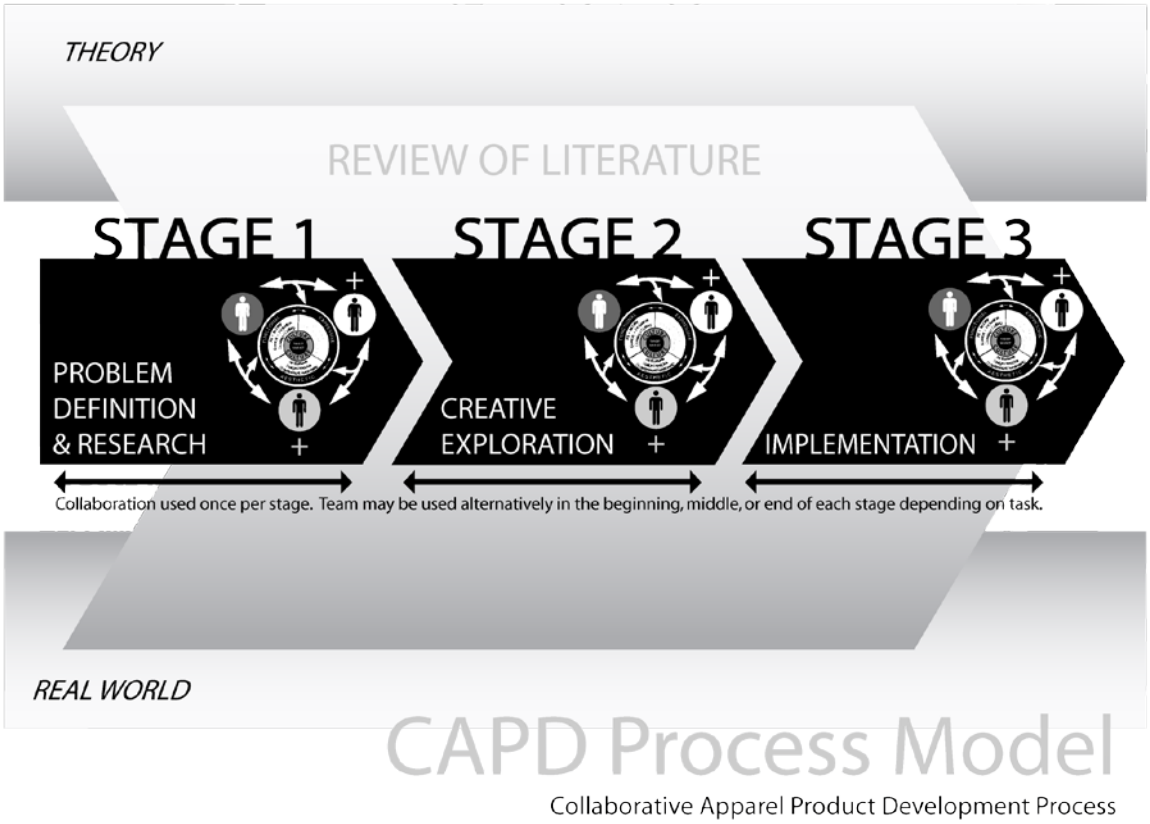


Figure 3.4
CAPD Model

The CAPD Model (Figure 3.4) is not a complete methodology, but a support for the collaboration between ICs and ECs and the apparel product development process. This framework was tested with a case study in this research project within the apparel industry. It was anticipated that further development and refinement of this framework would be necessary, and the revised model is presented in Chapter Six.

CHAPTER FOUR

METHODS AND PROCEDURES

The fourth chapter explains the 'research journey' and provides the methodology for the research path. This chapter describes previous research methods used in this field, the research design, the case study protocol, and methodology used for collecting data. An embedded single case study methodology was applied and examined. A discussion of methods of data analysis, sample selection, and discussion of quality of research concludes this chapter.

OVERVIEW OF METHODS FROM PREVIOUS LITERATURE

While reviewing the literature, many research methods were identified. Where clear research methodologies are mentioned, most studies gather data on trends in product development innovation through surveys. The majority of the studies reviewed on co-design were descriptive. More empirical qualitative studies would allow for better insights and understanding as to how and why companies are achieving success with their product development strategies. Research on consumer involvement implemented concept tests, show tests, and case studies to achieve data collection. Focus groups and concept tests have been used in, and have been found appropriate for apparel development (May-Plumlee & Little, 2006). Other methods for data collection that have been used for apparel development include reviewing trade publications, wear trials, and product customization (May-Plumlee & Little, 2006; Ng & Wang, 2007).

RESEARCH STRATEGY –CASE STUDY FRAMEWORK

Yin (2009) has described four different research strategies and their applicability to different inquiry conditions. The strategies include e*xperiment*, *survey*, a*rchival analysis*, and *case study*. When studying a phenomenon, where people and programs are of interest, or when the organization of different types of knowledge is necessary, case study is the preferred strategy (Yin, 2009; Scholz & Tietje, 2002; Stake, 1995). If the research is complex and contextualized, a case study is a very valuable research strategy (Scholz & Tietje, 2002). A case study is described as *"...an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident* (Yin, 2009)."

In general, a case study may be used as a research design strategy. Quantitative and qualitative data were collected during this research project, which is suitable for an embedded case study design in order to investigate contemporary phenomena in the natural context (Yin, 2009; Scholz & Tietje, 2002). A case study addresses both the technical situations, and has the advantage of relying upon multiple sources of evidence (Merriam, 1998). With the embedded case study strategy, it was possible to focus on interpretation and insight, rather than on the test of hypothesis (Scholz & Tietje, 2002; Merriam, 1998). Case studies take a holistic account of a phenomenon by examining real-life situations (Merriam, 1998; Stake, 1995).

Case studies have been criticized, however, that the study is open to incorrect interpretation of data or biased results when the researcher cannot remove their objective opinions and experiences (Yin, 2009; Merriam, 1998). This required the researcher to be conscious of these criticisms and actively prevent such influences from permeating the research project.

Case studies as a formal research method have been used across many disciplines dating as far back as 1855 by Le Play, a French sociologist (Scholz & Tietje, 2002). Other areas that are increasingly using case studies include (adapted from Scholz & Tietje, 2002):

- Apparel design
- Civil engineering
- Education
- Environmental science
- Interior design
- Logistics
- Management
- Medical Psychology
- Policy and public administration research
- Product development
- Sociology

A content analysis of the Journal of Family and Consumer Sciences, Family and Consumer Sciences Research Journal, and Clothing and Textiles Research Journal, revealed that 19.9% of the total scholarly journals published from 2000-2007 were case study/field work designs (Kang, 2009). This increase is substantial, considering from 1980-1999 only 4.9% of the research strategies used were case study/fieldwork designs (Kang, 2009). Specifically in apparel design and product development research, case studies have been used to develop and test products ranging from sailing apparel (Bye & Hakala, 2005) and knitwear (Pitimaneeyakul, LaBat, & DeLong, 2004) to technology implementation (Park & DeLong, 2009) and collaborative decision-making tactics (Eriksson, 2009).

In this research, collaboration was viewed as the phenomenon, while the organization of the product development project was considered the context. Interactions took place with collaborators inside as well as outside the project.

Case Company Background and Platform

The case that was selected to test the CAPD Model was the development of a nursing athletic bra, commissioned by a Colorado-based maternity athletic apparel manufacturer. The case study was conducted in Denver, Colorado in 2010 with the aim of testing the CAPD Model through one in-depth product development project (i.e. nursing sports bra), and identify key factors to success within the collaborative process by studying the collaborators involved in the project. The main contribution of the study is the answer to research questions Q1 and Q2.

In the second year of business, the sponsor company more than doubled in sales growth. Sales reports from January 1, 2010 to March 1, 2010 show a 35% increase in sales over the same period in 2009. At the beginning of the research, the sponsor company was located in Northern Colorado and employed 12 people (including national sales staff) with expected growth. At the conclusion of the research, the company had relocated to Denver, Colorado in an effort to become more centralized and they continue to employ 12 people, albeit with some changes in position and responsibilities.

The company structure is organized by one main point person in top management, sales, finances and logistics, design and production, public relations (PR), and marketing (e.g. social networking and website maintenance). Support is given to each department through part-time employees and interns. The company has a high degree of interaction between the different departments, but has difficulty managing and organizing the internal collaboration. Primarily, the company utilizes customer oriented product development, where customers come up with product suggestions and the company develops the products. The contributing consumers are from within the company (i.e. sales reps), and outside of the company (i.e. public). The requirements from the consumers vary in depth and specifications. The sponsor

company has a production lead-time of nine to eighteen months and works with manufacturing facilities in China, Taiwan, and Vietnam.

The sponsor company's target market is expectant moms; aged 25 to 37, who participate regularly in athletic activities and seek high quality activewear that fits their changing bodies, but does not sacrifice style. The sponsor company has been sensitive to market interest for a nursing bra alternative to the traditional women's sports bra. The development of a benchmark product or the process of designing new products, such as a nursing sports bra was a perfect opportunity to test the CAPD Model for collaborative design (Ulrich & Eppinger, 2003).

The nursing bra 'problem,' as is defined by the sponsor company, their target market, and internet forums is that the current market offering is limited in providing a nursing bra that offers the necessary features for nursing women. "I need a sports bra that is *specifically* made for maternity with extra support (Hodge, 2009)," writes one blogger. Another blogger shares, "... maternity bras out there now are not supportive enough for women who actually want to work out (Cassill, 2009)!" Because of this market demand, the sponsor company has accepted the challenge of developing a nursing sports bra. What was most decisive for this case study was that the nursing bra, or specific product, is considered as a discourse to the universality of producing apparel products as a whole.

THEORETICAL FRAMEWORK IN CASE STUDY

A review of the CAPD Model, presented in chapter three is presented in this section. The CAPD Model was used as the framework of this case study, and was tested throughout the case study process. The CAPD Model was developed to test the partnership between ICs and ECs and the apparel product development process. The CAPD Model utilizes the Three Stage Design Process (LaBat & Sokolowski, 1999) and collaboration is implemented at each stage. A visual

representation of this model is illustrated in Figure 4.1. A more comprehensive discussion of this model may be found in chapter three.

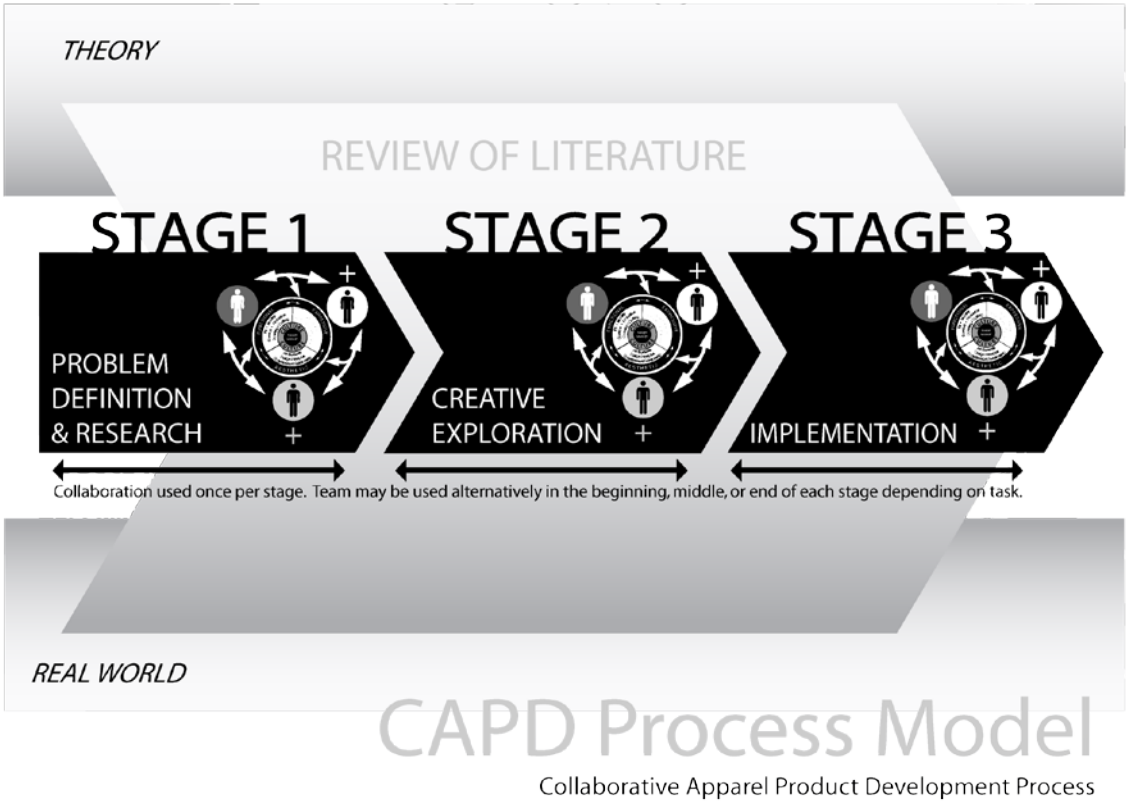


Figure 4.1
CAPD Model

ORGANIZATION OF THE RESEARCH DESIGN

This section outlines the research process and establishes a case study protocol, which has guided the case study along the line of inquiry. Figure 4.2 visually depicts the research process. The process was iterative, starting with theory, moving onto the case study where new knowledge was attained, and back to a more prescriptive phase where the model was revised. Embedded units of analysis pertaining to the case study were analyzed first, and then conclusions were drawn across the whole case. The iterative process is common within case studies (Yin, 2009; Scholz & Tietje, 2002). Combinations of these steps in the process were often

made throughout the case study. The output of the process is new knowledge to academia, the growing body of literature, and the industry in terms of models and systems.

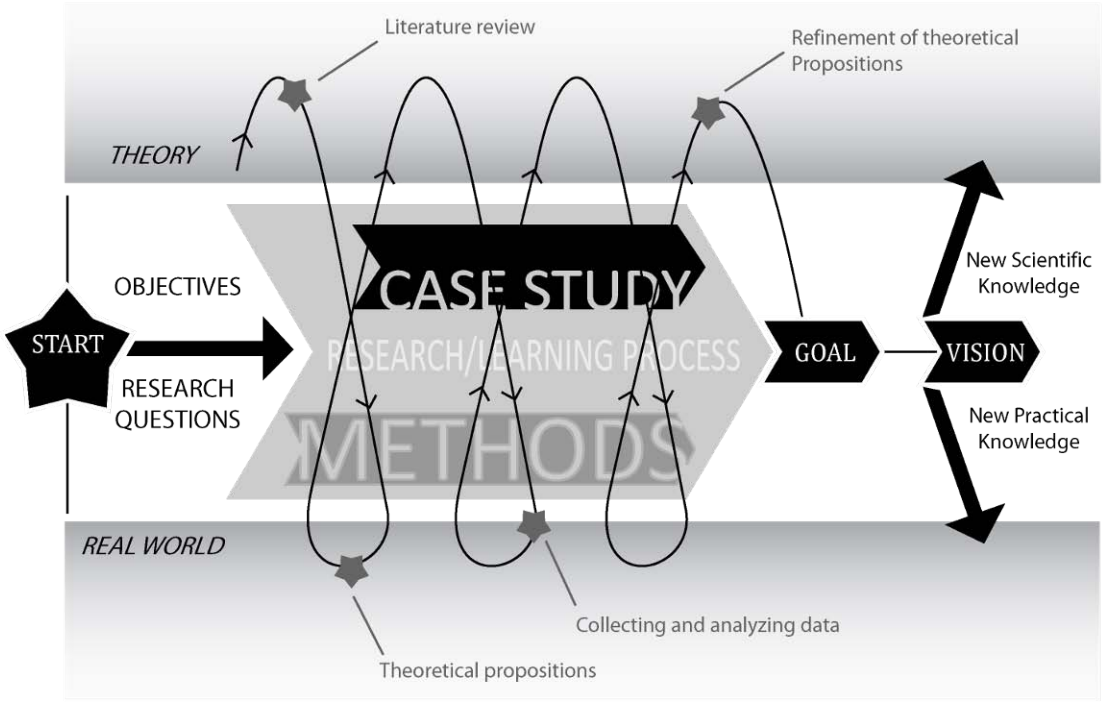


Figure 4.2
The research process while investigating collaborative product development settings

Protocol Stage One: Methods for Collecting Data

The main principal of data collection in a case study is to use multiple sources of evidence (Yin, 2009). With an embedded single-case study, the methods for collecting data may be broadened to include mixed methods such as survey research, documentation collection and analysis, reviewing archival records, interviews, direct observations, participant-observations, and analysis of artifacts (Yin, 2009; Scholz & Tietje, 2002). Typically, interviews or open ended questionnaires and documentation analysis are used in case studies (Yin, 2009). Open-ended questions are used to gather data from participants of the phenomenon of interest, and analysis

of documentation is used primarily to uphold and supplement evidence from other sources (Yin, 2009).

Because this research is an embedded single-case study design, multiple analytical strategies were employed. Scholz & Tietje (2002) depict the multiple levels of the embedded case study as a tri-level diagram. The first level is a holistic view of the research, which is called the *understanding*. The second level, known as *conceptualizing,* is a conceptual model of the real world or the case itself. The final level represents the scattered data and results from subprojects, which is called *explaining*. The major interest of the study, or the *understanding,* was the process by which the case study is executed, the embedded portion of this study was the case study, or conceptualization. The third level of this research was the subprojects, which occur in the case study (i.e. focus group, wear trial, surveys) where the explaining will happen.

The overarching unit of analysis was the ICs and ECs perceptions of the use of the CAPD Model. The research questions outlined in chapter one pertains to the overarching unit of analysis. The embedded unit of analysis, or case study, was the development of the nursing athletic bra.

Data Collection Process

To measure the overarching unit of analysis, questionnaires with open ended questions, and reflexive journaling strategies were employed. To measure the case study unit of analysis, literature reviews, a focus group, surveys, and wear trials were utilized. After approval from the Human Subjects Research Committee at Colorado State University, data collection was initiated.

Consideration of participants as ICs was suggested by the sponsor company. Once IC access was granted, potential participants were contacted and asked to participate in this

research study. Internal collaborators were asked to sign a copy of the Informed Consent Form – Internal Collaborators (Appendix B) and a copy of the consent form was given to the participant to keep for their records and for contact information. Further communication with ICs was coded with the participant's identification number. An Excel spreadsheet was kept as a key for participant names and id numbers. After the conclusion of the research, the spreadsheet was destroyed.

An initial meeting with ICs was scheduled to introduce the CAPD Model, review the research schedule, and administer an entrance survey entitled 'Internal Collaborator Collaboration and Demographics Questionnaire' (Appendix C). Internal collaborators were then followed up with to clarify and perceived issues.

Consumers, or end-users, were recruited and asked to participate in a focus group as ECs. Five local focus group participants were recruited through a purposeful sample selection process. A homogeneous purposeful sample selection process enabled the researcher to select an 'information-rich case' for in depth study (Patton, 1987). A homogeneous sample is particularly useful when researchers need in depth information, and are able to bring together people of similar backgrounds and experiences to address issues that affect them (Patton, 1987). The recruitment channels were through the sponsor company's monthly newsletter, and posting the recruitment documents on the sponsor company's blog. One focus group session was necessary to accommodate all focus group participants. Due to high interest levels from national participants, the focus group schedule was transcribed and emailed to three additional focus group participants along with the survey material and consent forms.

Focus group participants were asked to sign one copy of the Informed Consent Form – External Collaborators (Appendix B), and a copy of the consent form was given to the participant

to keep in their records. All documentation pertaining to focus group ECs was coded with participant identification numbers. Focus group participants were also asked to fill out the External Collaborator Purchase Habits Survey (Appendix C) before the start of the research process.

After ECs were confirmed, a focus group was scheduled at a neutral location in Denver, Colorado. All ECs, as well as ICs, were asked to attend. The purpose of the focus group was to identify and define what problems with bras that women who are breastfeeding have with their bras, while performing moderate to high impact exercise. The focus group followed an agenda, and was audio-taped and transcribed. After the problems were identified through the focus group, the ICs identified which problems could be addressed through product design.

At the conclusion of the focus group, all ECs were given the opportunity to volunteer further as wear trial participants. Anyone interested in continuing the collaborative design relationship was informed of what to expect in the role of a wear trial participant. As Nambisan (2002) recognized in his research, ECs who are better informed about the research inquiry, provide better output and ideas than collaborators who are new to the project. All five local ECs volunteered to participate with the exception of one participant who had to drop from the research study due to a foot injury. Internal and external collaborators were asked to meet once during each of the three stages of the CAPD Model. During each meeting, specific issues regarding the product development process were addressed. Throughout the research process, the researcher kept a research log, or reflexive journal, as to ensure quality and objectivity through the research process (Swigert & Boyd, 2010; Cutcliffe, 2003). The research log reflected on data collected, data analyzed, and experiences. The rational for the use of multiple sources of

evidence for this case study is to assist with triangulation and creating a strong, reliable case study (Yin, 2009; Waddington, 2004; Stake, 1995).

The second meeting between the ICs and ECs took place at the end of the second stage to evaluate the prototypes. Wear trials were utilized in this stage to test the prototype bras (Whitehead, 1996). The five ECs were each provided with a prototype bra and a wear trial journal (Appendix D) to fill out as the garment was worn. Prior to distribution of the prototypes, the bras were measured and visually analyzed. After each wear, the participants were asked to launder the prototypes as per AATCC test method 135-2009 (Appendix D), Dimensional Changes in Automatic Home Laundering of Woven and Knit Fabrics (AATCC, 2009) to preserve fabrics and elastics used in the prototype.

External collaborators were asked to wear the prototype bra for three trial periods over the course of two weeks, and record their experience in the Wear Test Journal. The ECs were asked to alternate the prototype bra with their 'favorite' bra for two trial periods, and alternate in a nursing bra they wear for non-athletic activities for two trial periods. The ECs were asked to reflect on their experience of wearing the different bras while exercising. Although the data from the journal entries of the 'favorite' bra, and non-athletic nursing bra may not be considered a control, this data provided a point of comparison when evaluating the prototype bra. The wear trial journals and prototypes were collected at the end of the wear test period. The third and final meeting was to implement and finalize product refinements emerging from the wear testing. External collaborators were asked to make comments in the wear trial journals to communicate any changes or problems with the prototype during the wear trials before production ramp-up. Major alterations were documented for future product refinement. Both ICs and ECs were asked to fill out an exit survey entitled, 'Collaborator Experience Survey'

(Appendix C) to collect data on the experience of the collaborative process throughout the entire CAPD Model.

Both ICs and ECs were provided with transcriptions from the CAPD Model, information regarding findings of this research study, and formal letters of thank you after the conclusion of the data analysis.

Protocol Stage Two: Collaborator Considerations

Two levels of participant recruitment were necessary for this case (Merriam, 1998). Because of the nature of this case study, a third level of criteria was necessary to define the participants as ICs and ECs. The criteria for participants within this case study were:

The sponsor company was selected based on the criteria outlined below:

1. The sponsor company is a U.S. based apparel manufacturing company.
2. The sponsor company conducts business in an urban area with populations over fifty thousand persons.
3. The sponsor company produces over $200,000 annual gross revenue.
4. The sponsor company actively participates in the manufacture of *new* benchmark products.

Inclusion Criteria for Participants:

Internal Collaborators (IC)

Internal collaborators (ICs) were suggested by the owner of the sponsor company and invitations to participate were extended to all employees located in Colorado. National sales staff was not invited to participate, as they are not involved in daily company operations. The total number of ICs consisted of seven participants; however, two participants decided to discontinue their study participation, due to job termination with the sponsor company. Demographics of the ICs were gathered through a questionnaire.

Internal collaborators were recruited and included in this study because they met the following criteria:

1. All internal collaborator participants are employed by the case company, and have a minimum of one year professional experience in the apparel design field.
2. All internal collaborator participants have an understanding of the case company's vision, their target market, and the production process.

DEMOGRAPHIC INFORMATION

As Table 4.1 depicts, all ICs were female and ranged in age from 23-41 years old. On average, 80% of the participants had worked in the apparel field for ten years or less, and the remaining 20% of the participants indicated they had been working in the apparel field for over 15 years. Participants indicated that they had been working for the sponsor company for one to five years, with the exception of the owner who has operated the business for seven years. The majority of the participants work with the sponsor company on a contract/freelance agreement (60%), while the remaining participants are split between company owner and part-time employment and on average employees work from 1 to 30 hours a week, with the owner indicating an average work week of 40+ hours. All participants indicated multiple roles within the company; out of the five collaborators, four ICs answered that they were involved in marketing roles; two in sales; one in logistics; and one in accounting. No collaborators were in a design role.

Table 4.1

Demographic characteristics of ICs

Characteristic	No.	%
No. of participants	5*	
Gender		
Male	0	0.00%
Female	100	100.00%
Age (years)		
18-30	1	20.00%
31-40	3	60.00%
41-50	1	20.00%
> 51	0	0.00%
Years worked in field		
1-5	2	40.00%
6-10	2	40.00%
11-15	0	0.00%
16-20	1	20.00%
Employment Status		
Owner	1	20.00%
Full-Time	0	0.00%
Part-Time	1	20.00%
Contract/Freelance	3	60.00%
Years worked with sponsor company		
1-5	4	80.00%
6-10	1	20.00%
11-15	0	0.00%
16-20	0	0.00%
Department within sponsor company		
Accounting	1	9.09%
Design	0	0.00%
Logistics	1	9.09%
Marketing	5	45.45%
Sales	2	18.18%
Other	2	18.18%
Hours worked per week		
1-10	2	40.00%
11-20	1	20.00%
21-30	1	20.00%
31-40	0	0.00%
>41	1	20.00%

* The total number of participants was 7; 5 of them (71%) continued throughout the entire research process; the figures in the table omit the responses from participants who discontinued the research.

External Collaborators (EC)

External collaborators (ECs) were recruited by posting the recruitment documents on the sponsor company's blog and Facebook page. Due to the high interest level from potential ECs, the focus group schedule was converted into an online survey and emailed to three additional focus group ECs along with the EC Purchase Habit Survey in order to obtain a larger

sample size. First ECs were recruited for the focus group, and then ECs were invited to participate in the wear trials, of which four of eight focus group ECs accepted the invitation. One additional EC was referred by one of the focus group collaborator to total five wear trial ECs.

External collaborators were recruited and included in this study because they met the following criteria:

1. No external collaborators are employed by the case company.
2. External collaborators actively participate in moderate impact to high impact sports on a daily basis.
3. External collaborators are in good physical condition.
4. All external collaborators belong to the target market for which the apparel company produces product.
5. External collaborators have given birth within the past nine months and/or are currently nursing.

DEMOGRAPHIC INFORMATION

Demographic information was gathered through the EC Purchase Habit Survey and mean scores were calculated using Microsoft Xcel. As Table 4.2 depicts, all ECs were female and ranged in age from 29-38 years old. All ECs (100%) reported they were college graduates or have obtained a graduate/professional degree. External collaborators who reported a combined household income over $110,000 was 40%, with 20% reporting $90,000-$109,000, 20% earning $70,000- $89,000, and 20% earning between $50,000- $69,000. On average, 60% of ECs have given birth in the past year, and all the ECs (100%) have two children or less, with 80% having one child. All (100%) ECs reported giving birth to a single baby during their last pregnancy, and 60% of the ECs indicated that their most recent child is younger than one year. The remaining participants have children who are between 1-3 years old. All ECs reported that they anticipate to breastfeed their most recent child ranging from 0-12 months, with the majority (60%) reporting they plan to breastfeed their most recent child for 0-6 months.

Table 4.2

Demographic characteristics of external collaborators

Characteristic	No.	%
No. of participants	5*	100.00%
Gender		
Male	0	0.00%
Female	100	100.00%
Age		
18-30 years	1	20.00%
31-40 years	4	80.00%
41-50 years	0	0.00%
> 51 years	0	0.00%
Education Level		
High School Graduate	0	0.00%
Some College	0	0.00%
College Graduate	1	20.00%
Graduate/Professional	4	80.00%
Combined Family Income		
< $69,000	1	20.00%
$70,000-$89,000	1	20.00%
$90,000 - $109,000	1	20.00%
> $ 110,000	2	40.00%
Given Birth in the Past Year		
Yes	3	60.00%
No	2	40.00%
Number of Total Children		
1	4	80.00%
2	1	20.00%
3 or more	0	0.00%
Number of Children Birthed During Most Recent Pregnancy		
1	5	100.00%
2 or more	0	0.00%
Age of Most Recent Child		
0-1 years	3	60.00%
1-2 years	1	20.00%
2-3 years	1	20.00%
> 3 years	0	0.00%
Anticipated Duration for Breastfeeding		
0-6 months	3	60.00%
7-12 months	2	40.00%
13-18 months	0	0.00%
19-24 months	0	0.00%

* The total number of external collaborators, which participated to the end of the research study, was 5; the figures in the table do not include information on participants who discontinued the research.

Protocol Stage Three: Addressing the Research Questions

This section organizes the appropriate method of data collection for each research question. An illustrative table of the research questions, the contextual settings, and unit of analysis may be found in Table 4.3.

Table 4.3
Description of the contextual settings, instrumentation, and data analysis for the overarching research questions

OVERARCHING RESEARCH QUESTIONS	CONTEXT	DATA COLLECTION	DATA ANALYSIS
Q1 **What key factors may be identified and related to the efficient execution of collaborative product development projects?** Q1a What challenges do companies experience when they adopt the collaborative apparel product development (CAPD) process? Q1b What advantages do companies experience when they adopt the collaborative apparel product development (CAPD) process?	THROUGHOUT CASE STUDY POST CASE STUDY	Entrance Survey: Internal Collaborator Collaboration and Demographics Questionnaire Exit Survey: Internal & External Collaborator Experience Survey	SPSS; Paired t-test & Descriptive statistics + a *Priori* and coding of open ended questions
Q2 **Has the proposed framework enabled successful product development in relation to increasing perceived efficiency and reducing iteration in the product development process?** Q2a What tools would aid in the management of CAPD to enhance the proposed framework? Q2b How can interactions between internal and external collaborators be efficiently managed in order to support successful CAPD projects?	THROUGHOUT CASE STUDY POST CASE STUDY	Entrance Survey: Internal Collaborator Collaboration and Demographics Questionnaire Exit Survey: Internal & External Collaborator Experience Survey	SPSS; Paired t-test & Descriptive statistics + a *Priori* and coding of open ended questions

Overarching Research Questions

The methods implemented to answer overarching research question one (and sub questions) included the entrance and exit surveys and continual review of the literature. Overarching research question two (and sub questions) was addressed by comparing responses from the entrance survey with the exit survey.

Case Study Research Questions

The case study research questions are better organized, not by specific question, but by the stage of the CAPD Model, they occur within. Table 4.4 provides a visual illustration of how case-specific questions were used in the CAPD Model, data collection method, and unit of analysis.

Table 4.4

Description of the contextual settings, case study unit of analysis, instrumentation, and analysis

CONTEXT WITHIN CASE STUDY	CASE STUDY RESEARCH QUESTIONS	DATA COLLECTION INSTRUMENT	DATA ANALYSIS
STAGE 1: Market Research	Demographics	External Collaborator Purchase Habits Survey	SPSS; Descriptive statistics
	Perceptions of current market offering + *User Needs of Physical, Physiological, and Psychological Comfort*	Focus Group	Template analysis coding of Focus Group Transcriptions
STAGE 2: Creative Exploration	*User Needs of Physical, Physiological, and Psychological Comfort-REFINED*	Focus Group Results	
	Prototype Evaluation of function and comfort	Wear Trial Journal	SPSS; ANOVA and Descriptive statistics + template analysis coding of open ended questions
STAGE 3: Implementation	*Level of which product, through collaborative design achieved function, expressive, and aesthetic concerns of end-user*	Internal & External Collaborator Experience Survey (Exit Survey)	SPSS; Descriptive statistics + template analysis coding of open ended questions

Stage 1: The first stage of the CAPD Model is market research and problem definition. During the market research portion of this stage, questions such as, *what products are currently available in the market?* were addressed through observation. Observations including fabric, design details, fitting elements, and price were recorded from retail and online stores and confirmed/clarified during the focus group. Physical samples were also collected and used in the focus group for review and use of visual aids. Questions pertaining demographics were collected via the External Collaborator Purchase Habits Survey, including*: age, marital status, number of children, age of children, activity level pre-pregnancy, activity level post-pregnancy* as part of the market research being conducted during this phase.

Questions pertaining to comfort were also addressed in the focus group, including: *What physical, physiological, and psychological comfort properties, need to be addressed to satisfy the needs of the consumer?*

Stage 2: The second stage of the CAPD Model is creative exploration. During the creative exploration stage, prototype designs were refined according to the results of the focus group. A single prototype design was developed into five prototype bras. The prototype bra was evaluated, using the wear trial journal, where questions pertaining to function, were addressed including: *Did the prototype bra provide adequate support? Does the bra restrict movement? Is the bra breathable and did moisture evaporate quickly?*

Stage 3: The final stage of the CAPD Model is implementation. During the implementation stage, minor changes were suggested for immediate refinement of the design and major revisions were recorded for future refinement. Questions pertaining to market acceptance according to the ECs were addressed, including: *Has the nursing athletic bra achieved the needs of the end-user? Has the product achieved the functional, expressive, and aesthetic needs of the end-user?* The answers to these questions were recorded as a component to the exit survey.

Protocol Stage Four: Methods for Analyzing Data

The overarching unit of analysis as a whole was analyzed using a template analysis strategy and the Statistical Package for the Social Sciences (SPSS). As depicted in Figure 4.3 findings from each data collection point were analyzed and synthesized as a single source of evidence from which conclusions were drawn (Yin, 2009; Scholz & Tietje, 2002). The methods for analyzing data are defined for each overarching research question. The case study unit of analysis included lesser modes of analysis, and is defined.

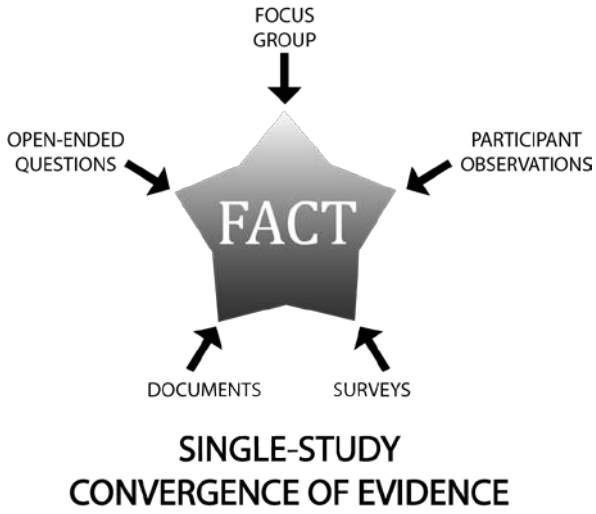


Figure 4.3
Convergence of multiple sources of evidence adapted from Yin (2009)

Analysis of Overarching Research Questions

The overarching research questions were answered through both qualitative and quantitative data analysis. Template analysis technique was used to analyze the textual data in this research, and SPSS was used for the analysis of the quantitative data. Template analysis is a qualitative research method that uses at template of a *priori* codes to thematically organize and analyze qualitative data (King, 2004). Template analysis is used by many researchers due to the flexibility of the technique, and the ability of the method to compare perspectives of different groups of people (i.e. employees) within a specific context (King, 2004).

In template analysis, the list of a *priori* codes are modified and expanded as the researcher reads and analyzes the data. The codes in the template were ranked by importance (King, 2004). Once the initial template of a *priori* codes was established from the review of literature, and analyzing and the open-ended questions from the first surveys for both groups, the template was applied to the full data set (King, 1994). Two separate templates were

necessary to analyze the overarching unit of analysis and the case study unit of analysis. As themes emerge from the data, the researcher interpreted the relationship of these themes to the CAPD Model. The final template was used to interpret and write up the findings (King, 2004). To achieve validity of the data, peer debriefing was utilized. This process exposed the data to a researcher outside the research project, with the intention of exploring aspects of the inquiry that may otherwise not have been brought to the attention of the primary researcher (Lincoln & Guba, 1985).

Throughout the template analysis process, the data was coded, deconstructed, compared, categorized, and reconstructed in new ways (Miles & Hubberman, 1994). From the template analysis coding process, the researcher reviewed the data to find patterns and linkages of data to create themes (Yin, 2009). Open ended questions from the entrance and exit surveys were analyzed using template analysis. The final thematic codes the overarching units of analysis are: a*dvantages, challenges, and efficiency*. Thematic codes for the case study unit of analysis include: c*omfort, user needs, aesthetics, and purchase habits* both units of analysis were addressed using quantitative statistical analysis.

Analysis of Case Study Research Questions

As depicted in Table 4.2, qualitative data analysis was utilized during the focus group and wear trial. Transcribed focus group audio recordings were organized in Microsoft Word, which allowed participant quotes to be identified, identification numbers assigned, and coding for each participants comments.

Template analysis, as described in the previous section, was used to code the transcriptions, develop patterns, and themes. The IC entrance survey was analyzed using SPSS. Descriptive statistics were run on the following variables: *age, numbers of hours worked per*

week, number of years working in apparel product development, educational level, and familiarity with target market. The EC Purchase Habits Survey was also analyzed using SPSS. Descriptive statistics were run on the following variables: *age, education level, type of employment, income level, marital status, number of children, and months since last birth*. The wear trial journal was also statistically analyzed using SPSS using ANOVA test for variance. The following variables were analyzed: *support, fit, and range of motion, comfort, and more*. Finally, the entrance and exit surveys were analyzed using a paired t-test to look for differences across the groups.

PILOT STUDY

A pilot study was conducted to familiarize the researcher with the dynamics of collaborative teams. The pilot test also allowed the researcher the opportunity to test the instruments. A peer who was pursuing a product development project as coursework was approached as for a reviewer of this pilot study.

In-depth market research on existing athletic bras and nursing bras was completed during the first phase of the research study; however, during the pilot study preliminary market research was necessary to familiarize the researcher with athletic and nursing bra construction, fabrication, and use.

RESEARCHER'S ROLE

The researcher's history and familiarity with the apparel design process as a product developer contributed to an insider's perspective of the interactions between ICs and ECs. This internal understanding informed the interpretation of the data collected and enriched the understanding of the interpretations especially with the relationship to the collaborative design

process and met and unmet needs of ICs and ECs. During the research process, the researcher acted as the 'Team Leader' in the collaboration team to guide the group through the initial testing of the CAPD Model.

QUALITY ASSURANCE

Because quality assurance is particularly important in creating a trustworthy case study, a description of the methods utilized throughout the data collection and analysis is described below. This research, carried out through a case study, is measured using the terms Validity and Reliability (Yin, 2009; Scholz & Tietje, 2002; Merriam, 1998).

Validity

Internal and external validity should be used to conduct case study research (Yin, 2009; Stake, 1995). Internal validity is summarized as the ability of the study to examine the topic that it claims to examine (King, 1994). External validity, is the reliability of the results regarding the applicability to similar situations besides the one studied in the current case study (Yin, 2009).

To address the issue of validity multiple sources of data collection were utilized. Because this is a single-case design, the issue of external validity is still prevalent. It is suggested in the 'future research' section in chapter seven of this research that the framework and methods be duplicated in additional case studies to assist in external validation. Detailed descriptions of the conducted case study were emphasized to illustrate the context in which results are valid.

Reliability

Reliability is the ability for future researchers to duplicate the current research and reach the same conclusions (Yin, 2009; Merriam, 1998). Reliability is focused on what measurements were utilized, and how precisely they were used during the study. Yin (2009) proposes that reliability is possible if other researchers are allowed access to the exact documentation and detailed research procedures used by the first researcher to duplicate this study. Lincoln & Guba (1985) and King (1994) stress that reliability may be achieved by constantly discussing and examining the coding with researchers not affiliated with the study. To increase reliability during this research, detailed process notes were documented within the reflexive journal kept by the researcher.

This research was carried out using methods such as questionnaires, documentation, and focus groups within an industrial context. Because no two case study situations will ever be identical, challenges in replication of the study will be difficult. However, if the research questions presented in this research are presented in future case studies, results will be similar.

CHAPTER FIVE

RESULTS & DISCUSSION– EMBEDDED UNIT OF ANALYSIS (CASE STUDY)

Chapter five presents the main results from the embedded unit of analysis (case study) and a discussion of the results. The case study results and discussion are organized into the three stages of the CAPD Model. In an effort to address each stage of the CAPD Model, results are presented first, and then a discussion of the results is provided immediately after.

The case study provides valuable information for both this research objective and the sponsor company. Additional information from data collection, which is not addressed in this chapter, is compiled into a Case Study Brief in Appendix B. The results and discussion from the case study work as the foundation for improvements to the CAPD Model further developed in Chapter 6.

TESTING THE CAPD MODEL - RESULTS

The case study was organized by the three stages of the proposed CAPD process (Figure 5.1): Market Research, Creative Exploration, and Implementation. During each of the three stages, multiple data collection tools were utilized. Stage one captured perceptions of the current market offering and the user needs through the External Collaborator (EC), Purchase Habits Survey and a focus group.

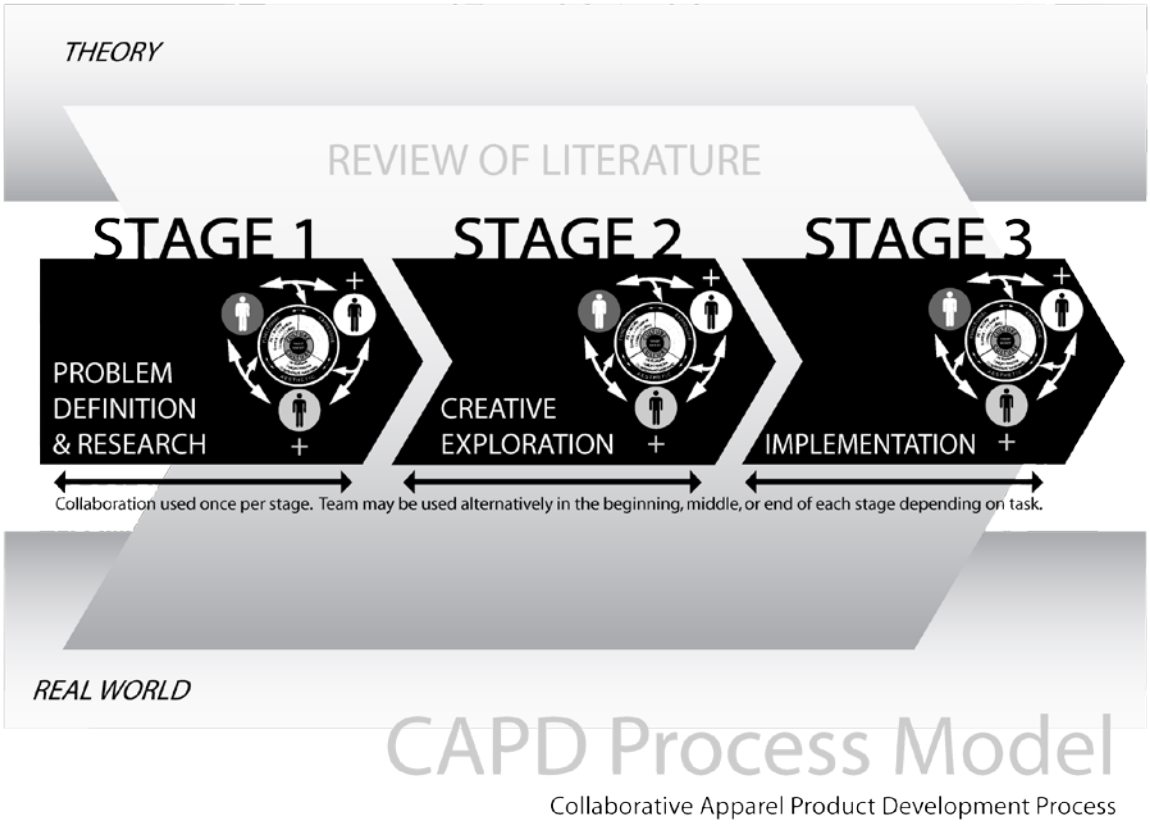


Figure 5.1
Proposed CAPD Model

Stage two used the focus group results, and data from the wear trial journal to develop and evaluate the prototype. Stage three used data gathered from the Collaborator Experience Survey, which will be referred to from here as the exit survey. Table 5.1 illustrates how each stage was used to collect data.

Table 5.1
Description of the contextual settings, case study unit of analysis, instrumentation, and analysis

CONTEXT WITHIN CASE STUDY	CASE STUDY RESEARCH QUESTIONS	DATA COLLECTION INSTRUMENT	DATA ANALYSIS
STAGE 1: Market Research	Demographics	External Collaborator Purchase Habits Survey	SPSS; Descriptive statistics
	Perceptions of current market offering + *User Needs of Physical, Physiological, and Psychological Comfort*	Focus Group	Template analysis coding of Focus Group Transcriptions
STAGE 2: Creative Exploration	*User Needs of Physical, Physiological, and Psychological Comfort-REFINED*	Focus Group Results	
	Prototype Evaluation of function and comfort	Wear Trial Journal	SPSS; ANOVA and Descriptive statistics + template analysis coding of open ended questions
STAGE 3: Implementation	*Level of which product, through collaborative design achieved function, expressive, and aesthetic concerns of end-user*	Collaborator Experience Survey (Exit Survey)	SPSS; Descriptive statistics + template analysis coding of open ended questions

Stage One: Market Research Results

The first stage of the proposed CAPD Model was market research and problem definition. During the market research stage, information was gathered using the EC Purchase Habits Survey, a focus group, and web-based communications.

Quantitative Data - EC Purchase Habits Survey

Results from the survey uncovered important information regarding experiences of ECs during exercise, shopping, and aesthetic preferences. Demographic data regarding ECs may be found in Chapter Four.

The survey began by addressing how breastfeeding has affected participation in athletic activities. In regard to participating in high impact sports while not breastfeeding, the range of participation is higher than when ECs are breastfeeding. For example, ECs who are *not* breastfeeding exercise 1-6 times per week whereas ECs who are breastfeeding report exercising 1-4 times a week.

External collaborators indicated that when they do *not* have a child who is breastfeeding, 87.5% do not experience breast soreness and 12.5% experience soreness after exercise. However, when ECs have a child who is breastfeeding, 50% indicated breast soreness during exercise, 12.5% experience soreness after exercise, and 37.5% do not experience soreness.

External Collaborators reported that they waited 3-4 weeks (50%) to resume exercising after giving birth while 25% indicated they waited only 1-2 weeks, and the remaining 25% reported waiting 7-8 weeks. In addition, the majority of ECs (87.5%) indicated that nursing has influenced their participation in exercise.

All ECs (100%) indicated they wear athletic bras during both exercise when they have and when they do not have a child who is breastfeeding. In regard to fit, pre and post breastfeeding, ECs reported an average increase of one cup size and an increase of 1.38 sizes in band length (i.e. 36B to 38C). Moreover, 86% of ECs report increasing one letter size (i.e. M to L) in athletic bras.

When asked how many athletic bras each ECs owned, there was a wide range. External collaborators reported owning 1-2 bras (25%), 3-4 (12.5%), 5-6 (25%), 7-8 (12.5%), and over 8 (25%). As compared to nursing bras, all ECs indicated owning less than seven nursing bras with 1-2 (12.5%), 3-4 (25%), and 5-6 (62.5%).

When ECs were asked what they considered to be a reasonable price for an athletic bra, 100% of the ECs indicating $21-50 for an athletic bra. As compared to nursing bras, the majority (62.5%) indicated a higher price range of $41-50. Although the price range for nursing bras was higher, the monetary spread of what ECs were willing to pay for a nursing bra was large ($11-50).

External collaborators indicated that they prefer retail stores (66.67%) to online shopping (33.33%) when shopping for a nursing bra. Prior to shopping for a bra, 62.5% of the ECs perform preliminary product research. When collaborators were asked if they typically found what they were looking for when they go shopping for nursing bras, 37.5% indicated that they find what they are looking for, 12.5% indicated they find what they are looking for but not the brand, size, or color. In addition, 25% indicated they find a related product, but not what they wanted, or they did not find what they were looking for (25%).

Concerning aesthetics, all ECs (100%) indicated they prefer solid colored fabric to printed fabric for athletic apparel, including sports bras. External Collaborators indicated that the color black (29.41%) was their favorite color, followed by white (23.53%), blue (23.53%), nude/flesh (11.76%), green (5.88%), and gray (5.88%) for athletic apparel. Additional color and print information is available in Appendix B.

Qualitative Data – EC Purchase Habit Survey + Focus Group

Analysis of open ended questions from the survey helps explain and substantiate quantitative findings. A template was developed based off information provided in the survey, and was applied to analyze the focus group transcriptions. The information obtained in this survey is very similar to information found from the focus group, so the template analysis findings from this survey have been integrated into the template analysis of the focus group. The original template for the EC Purchase Habit Survey can be found in Appendix B.

The focus group was conducted to gather detailed qualitative insights from ECs about important features of developing a nursing sports bra. To the surprise of the researchers, unsolicited web based communications were initiated by online ECs which could not participate in the study. The blog responses were also collected and grouped into the template analysis with the focus group and the EC survey. The template created for the EC survey was applied to

the focus group transcriptions. Analysis of the focus group transcription revealed four themes (Figure 5.2): *Comfort, User Needs, Aesthetics, and Purchase Habits.*

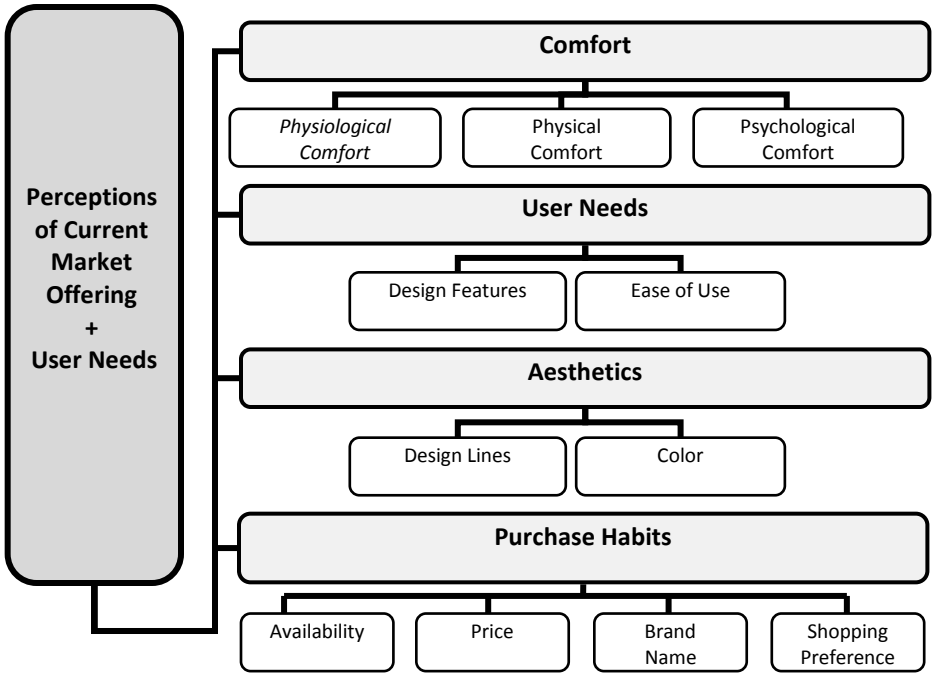


Figure 5.2 Qualitative data analysis of EC Purchase Habit Survey and Focus Group

Comfort

The first major theme that emerged from the template analysis was *Comfort*. Within this theme, three sub-themes emerged: *Physiological comfort, physical comfort, and psychological comfort.*

Physiological Comfort: *Support* was an overall theme for physiological comfort and the most important factor for the ECs during the focus group. However, there were contradictory comments that the ECs needed support, but they also wanted as little compression of the breast as possible due to tenderness. Because of this dynamic need, traditional methods of sports bra support should be examined. The ECs also expressed that acceptable nursing bra brands (i.e. Mideva and Motherhood Maternity) are comfortable but do not provide enough support. Sports

bras, however (i.e. Moving Comfort and Danskin) are supportive enough, but do not allow nursing. As one EC explained, “I have been exercising a lot less. I am usually a runner, but not while nursing. I get a lot more ‘bounce’ and it is uncomfortable for me.”

Ease of *movement* was also very important by the focus group collaborators. External Collaborators expressed a range of concerns including ease of donning and doffing, and unrestricted movement in order to nurse. Due to increased breast tenderness and swelling, the focus group ECs explained that they have altered their normal exercise routines, as one collaborator explained: “I have to plan runs around feeding because it is more comfortable to go after feedings.”

Physical Comfort: Fabric also plays an important role in satisfying physical comfort needs. Collaborators expressed that the fabric should be *breathable and quick drying*. Unique to this demographic is that not only sweat needs to be wicked away from the skin, but excess milk should also be removed from the skin. One collaborator explained, ‘[The fabric] needs to be something that wicks, but is soft like cotton.’

Another concern of fabric was the *density/weight* and supportiveness. Fabrics that were made of a heavier weight and had less spandex were preferred by the focus group collaborators after they examined several sport and nursing bra samples provided at the focus group. A final concern was over the lifespan of bras with spandex in them. One focus group collaborator explained that she has to replace her bras with Lycra in them because they lose support over time as the spandex degrades.

Fit plays an important role in overall performance of the bra. The consensus was that the bra should be comfortably tight over the chest in order to support the breasts, and long enough to stay down when lifting arms above the head. The bra should also fit well over the chest so it does not flatten the breast or create an odd silhouette.

Psychological Comfort: Focus group collaborators expressed many psychological comfort related issues. Many ECs have *negative perceptions* of *feeling exposed* while nursing. Many negative feelings of exposure came from exposing the stomach while nursing. One EC explained that she nearly always wears a camisole under her top, so when she has to nurse, she can pull the camisole down and lift her bra up to nurse without exposing her stomach. Nearly all ECs related to wanting to keep their stomachs covered, especially if they are sweaty and do not want the baby to be exposed to their perspiration. Another concern was exposed nipples through the bra and shirt. One EC suggested removable pads to counter 'show through'.

Another *negative perception* was of different bra features having *detrimental physical effects* on the body. Underwires in nursing bras were perceived by the ECs as having a possibility of cutting off milk supply. Another nursing bra design feature that elicited a negative perception were bras which have a circular opening (a hole) inside the drop cup to expose the breast for nursing. Collaborators expressed great resistance to this feature due to the physical comfort attributes (i.e. the opening is not the right size for the wearer, rubbing). This style of bra also elicited negative psychological associations such as stigmatizing sexual behavior, "I think the holes are weird. How do you know where the holes are going to be? I can move them around and place them, but I am not that big. I don't know when you have a large chest."

Another factor to psychological comfort was the *level of experience* ECs had with nursing. Many ECs expressed anxiety over having their first child. More experienced ECs explained that after your first child, you know more of what to expect and you are more comfortable. Another EC also explained that her workout regimen has relaxed also after each child.

The final psychological comfort was the need for *femininity* when being pregnant and working out. Collaborators expressed feeling 'ugly' and 'ridiculous' for having to wear large,

bulky clothing while being pregnant. Collaborators expressed wanting to feel good while their body experiences dramatic changes pre and post delivery, and while ECs exercise to get back to their pre-pregnancy body weight.

User Needs

The second major theme that emerged from the template analysis was *User Needs*. Within this theme, two sub-themes emerged: *Design features* and *Ease of Use.*

Design Features: Throughout the focus group, *design features* were discussed. Collaborators expressed they preferred bras that closed with a hook-and-eye clasp than bras that pull over the head due to ease in donning and doffing. All ECs agreed that adjustable straps were important to help with variations in breast size and ECs explained that the straps should be comfortable and not cut into you. Collaborators addressed that there should not be an underwire. Easy, one-hand nursing clips were preferred by ECs, however, the traditional drop down cups were not viewed as the only way to design a nursing sports bra. Collaborators discussed a variety of options for accessibility in nursing including cups that opened from center front, cups that snapped together, and cups that opened from the side. The ECs could not brainstorm a good alternative, but many ideas were covered and all agreed that nursing should be easy and comfortable for both the wearer and the baby without fabric getting in the way. Collaborators also addressed removable pads in the bras. Many ECs liked the idea of the pads as long as they were removable. One EC explained,

> "I like the option [of pads], because for the first three months, I had to have something in there because I was leaking all the time, but now I don't produce that much milk at all. But to have the option to take those out would be huge. To increase the longevity of the bra is important because you don't want to have to buy a new sports bra every three months. I want to be able to buy something that I can wear for awhile."

Ease of Use: The collaborators also expressed importance in being able to *easily nurse* while wearing the bra. Collaborators agreed that you should be able to undo the clasp and start nursing with one hand. The ECs also expressed the need for the bra to be easy to use due to time constraints.

Time Efficiency was identified as a sub category to ease of use. Collaborators explained that timing was very important due to hectic schedules and finding time to run between feedings. One EC explained, "I am trying to juggle my baby's nap, my husband's schedule, my schedule, and then the nursing schedule. I'm like; can I just get thirty minutes to go for a run, really?" Another EC depends on multi-tasking in order to save on time,

> "…when I am on my way to the gym, depending on the day and my schedule I will actually pump in the car. I set it all up, put the seatbelt on, and I have this scarf that just hangs right here [over chest]. Then I have to take the [nursing bra and scarf off], and get re-dressed [with a sports bra] under the [scarf]. This usually happens in the parking lot. And it is just really awkward."

Other ECs agree that time is precious and explained that they too have difficulty pumping milk on the go.

Aesthetics

*Aesthetics also e*merged from the template analysis as a major theme. Within this theme, two sub-themes emerged: *Design lines* and *Color.* Table 5.10 displays the index codes as they relate to *Aesthetics.*

Design Lines: External Collaborators also expressed concern about *design lines* in a nursing sports bra. Collaborators agreed that no seams should be across the breast. Some ECs expressed that the seam show through shirts, and other explained that the seams were uncomfortable. One EC explained that, "seaming needs to be in the right places as to not show through or distort the breast [shape]."

Color: Concerning *color*, ECs put a lot of thought into their color choices. Collaborators liked basic colors such as white, black, and nude. However, some ECs did not like white because of staining, and some ECs did not like black because you can see it under your shirt. Most ECs expressed that color was not a big influence because they are interested in the function of the bra. Color was a novelty, as is expressed by one EC who said, 'I like to pick colors, but overall it is just about the function. A little [color] choice is nice.' Collaborators expressed the same feelings about printed fabric. Most ECs said they prefer solid fabric to printed fabrics, and again concern of the print showing through light colored shirts was expressed.

Purchase Habits

The final theme that emerged from the template analysis was *Purchase Habits*. Within this theme, four sub-themes emerged: *Availability, Price, Brand Name,* and *Shopping Preference.*

Availability: When the focus group ECs were asked about *availability* of sports bras specific for nursing, they all expressed there was limited availability with 'no viable options.' Collaborators explained that the best availability has come from online shopping, but therein, one EC explained that what she ends up doing was ordering multiple options, and then returned what did not work for her.

Throughout the focus group, the lack of availability and the need to compromise when purchasing sport/nursing bras was constantly addressed. Focus group collaborators explained that in order to gain enough support to control breast movement during running, many of them wore two sports bras. Collaborators divulged that when nursing, breasts could rapidly change in size, changing sizes throughout the day. Collaborators expressed frustration with not being able to remove both bras in order to nurse and one explained that two sports bras was not enough support. One EC shared that she read of a woman online who cut slits into her bra for accessibility and ease of nursing.

All ECs explained that the bras they currently use to work out in are sports bras and no ECs work out in nursing bras. Two ECs explained that they also double up bras where they wear a sports bra over a nursing bra. One online EC shared on the sponsor company blog site that, "I find that my regular sports bra is not supportive enough. I usually wear a nursing bra underneath a sports bra in order to exercise, but running is still really 'bouncy' for me, and I do like the convenience of being able to nurse."

Price: When asked about *price* preferences for nursing/sports bras, the ECs on average said they would pay between $25 to $75 for a nursing bra or an average of $44 for a sports bra. One EC expressed that she would pay 'anything' for a bra that met her needs. Others explained that they would pay more on a 'really great' nursing bra that is perceived as 'doing more for you.'

Brand Name: The *brands* of athletic bras, which the ECs liked, included Adidas, Nike, Prana, Bally's, Champion, and Moving Comfort. Brands the ECs liked of nursing bras included: Bravado and Elomi.

Shopping Preference: When asked about *shopping preferences* the ECs divulged that they use word of mouth, talk with store employees, and look at reviews online. Collaborators have also looked at blogs geared towards mothers as one EC explained, "…mommy blogs have a lot of pull!" Among the focus group collaborators most ECs referred to online product reviews and sales reps for technical information regarding the product.

The focus group and EC Purchase Habits Survey allowed for deep information gathering which guided the development of the nursing sports bra prototype. This method of obtaining ECs insights was very valuable concerning reducing risk. The next part of the chapter will discuss how the nursing sports bra prototype was developed, using the framework of the three-stage product development process, proposed by LaBat and Sokolowski (1999). Discussion of the results of Stage One is provided below.

Stage One: Market Research
Discussion of Results

The focus group and EC Purchase Habits Survey allowed for deep information gathering which guided the development of the nursing sports bra prototype. This method of obtaining ECs insights was very valuable concerning understanding user needs for the prototype development at the front end of the process. According to Unger and Eppinger (2006), the purpose of a product development process is to provide a structure to manage uncertainties and risks associated to each project. Segmenting the process into smaller sections allows for better risk management. As researchers have found previously, the most successful innovative products require great understanding of continually changing needs of the consumers (Hines & Quinn, 2007; Ng & Wang, 2007).

The focus group and survey were used at the front end of the product development process as the first measure of consumer needs. Researchers have identified that at the initial state of product development; many ideas are generated and funneled down to potentially successful design concepts (Sanders & Stappers, 2008; Koen et al., 2001). As Ng & Wang (2007) noted, design in the clothing and textile field is moving increasingly toward hybrid trends. These trends integrate models that address consumer aesthetics into the fuzzy front end of design in order to gather rich consumer insight. Internal collaborators also addressed this in the entrance survey stating, “This is where we’ll get the best feedback, creative ideas, and insight. A variety of perspectives and collaborative design ideas can only help enhance the product.”

Prior to this case study, the sponsor company had never aggressively sought rich consumer information at the front end. The sponsor company had relied on sparse and sporadic feedback information from retail stores and direct consumers. An IC expressed, “currently we are taking most feedback from sales reps, who sell to our retailers but it’s not direct feedback from

customers wearing the product. We do take some feedback direct from customers, but not enough." Use of the CAPD Model has solicited rich data, and provided a way for the sponsor company to organize the findings.

However, there were some implications of using ECs during the focus group. During one portion of the focus group, as collaborators were discussing options for accessibility in nursing, the ECs could not brainstorm a solution to ease the nursing problem. Many ideas were covered however; the ECs were unable to come up with a suitable solution. As von Hipple (1998) addressed, by pointing out that consumers may not know what they want before they are able to see physical prototypes and consequently they may not be able to verbalize their needs. Overall, the focus group was a suitable platform for obtaining specific consumer needs.

Stage Two: Creative Exploration
Results

Product Development

Based off information from the focus group and EC Purchase Habit Survey, prototype development began. Initial design concepts were drawn up and reviewed with ICs. From suggestions of ICs, further design refinements took place and a final design was decided and illustrated in Figure 5.3. Based off the focus group findings, the following design features were addressed to satisfy the focus group participants:

Comfort

Physiological Comfort: Support was addressed by using a slightly heavier fabric that had moisture wicking to help with the breathability. Ideas from the participants about wearing a sports bra over a nursing bra gave way to the idea of creating a bralette under a sports bra shell. The 'two' bra approach to address support is responded to in one bra. Attention was also paid to the straps, armholes, and neckline as so they did not restrict or cause additional movement.

The bra was designed to have a back hook-and-eye closure for ease of putting the bra on and taking the bra off. With additional support, it was expected that participants could go back to their normal exercise routine without pain.

Physical Comfort: Fabrics for the bras were sourced nationally, and a sueded wick away Lycra was chosen. The wick away component was important for moisture management and breathability for physical comfort. A nylon/spandex tricot power mesh was sourced for the interior bralette. This fabric was chosen in order to reduce bulk, increase breathability, and provide an extra level of support. The fit of the bra was cut to be slightly snug, but not binding. Additional length was added at the sides for additional support and full coverage. Measurements for the pattern were based off the sponsor company's grading standards for a sample size medium.

Psychological Comfort: Removable bra cups were included in the product to avoid show through of the nipples. The feeling of exposure across the stomach was thought about over and over, and without developing a companion tank or top, no solution was addressed with this issue. In order to replicate the additional support underwires provide in bras, a faux underwire was created out of channeling. The faux underwire also provides breast definition without restricting breast milk flow. Additional aesthetic touches were implemented to make the wearer feel feminine including the mesh trim, which extends beyond the neckline slightly and shaping inside the bra with the underwire and removable cups.

User Needs

Design Features

User needs concerning function, expressive, and aesthetics from Lamb and Kallal's (1992) FEA Consumer Needs Model were consciously and sub-consciously addressed during the

design and development stage of the prototype. Clearly defined functional, and aesthetic design needs were addressed by the ECs during the focus. When consulting with ICs about prototype features, the culture of the sponsor company through expressiveness was integrated. During each decision making process throughout the prototype development, both the FEA needs of the ICs and ECs were taken into consideration.

***Straps and Clasps*:** The straps are a unique feature of this bra. They are wider than traditional bra straps and slightly padded for extra comfort. The bra straps are also adjustable with Velcro at the back. This adjustability is important for variations in breast size across consumers and within consumers. Finally, the straps may be crossed in the back into a racerback orientation for additional support.

No Underwire: A faux underwire was created by using underwire channeling under the cups to create definition and additional support. Due to perceived negative effects of underwire during nursing, no wires were used in this bra.

Cup Shape: A traditional drop down cup for the bra was decided as the best option for this bra. Focus group participants discussed alternatives to this method that may be easier to nurse with, however for the issue of support, a drop down cup would provide the best support and reduce breast displacement.

***Removable Pads*:** Removable pads were included for users who were concerned about breast definition and nipple show through. However, the pads could be removed for users who did not care for them.

Ease of Use: The bra was designed with easy one-hand nursing bra clips, and the interior of the bra was created to allow the wearer to nurse. The bralette is a surplice design made of two layers of mesh. The mesh was chosen to aid in the breathability of the garment. The surplice

construction was chosen to allow easy access for nursing. Because this bra is both a nursing bra and a sports bra, the users should be able to wear it for pumping without having to change into a sports bra when they want to work out, in regard to saving time.

Aesthetics

Design Lines: It was important to the collaborators that no seams crossed over the bust due to comfort and aesthetic reasons, so special attention was paid to address this concern. The interior bralette was designed so no seams cross the bust. There are two seams on the outside panel, which are necessary to hold the removable pads in place, but the seams do not cross over the bust.

Color: The color of the prototype was chosen based off fabric availability. However, a dark basic solid color was preferred, based off perceptions of white fabric, and the collaborators variety of responses to prints. For this prototype, a dark solid color was chosen as to not take away from the overall reaction of the consumer on the bra due to color.

Purchase Habits

Availability: Many ECs addressed having to compromise with the types of bras they used to exercise. This bra was designed to act as two bras in one – it is the hope that this bra can replace the 'make do' attitude and having to wear two bras while exercising.

Price: The fabrics and findings to develop the prototype were purchased at retail value. The average cost to produce one prototype bra was $24.00 (excluding labor costs). For a bra produced by a manufacturer at wholesale pricing, the cost of production would be substantially less. The sponsor company had previously been quoted on a similar bra, and the quotes based off a 1200 piece minimum were approximately $10.00 FOB. Although this price is high, it is within the range of prices defined by the collaborators. Researchers have found, with the

movement toward designing for longevity, consumers are gravitating towards simpler products and considering spending more money on products that will last longer (Hines, Calder, & Abraham, 2009).

Brand Name: Overall Brand names did not seem as important as functionality for a nursing sports bra. However, a strong brand name does help product credibility. This is an issue the sponsor company will have to address. It will be suggested to the sponsor company that they market this product online as well as at store locations. Product reviews and detailed fit, support, and functional highlights should be clearly shared on the company website, online retailer websites, and blogs.

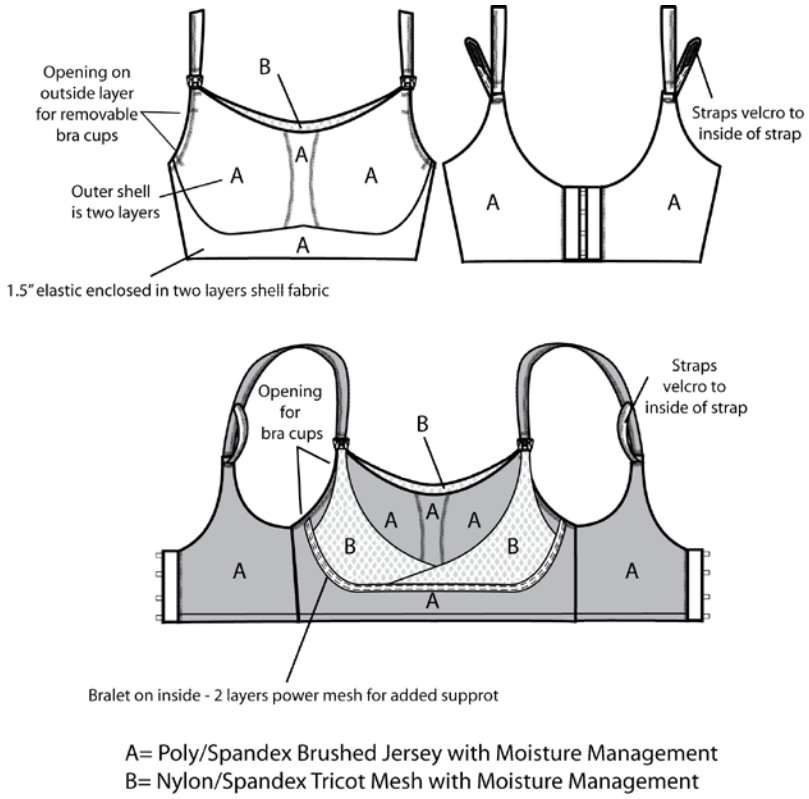


Figure 5.3
Final sport nursing bra design

Wear Trials and Prototype Evaluation

Five prototypes were developed (one for each EC) in an effort to efficiently and simultaneously collect data from wear trials. All prototypes were developed in a sample size medium (based off grading established by the sponsor company). If necessary the bras would have been created in different sizes for each participant (e.g. large, or small), however all participants measured a sample size medium. Quantitative data from the wear trials were analyzed using ANOVA with the interest of examining the interaction between the activity level and the bra. Qualitative data from the wear trials were isolated and analyzed using the template developed from the focus group.

Quantitative Data – Wear Trials

Collaborators were asked to test the prototype bra for three trials and alternate their 'favorite' athletic bra or 'favorite' nursing bra for two trials. Each time a bra was tested, the ECs were asked to report the level of activity they participated in. Levels of activity ranged from medium or low impact (e.g. yoga, walking, cycling) to high impact (e.g. running, playing soccer). Collaborators evaluated the bras on a 7-point Likert scale in the Wear Trial Journal (Appendix E) on the following variables: support, fit, comfort, attractiveness, ease of movement, donning/doffing, breathability, and ease of nursing. In order to understand the performance of the prototype bra under most extreme conditions, the interaction between the prototype bra and high levels of activity were analyzed using Analysis of Variance (ANOVA) where α=0.05. The test variable (dependent variable) was the bra type and was measured on the level of activity scale (high or medium/low). Over the course of two weeks, the prototype bra was tested by the five collaborators 19 (46.3%) times in total and the 'favorite' bra was tested 15 (36.6%) times. Collaborators participated in high level activities 46.3% of the time and medium/low level

activities 36.6% of the time. Each of the eight variables were tested and compared to the null hypothesis. Figure 5.4 compares the mean scores of the prototype bra and the 'favorite' bra for each of the eight variables.

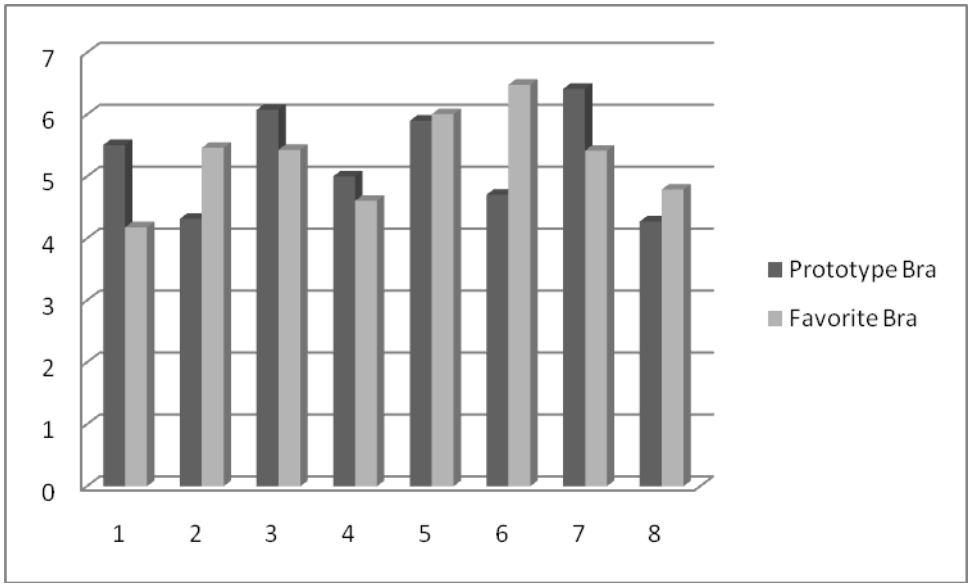


Figure 5.4
Evaluation of prototype bra and 'favorite' bra for high impact activities; 1= Support; 2= Fit; 3=Comfort; 4=Attractiveness; 5=Movement; 6=Don/Doff; 7= Breathability; 8= Ease of Nursing

For each of the variables, statistical significance was examined. Results of each variable are reported below:

Support: The level of activity has a significant effect (p=0.023) on support concerning high activity levels, and the type of bra has a significant effect (p=0.021) concerning support. The prototype bra overall was evaluated higher ($\overline{x}$ =5.509) for support than the 'favorite' bra ($\overline{x}$ = 4.181).

Fit: No significant difference (p=0.235) was found in the interaction of level of activity and type of bra in regard to fit, thus the null hypothesis is validated. The level of activity has no significant effect (p=0.263) on fit, however the type of bra has a significant effect (p=0.030) on fit. The 'favorite' bra was evaluated higher ($\overline{x}$ =5.463) than the prototype bra ($\overline{x}$ =4.318) concerning fit.

Comfort: No significant difference (p=0.789) was found in the interaction level of activity and type of bra in regard to comfort, thus the null hypothesis is validated. The level of activity has no significant effect (*p*=0.067) on comfort, and the type of bra has no significant effect (*p*=0.057) on comfort. Overall the prototype bra was evaluated higher ($\bar{x}$ =6.076) over the 'favorite' bra ($\bar{x}$ =5.430) for comfort.

Attractiveness: No significant difference (*p*=0.337) was found in the interaction level of activity and type of bra concerning attractiveness, thus the null hypothesis is validated. The level of activity has no effect (*p*=0.061) on attractiveness, and the type of bra has no significant effect (*p*=0.164) on attractiveness. The prototype bra rated more attractive ($\bar{x}$ =5.003) over the 'favorite' bra ($\bar{x}$ =4.608).

Ease of Movement: No significant difference (*p*=0.714) was found in the interaction of level of activity and type of bra in regard to ease of movement, thus the null hypothesis is validated. The level of activity does not have an effect (*p*=0.498) on ease of movement, and type of bra has no effect (*p*=0.732) on ease of movement. Overall the 'favorite' bra was rated higher ($\bar{x}$ =6.077) than the prototype bra ($\bar{x}$ =5.908) with regard to ease of movement.

Don/Doff: No significant difference (*p*=0.735) was found in the interaction of level of activity and type of bra concerning donning and doffing, thus the null hypothesis is validated. The level of activity has an effect (*p*=0.028) concerning donning and doffing where medium/low activity had an impact. In addition, the bra type has an effect (*p*=0.000) on donning and doffing. The favorite bra was rated higher ($\bar{x}$ =6.481) than the prototype bra ($\bar{x}$ =4.707).

Breathability: Significant difference (*p*=0.038) was found in the interaction of level of activity and type of bra for breathability, thus the null hypothesis is accepted. The level of activity has no significant effect (*p*=0.921) on fabric breathability, however, the bra type had a significant effect

(p=0.016) on breathability. The prototype bra was more favorably rated ($\bar{x}$ =6.415) than the 'favorite' bra ($\bar{x}$ =5.417).

Ease of Nursing: Statistically significant difference (p=0.023) was also found in the interaction of level of activity and type of bra for ease of nursing, thus the null hypothesis was rejected. The level of activity has a significant effect (p=0.049) on ease of nursing where low levels of activity are better, however, the bra type had no significantly different effect (p=.464) on ease of nursing. The 'favorite' bra was rated higher ($\bar{x}$ =4.790) than the prototype bra ($\bar{x}$ =4.274).

As compared with the prototype bra, the 'favorite' bra was rated higher than the 'favorite' bra (Table 5.2) for support, comfort, attractiveness, and fabric breathability. The 'favorite' was rated more favorably on the fit, ease of movement, donning/doffing, and ease of nursing. Qualitative data analysis further explains these findings.

Table 5.2
Comparison of mean scores for prototype bra and 'favorite' bra

Variable	Prototype Bra	Favorite Bra
Support	5.509	4.181
Fit	4.318	5.463
Comfort	6.076	5.430
Attractiveness	5.003	4.608
Ease of Movement	5.908	6.077
Don/Doff	4.707	6.481
Breathability	6.415	5.417
Ease of Nursing	4.274	4.790

* 7-point Likert scale

Qualitative Data - Wear Trials

Template analysis revealed three of the four thematic codes of *Comfort, User Needs,* and *Aesthetics* remained constant throughout the wear trials, with the exception of *Purchase Habits, which* was not mentioned by the ECs. The index codes were contracted to five, and the

axial codes were minimized to eight. Figure 5.5 displays the themes and sub-themes for the wear trials.

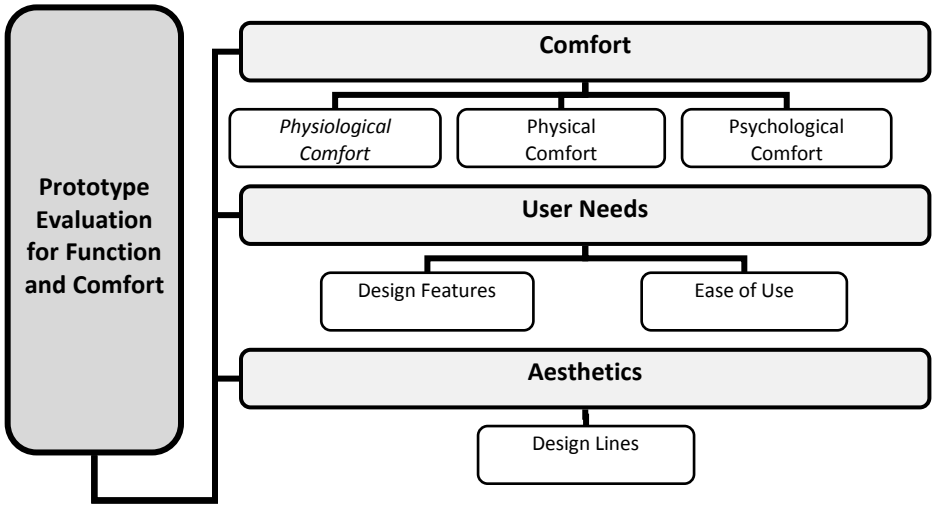


Figure 5.5 Qualitative data analysis of Wear Trials

Comfort

Again, *comfort* was addressed by the wear trial collaborators as a major theme for the evaluation of the prototype bra. Comments from the wear trial ECs addressed: *Physiological Comfort, Physical Comfort, and Psychological Comfort.*

Physiological Comfort: Concerning *support*, the wear trial ECs had mixed reviews, as one collaborator explained, "While [the bra] was comfortable, there was way too little support for me." Another collaborator expressed, "the bra was very comfortable to run in with good support."

Physical Comfort: Collaborators commented on the *fabric* of the bra, as one collaborator explained, "I did my son's school fun run. It was early, the day was hot, and the fabric is not as breathable when it was hot. It was easy to nurse after the run, though, and I didn't feel totally sweaty." Collaborators also addressed the *fit* of the prototype as one collaborator explained

that, “the coverage was not adequate. The bra was cut too low in the front and not quite far back enough on the sides.”

Psychological Comfort: One wear trial EC addressed the *negative perception of feeling exposed* or self conscious in regard to show through under a work out shirt, the EC explained, “with thinner, more sheer shirt fabric, the pads definitely helped [with showing through], however I was still self conscious and changed shirts.”

User Needs

User needs were also addressed by the wear trial collaborators as to specifically address *design features* and *ease of use.*

Design Features: The wear trial collaborators found the bra straps set to widely apart across the shoulders to be a consistent problem. Collaborators addressed this issue by crossing the straps into a racerback position, which seemed to help, however, ECs still experienced trouble, as one collaborator expressed,

> “I noticed the straps were placed too wide. I needed to tighten/adjust the straps. I prefer the straps in the racerback orientation. Maybe the bra could work both ways to suit individual preferences, but the best fit is in the racerback orientation. I like the adjustable straps with the Velcro, not hinge [slider].”

Collaborators also addressed the fact that with the straps crossed in the racerback orientation, the bra was hard to take don and doff. Another point of concern to the wear trial was the size of the hook and eye closure on the back of the bra as one EC explained, “the hooks on the back seem too small to attach behind your back; it takes a few tries to get it hooked.”

The final *design feature* the wear trial collaborators addressed was the removable pads. Most ECs were not satisfied with the pads although they thought it was a good idea as one collaborator explained, “I removed the inserts right away! Good option for others, but I never use them.” Other ECs addressed the difficulty to nurse with the pads in the bra. One EC was

pleased with the pads stating, “The padding offers good ‘coverage’ especially after pumping or nursing, but they do seem to be a little bulky.”

Ease of Use: Wear trial collaborators found the prototype bra not *easy to use* for nursing. One EC expressed, “[I] had to take the bra off to nurse. Inside panels are too big and even when pulled down, it was difficult to nurse…, plus when only one side was released the paned does not come down far at all.”

Aesthetics

Aesthetics were also addressed by the wear trial collaborators concerning the look and functionality of the *design lines.*

Design Lines: Overall collaborators found the prototype to be attractive, however utility over fashion was still important to the collaborators as one EC explained, “The black material on the top of the bra looks nice, but I am not sure of its function; it looks a little ‘bunchy’ under a sheer, fitted workout shirt, but overall I like the design.”

Stage Two: Creative Exploration
Discussion of Results

The prototype was developed from criteria established from ECs during Stage One of the CAPD Model. Each theme was addressed through a unique design solution. The evaluation of the prototype through the wear trials provided great insight into the success or failure of each design solution. By using ECs throughout the process, they are better able to analyze the product, based off discussion from the focus group. As researchers have addressed, consumers who have a deeper understanding of the projects may provide more pertinent feedback and ideas (Hines et al., 2009).

As compared with the ‘favorite’ bra, the prototype bra was rated more favorably on the variables of support, comfort, attractiveness, and fabric breathability. The ‘favorite’ was rated

more favorably on fit, ease of movement, donning/doffing, and ease of nursing. Qualitative data analysis further explains these findings.

One design flaw, which affected the fit of the prototype, was the strap placement. For example, one EC expressed,

> "I noticed the straps were placed to wide. I needed to tighten/adjust the straps. I prefer the straps in the racerback orientation. Maybe the bra could work both ways to suit individual preferences, but the best fit is in the racerback orientation. I like the adjustable straps with the Velcro, not hinge [slider]."

When the participants crossed the straps into the racerback orientation, ECs experienced restricted movement and trouble in donning and doffing, as one EC expressed, "With the straps in the racerback positions, it was hard to get over my head and hooked in the back. With the straps crossed, they went right over my shoulder blades, making it a little restrictive. However, once the straps were crossed, the support felt much better!" The hook and eye closure on the back was difficult for ECs. External collaborators also found the prototype difficult to nurse in, as one EC expressed, "[I] had to take the bra off to nurse. Inside panels are too big and even when pulled down, it was difficult to nurse…, plus when only one side was released the paned does not come down far at all." Another EC addressed the removable pads as inhibiting nursing as she exclaimed, "The padding inside made it hard to fold down to nurse and pump, but once I got it down, and it wasn't bad." Quantitative data along with qualitative data from the wear trials showed how these design flaws had a substantial effect on the means scores.

Using wear trials to obtain consumer feedback and product evaluation, the sponsor company was able to easily and thoughtfully retrieve information about the prototype bra. As researchers explain, incorporating ECs is a strong approach to developing workable and

innovative solutions that bring end-users into the design process to identify real customer needs (e.g. Binder et al., 2008; Ng & Wang, 2007; Shen et al., 2000). Prior to the case study, the sponsor company developed prototypes overseas and called a fitting to evaluate the prototype. The sponsor company did not utilize wear trials for product testing, which may be a result of organization and timing. Lack of organization and lack of methods/procedures was a challenge for efficient product development before testing the CAPD Model. One IC explained, "I feel that we are incorporating more methods/processes and thus increasing our efficiencies. We are getting there."

Stage Three: Implementation
Results

During the exit survey, ECs were asked how they felt the product developed in the case study met the needs of the consumers as an overall analysis at the conclusion of the wear trials.

Quantitative & Qualitative Data – EC Exit Survey

Results from the survey question uncovered important information regarding necessary improvements to the prototype before the style went in to production. The ECs were asked one final time to reflect on the prototype. Upon final consideration, the prototype bra was moderately rated ($\bar{x}$ =4.600).

Analysis of comments by ECs on how they felt the prototype met the needs of the target consumer helps explain quantitative findings. The template from the focus group and wear trials was used to analyze the comments from ECs. Template analysis revealed three of the four themes of *Comfort, User Needs,* and *Purchase Habits* remained constant in the final evaluation of the prototype bra (Figure 5.6). *Aesthetics* were not mentioned by the ECs.

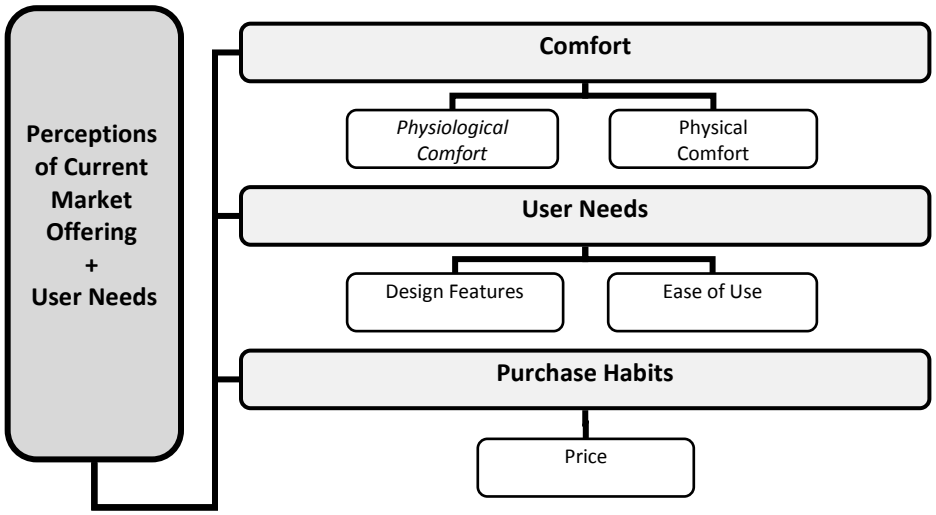


Figure 5.6 Qualitative data analysis of overall perception of prototype bra from exit survey

Comfort

Comfort was again addressed with the prototype. External Collaborators were mixed on the support of the bra, as one IC exclaimed, "I love this bra! It offers support." While another EC commented, "[The bra] didn't fit right or have enough support. *Physical Comfort* of the fabric was favorable to one EC who exclaimed, "It is comfortable and breathable!"

User Needs

Design features were also addressed and again ECs had mixed reviews. One EC exclaimed, "The product I got…seemed to have everything we moms discussed wanting in a nursing/sports bra." Another EC commented, "I love this bra! It opens for nursing at the top, and has adjustable shoulder straps."While another EC suggested, "There are design issues that need to be met before I would buy this product." *Ease of Use* for nursing was another issue addressed by EC, as one participant explained, "I cannot nurse in this bra."

Purchase Habits

Purchase habits were briefly touched on concerning *price.* One EC who had favorable comments about the fit and fabric expressed concern over price as she exclaimed, “now, I just wonder what the price would be.”

Stage Three: Implementation
Discussion of Results

Based off quantitative and qualitative information from the wear trials, it was found that further improvements to the prototype bra are necessary before entering production ramp-up. Minor design changes, which need to be addressed, as was suggested by ECs during the wear trials include:

- Bring in the bra straps so they sit closer to the neck to improve fit and donning/doffing
- Decrease the armhole depth for coverage
- Reduce the size of the interior bralette to make it easier to nurse

Major revisions, which need to be addressed for future refinement, include addressing support while still allowing for ease of nursing.

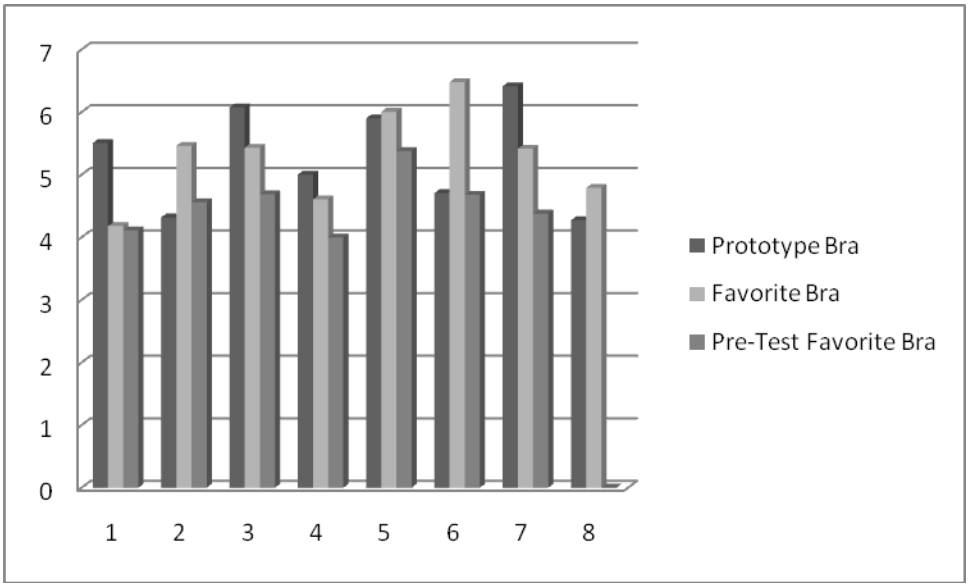


Figure 5.7 Comparison of prototype bra, 'favorite' bra, and pre-test 'favorite' bra; 1= Support; 2= Fit; 3=Comfort; 4=Attractiveness; 5=Movement; 6=Don/Doff; 7= Breathability; 8=Ease of Nursing*

*Participants were not asked to address Ease of Nursing in pre-test

One interesting aspect from the surveys is how ECs perceive fit, function, and comfort of their bras when they are not currently wearing them. As is expressed in Figure 5.7, the collaborators rated their 'favorite' bra pre-test less favorably than their 'favorite' bra during the wear trials and the prototype bra during the wear trials. When collaborators are asked to evaluate the bra they are wearing, the scores are overall higher. This information may also be applied to how ECs perceived the prototype bra after they were no longer wearing the bra. Because the mean score of the prototype bra ($\bar{x}$ =4.600) was so close to the 'favorite' bras ($\bar{x}$ =4.541), the prototype bra was not any better or any worse in satisfying consumer needs. Before this product goes into production, it is necessary to continue to improve/refine the product with further prototypes. As one researcher points out, working with collaborators has some limitations including increased iteration between steps, as the trial-and-error method of creating prototypes may extended product life cycle time (Cooper, 2008).

The process of holding a focus group to develop a product, and testing the product through a wear trial has enabled substantial information exchange on the necessary improvements of the prototype. Although this method of testing products has been used before, the use of the same ECs throughout the research process has enabled a deep understanding as to why the product was successful or unsuccessful in meeting consumer needs. Also reported by Nambisan (2002), consumer involvement tends to elongate the product time cycles but has the potential to develop products that are more successful.

CHAPTER SIX

RESULTS & DISCUSSION – OVERARCHING UNIT OF ANALYSIS

Chapter six presents the main results from the overarching unit of analysis and a discussion of the results. The overarching unit of analysis measures the effectiveness of the CAPD process, based on the entrance and exit surveys by the collaborators (ICs & ECs). This analysis uses both quantitative and qualitative methods, and provides valuable information for both this research objective and the sponsor company on the efficiency of the CAPD model in a product development setting. This chapter will also suggest modifications to the CAPD Model and discuss application of the research findings to each specific research question.

ANALYSIS OF CAPD MODEL – RESULTS

Throughout the investigation, research questions have guided the data collection, analysis, and discussion. In order to answer the research questions, multiple data collection tools were utilized. Both research questions were addressed across the case study using the entrance survey and the exit survey where quantitative and qualitative information were gathered. An illustrative table of the research questions and the contextual settings may be found in Table 6.1.

Table 6.1
Description of the contextual settings, instrumentation, and data analysis for the overarching research questions

OVERARCHING RESEARCH QUESTIONS	CONTEXT	DATA COLLECTION	DATA ANALYSIS
Q1 **What key factors may be identified and related to the efficient execution of collaborative product development projects?** Q1a What challenges do companies experience when they adopt the collaborative apparel product development (CAPD) process? Q1b What advantages do companies experience when they adopt the collaborative apparel product development (CAPD) process?	THROUGHOUT CASE STUDY POST CASE STUDY	Entrance Survey: Internal Collaborator Collaboration and Demographics Questionnaire Exit Survey Collaborator Experience Survey	SPSS; Paired t-test & Descriptive statistics + a *Priori* and coding of open ended questions
Q2 **Has the proposed framework enabled successful product development in relation to increasing perceived efficiency and reducing iteration in the product development process?** Q2a What tools would aid in the management of CAPD to enhance the proposed framework? Q2b How can interactions between internal and external collaborators be efficiently managed in order to support successful CAPD projects?	THROUGHOUT CASE STUDY POST CASE STUDY	Entrance Survey: Internal Collaborator Collaboration and Demographics Questionnaire Exit Survey: Collaborator Experience Survey	SPSS; Paired t-test & Descriptive statistics + a *Priori* and coding of open ended questions

A paired t-test was run to compare changes in perception of ICs between the entrance and exit survey. The paired t-test was not performed with the EC survey data; because at the point of the entrance survey, ECs had limited information regarding the product development process of the sponsor company and would not be able to answer the questions. The exit surveys were then compared by collaboration group (IC vs. EC) to gather information on how each group perceived the CAPD process. Table 6.2 delineates the relationship between the surveys and the how they were tested concerning the groups of collaborators (IC vs. EC).

Table 6.2
Relationship of analysis of entrance and exit surveys across groups

Entrance Survey	Exit Survey
Internal Collaborators →	Internal Collaborators ↓
X*	External Collaborators ▼
***no responses from EC**	

Quantitative Data – IC Entrance and Exit Surveys

The entrance survey entitled "Internal Collaborator Collaboration and Demographic Questionnaire" was used to gather data from ICs regarding initial perceptions of the sponsor company's interaction with the target consumer, collaboration, and efficiency. This survey was conducted at the onset of data collection. The data collected through the entrance survey were then compared with information from the exit survey entitled "IC Experience Questionnaire," which asked follow up questions at the conclusion of the data collection. The quantitative data were analyzed using a paired t-test with a 95% confidence interval. Because of the small sample size (n=5), it is important to note that the statistical data is only used to provide insight into this singular case study. Findings from this research cannot and will not be used to generalize about the population.

Table 6.3
IC Entrance and Exit Survey Results

#	Question	n	Entrance Mean Score*	Exit Mean Score*
Q1	How important do you consider it to be that this company continues to participate in collaborative design?	5	6.40	5.80
Q2	How do you perceive the efficiency of development on this project?	5	4.40	6.40
Q3	How did you perceive this form of collaboration for addressing the target market's needs?	5	5.80	6.20

*Developed on a 7-point Likert Scale

Three questions from both the entrance and exit surveys were identified as pairs to cross examine for significant differences. The three questions addressed importance of participation in collaborative design, perceived efficiency of the product development processes, and how the product development process addressed consumer needs (Table 6.3). Due to the small sample size (n=5), statistical difference may not mean much in this analysis, but it is noteworthy that significant statistical difference (p=0.003) was found in response to the question: How do you perceive the sponsor company's product development process for efficiency? Results between the entrance and exit survey indicate a positive shift in the overall perception of efficiency by using the CAPD Model, however the model did not have any impact on the other two factors (Figure 6.1).

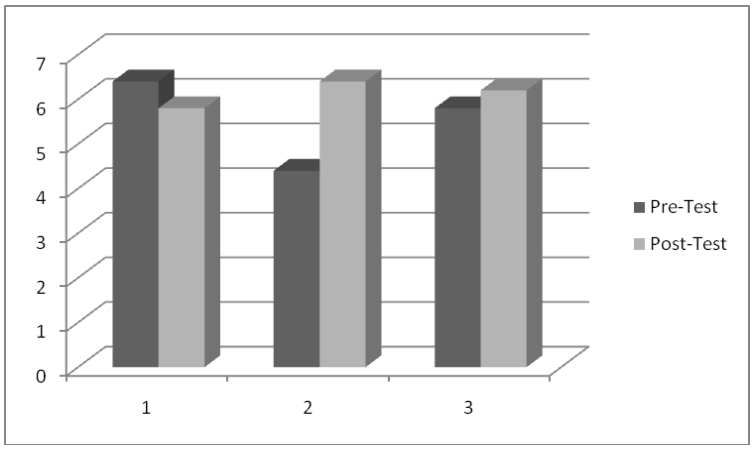


Figure 6.1 Comparison of IC Entrance (pre-test) and Exit Survey (post-test); 1= Q1; 2= Q2; 3=Q3

Quantitative Data - IC and EC Exit Survey

The exit surveys were also analyzed for significant difference between ICs and ECs perception of the CAPD Model at the conclusion of the research. The ICs and ECs responses were compared using a paired t-test with a 95% confidence interval. Qualitative information from open-ended questions and comments were analyzed using the template developed for the entrance survey.

Table 6.4.
Collaborator Experience Questionnaire (Exit Survey)

#	Question	Group	n	Mean Score*
Q1	How would you rate your experience working in the collaboration teams?	IC	5	6.40
		EC	5	5.80
Q2	How important do you consider it that this company continues to participate in collaborative design?	IC	5	5.80
		EC	5	6.00
Q3	How do you perceive the efficiency of development on this project?	IC	5	6.40
		EC	4	6.00
Q4	How did you perceive this form of collaboration for addressing the target market's needs?	IC	5	6.20
		EC	5	5.80
Q5	Do you feel the product developed in the case study meets the needs of the consumer?	IC	5	6.60
		EC	5	4.60

* Developed on a 7-point Likert Scale

The data were analyzed for five questions using a 7-point Likert Scale that addressed overall experience with collaboration teams, importance in participation in collaborative design; perceived efficiency of the product development processes, how the product development process worked in addressing consumer needs, and how the product developed addressed consumer needs. No statistically significant difference was found between the two groups regarding any of the questions. However, an evaluation of the mean scores (Table 6.4) indicate that ICs rated more favorable the experience working in the collaboration teams ($\overline{x}$ =6.40), the efficiency of the project ($\overline{x}$ =6.40), perception of process in addressing target market needs ($\overline{x}$ =6.20), and perception of product in addressing consumer needs ($\overline{x}$ =6.60). Whereas the ECs rated higher perceived importance to continue in collaborative design ($\overline{x}$ =6.00). Figure 6.2 graphically illustrates the difference between each group for each question.

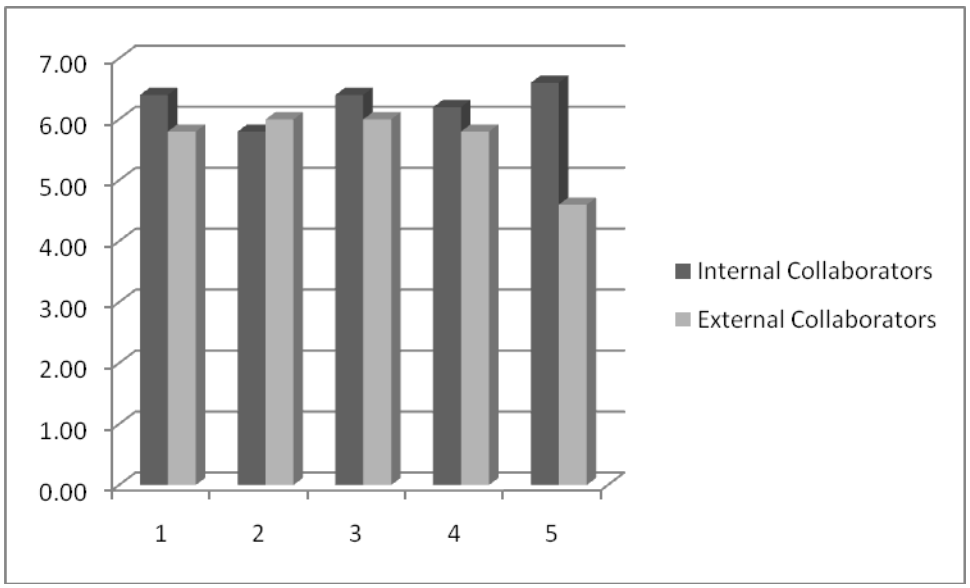


Figure 6.2 Comparison of IC and EC groups from Collaborator Experience Questionnaire (Exit Survey); 1= Q1; 2= Q2 3=Q3; 4=Q4; 5=Q5

Qualitative Data – IC Entrance and EC and IC Exit Surveys

Data from the qualitative open-ended questions from both surveys were analyzed using a template analysis method. The template was developed by analyzing data from open-ended questions and comments from the entrance survey to develop a set of a *priori* codes that were thematically organized. After the template was complete, the template was used to analyze qualitative data from the exit surveys as a way to compare perspectives of different groups. Results from the initial template analysis revealed three themes: *Advantages, Challenges,* and *Efficiency.* Complete findings from the template analysis of both survey tools are reported below (Figure 6.3).

Analyses of the entrance and exit surveys help explain and substantiate quantitative findings. The template analyses of the surveys confirm the three themes that were initially proposed. The overall thematic codes bring a broad understanding of the key factors needed for efficient collaborative product development, advantages, and challenges from collaborative design, and tools to manage and enhance collaborative product development.

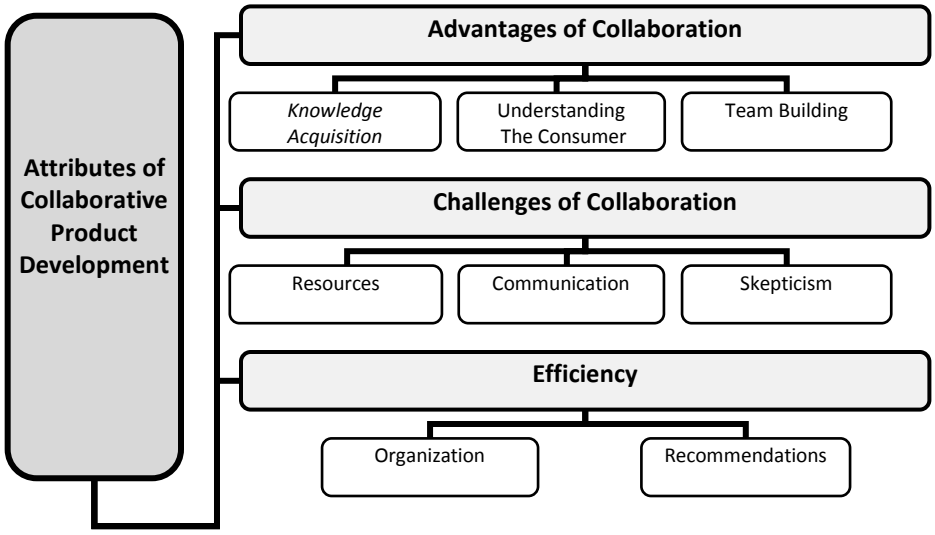


Figure 6.3 Qualitative data analysis of entrance and exit surveys that identify attributes of collaboration across the research

Advantage of Collaboration

The first major theme that emerged from the template analysis was *Advantages of Collaboration*. Within this theme, four sub-themes emerged: *Knowledge acquisition, Understanding the consumer, Satisfying the consumer,* and *Team building.*

Knowledge Acquisition: The primary advantage of collaboration as was reported by the participants was related to *acquiring knowledge*. As one IC explained, "This is where we'll get the best feedback, creative ideas, and insight. A variety of perspectives and collaborative design ideas can only help enhance the product." Collaborators collectively also expressed excitement over *Different Perspectives,* as one IC expressed "[we have] different perspectives right at our fingertips, [we] each deal with different aspects of the company and interact with different customers/retailers."

Understanding the Consumer: Consumer insight was suggested to lead to product enhancement. As one IC explains, "brainstorming ideas is very beneficial to create[ing] a product

and to avoid making products no one wants to buy." Also by understanding the consumer, it is effortless to identify consumer needs. One EC provided an insight on why understanding the consumer is valuable, suggesting, "[it] is important in order to find out what customers want and fuse that with your own knowledge of product design."

Satisfying the Consumer: In addition to understanding the consumer, ECs identified *consumer satisfaction* as an important outcome. As one IC explained, "we want to meet our customers' needs and that means listening to what everyone has to say." An EC divulged, "I am an avid exerciser and recently had a baby. I am passionate about keeping my baby healthy with breastfeeding. I am all for creating a product to help achieve both." The sponsor company is better equipped to satisfy the consumer, by learning of specific consumer insights.

Team Building: Team building was also mentioned by many of the collaborators. Internal Collaborators especially view team building as a positive outcome of collaboration stating, "[the sponsor company] is the type of organization that believes five minds are better than one," and "great ideas come from teams."

Challenges of Collaboration

The second major theme that emerged from the template analysis was *Challenges of Collaboration*. Within this theme, three sub-themes emerged: *Resources, Communication, and Skepticism.* Figure 6.1 displays the themes and sub-themes.

Resources: Internal Collaborators viewed *personnel* as an important resource contributing to challenges of collaboration as one IC explains,

> "I believe that [the sponsor company] makes every effort to accommodate my needs for my role. The organization has been extremely generous. I believe that in the future with growth, etc. we will be able to get to a place where we have more allocation [of resources]. This is just a result of company size and stage. Everyone always does their best to provide timely information."

Both ICs and ECs expressed *time* was a challenge for collaboration. One IC explained that the collaboration process was challenging because, 'there is lack of time with schedules." An account of an EC also illustrates the time issue with collaboration as follows: "I found [the focus group] enjoyable but as a nursing mom with a two-month old, I was eager to get home to nurse, etc. Glad it was not longer."

Communication: Solicitation of *Communication* was also identified as a challenge for ICs. How to engage consumers in *feedback* was identified as a communication test. For instance, an IC expressed, "currently we are taking most feedback from sales reps, who sell to our retailers but its' not direct feedback from customers wearing the product. We do take some feedback direct from customers, but not enough." An EC expressed satisfaction in *opening communication channels* with the sponsor company explaining, "I enjoyed sharing my opinions and hope they will be helpful." External collaborators also indicated that the sponsor company could *expand capacity* to a broader audience to contribute ideas as one EC expressed, "I thought the focus group was good – perhaps several of those would've yielded a wide range of insight."

Skepticism: *Skepticism* was also expressed by both ICs and ECs on the effectiveness of the CAPD Model. As one IC pointed out, "I believe that seeing the results will be a great indicator of how well it worked and how efficient it was." An EC also expressed skepticism due to communication

challenges stating, “I feel like I don’t have enough insight into the project to know [about efficiency].” Moreover, one IC still felt that the collaboration would be most beneficial if it were *departmentalized* stating, “I believe that it is beneficial and I personally LOVE being included, but I think that once the design team grows and becomes its own operating unit, it will be critical.”

Efficiency of the Process

The final major theme that emerged from the template analysis was *Efficiency of the Process*. Within this theme, two sub-themes emerged: *Organization* and *Efficiency Recommendations*.

Organization: The ICs mentioned that *organization* and lack of *methods or procedures* was a challenge for efficient product development before testing the CAPD Model. One IC explained, “I feel that we are incorporating more methods/processes and thus increasing our efficiencies. We are getting there.” Another IC explained, “Calendars for product development have been established, but we need to work on better ways to cost products.” After the CAPD Model, the ICs felt that the format enabled *concise delivery.* One IC explained, “The questions and meetings were concise and gathered information in an efficient process.” However, one IC still expressed that, “I don’t have enough insight into the project to know.”

Efficiency Recommendations: Recommendations to improve efficiency were suggested by both ICs and ECs. The major concern for efficiency was to improve *convenience* and one suggestion from an EC suggested, “One thing that would help efficiency is if the survey were available online.” Another EC expressed, “an online forum could’ve made things more efficient by limiting travel.”

ANALYSIS OF CAPD MODEL – DISCUSSION OF RESULTS

Based off quantitative information from the entrance and exit surveys of the ICs, it was found that the IC's perception of importance of using the CAPD process decreased. However, the IC's perception of efficiency increased, and perception of meeting the needs of the target consumers increased. Qualitative data has provided insights as to why these shifts in perception may have occurred.

The decrease in importance of the CAPD process could be a result of many factors including limited time, financial resources, and personnel resources. One IC who expressed these factors as challenges stated:

> "I believe that [the sponsor company] makes every effort to accommodate my needs for my role. The organization has been extremely generous. I believe that in the future with growth, etc. we will be able to get to a place where we have more allocation [of resources]. This is just a result of company size and stage. Everyone always does their best to provide timely information."

The ICs also addressed time as being a challenge for collaboration, and one IC blatantly stated, "There is lack of time with schedules." Throughout the research process, one main IC participated in each of the three stages. Other ICs were encouraged to participate throughout, but they predominantly contributed only to areas that they were familiar with (e.g. marketing department contributed in posting the research information on the sponsor company website and blog, but did not attend the focus group). However, both ICs and ECs provided suggestions to make the process more efficient, including moving some of the collaborative process to social networking websites and online forums. For example, one EC suggested, "One thing that would help efficiency is if the survey were available online." Another EC expressed, "an online forum could've made things more efficient by limiting travel." Researchers have also found the internet as a powerful tool to engaging consumers in multiple ways for different purposes

(Sawhney, Verona, & Prandelli, 2005). If used synergistically and simultaneously, different collaboration methods through social networking can be employed as part of an integrated innovation strategy to gather consumer dialogue (Sawhney, Verona, & Prandelli, 2005).

Social networking websites provide immediate access to a wide range of consumers (Mangold & Faulds, 2009). Both ICs and ECs recognized the advantage of adopting the new channel of communication would open up the collaboration process to attract more participants, as one EC expressed, "I thought the focus group was good – perhaps several of those would've yielded a wide range of insights." As was experienced by this research project, the Internet platform enabled ECs to participate in the focus group and survey even though they were not physically present. As is suggested by Mangold and Faulds (2009) in Chapter Two, a number of strategies exist to engage consumers online. Future collaboration projects by the sponsor company may explore methods of engaging a broad scope of consumers. The use of an online collaborative design platform would also address efficiency.

Efficiency of the process increased according to the quantitative data, and the qualitative data supports these findings. One IC expressed prior to starting the case study, "I feel that we are incorporating more methods/processes and thus increasing our efficiencies. We are getting there." Post-case study measurements indicated positive perceptions of the CAPD Model. However, it is unclear whether the CAPD Model was perceived as increasing efficiency due to collaboration, or because it was a clearly defined process of product development. Future research is needed, where the CAPD Model is tested within an apparel manufacturer with an already existing product development process. One advantage to testing the CAPD Model within a company who does not have an existing product development model is that the process is easier to update and modify than institute a completely new program (Griffin, 1997).

Perceptions of meeting consumer needs through the CAPD Model also increased for ICs. As one IC explained, “we want to meet our customers’ needs and that means listening to what everyone has to say.” By using the CAPD Model, a channel of communication has been opened for the sponsor company, where prior to the case study, the sponsor company had trouble engaging feedback. Through Lamb and Kallal’s (1996), FEA Consumer Needs Model the ICs and ECs were able to address consumer needs, consciously and sub-consciously through the interface between collaborators and the product development process.

Regarding perception of process in addressing market needs, the CAPD process was perceived by ICs as “efficient” to “very efficient” in addressing market needs. ECs also rated the CAPD process in addressing market needs as “efficient.” Although the CAPD Model utilized multiple data collection techniques including, surveys, focus groups, and wear trials, both the ICs and ECs perceived the process as efficient. As Cooper (2008) also found, going between stages is not an efficient process, however if cyclical sub-processes within each stage occur, which was the case for each product development stage, the product development process may become more efficient.

It was evident from the wear trial results that future product refinement was necessary before production ramp-up. It has been found that collaborative design may elongate the product time cycle by repeating the process until an acceptable prototype is obtained. Although, consumer involvement may have the potential to elongate the product time cycle, it was also found that the product being developed might be more successful in the market (Nambisan, 2002).

Interestingly, perceived perceptions of how the product addressed consumer needs, however, are contradicting. That is, ICs ($\overline{X}$ =6.60) rated the process much more favorably than

ECs ($\overline{x}$ =4.60). This result may be due to the interaction level with the actual prototype. ECs substantiate their score in experience the prototype bra first-hand, whereas, the ICs had no such experience. In order to address the dissimilarity between the perceptions of ICs and ECs, a final focus group with both ICs and ECs is suggested to provide a de-briefing session to disseminate knowledge obtained during the wear trials back out to a broader IC scope. The final collaboration meeting could be useful to communicate results of the collaborative project, as one IC pointed out, "I believe that seeing the results will be a great indicator of how well it worked and how efficient it was." For successful collaboration, the communication circle needs to be closed, as Schilling & Hill (2008), suggest strong interdepartmental communication throughout the teams.

External collaborators rated the variable, i*mportance of continuing collaboration process*, slightly more favorably than ICs. It is important to note that the mean scores were very similar, and that with an increased sample size, the mean scores may be different, however it is a message to the sponsor company that the ECs feel they should continue to participate in collaborative design. External collaborators reported the experience as being 'somewhat enjoyable' to 'enjoyable,' and as one EC elaborated in the open-ended questions, "I enjoyed sharing my opinions and hope they will be helpful."

REVISED CAPD MODEL

Based off the results and discussion, the CAPD Model was revised to accommodate the research findings. Overall, the proposed model was favorably rated among ICs and ECs for integrating a framework, which highlighted collaboration between ICs and ECs in the apparel product development process. It was anticipated at the start of the research, that further development and refinement of the CAPD Model would be necessary after testing. Presented below is the final revised model.

Forum for Collaboration

Neither the ICs nor ECs expressed any challenges with the forum for collaboration, nor does this part of the model remain relatively unchanged. Throughout the research process, it was found, that the deciding factor for participation on behalf of ICs was related to available time, and personnel resources. As was previously stated in the proposed model, it was essential that the right person from the right department is involved in the right product development phase (Wynstra et al., 2001) in order to efficiently utilize IC's time. Retaining ECs throughout the process, with the idea at each stage of the development process, their knowledge becomes richer and their output more valuable (Nambisan, 2002), was a success and was evident in thoughtful evaluations of the prototype at the conclusion of the research study. Retaining ECs was not difficult, as they were excited (with proper incentives) to participate in the wear trials after the focus group. Four of the five original focus group participants participated in the wear trials.

Since the collaborator groups participating in this study were new to the CAPD process, it was useful to conduct a focus group during the first phase of the model to gather rich collaborative insights (Griffin & Hauser, 1993). If the sponsor company continues to participate in collaborative design, they may wish to contact previous ECs, as they are already familiar with the process.

Based on the findings from Littler et al. (1995) an essential component to the collaboration team is a clear project leader. This was also true for the research study. In order for efficient development of the project, one organized leader is necessary. As depicted in Figure 6.4, any available number of ICs and ECs may be involved, but only one project leader was needed. By testing the CAPD Model, it was found that the use of the FEA Consumer Needs

Model was appropriate in guiding information gathering from consumers, and product development process (refer to figure 3.2 in Chapter Three) . As is the case with ECs, consistent group leaders may better understand and become more efficient across many CAPD projects. It is suggested that when possible group leaders should be carried over from one project to the next.

Application to Three Stage Design Process

Application of the collaboration teams into all stages of the Three Stage Design Process was successful. The compressed nature of the Three Stage Design Process allowed for flexibility within the design process. Cooper (2008) addressed efficiency by allowing cyclical sub-processes to occur within large, broad product development stages. However, it was found that adding another stage was necessary to efficiently manage and balance the design refinement and design development. The original stage two was very long, and it encompassed the majority of the product development effort. Thus, it was necessary to split this phase as figure 6.5 graphically represents. It was also evident from the case study that future prototyping and product refinement was necessary. Thus, the model was revised from a three stage linear process to a four stage cyclical process to address future prototyping and address consumer concerns from the wear trials.

All the pieces of the model are now summarized in a total framework supporting the collaboration between the FEA collaboration team and the four stage design process, which is represented in Figure 6.4. To make it easier to implement this framework in a functioning apparel company, a description is summarized over the phases in the product development process.

Stage 1 – Problem Definition and Research:

In this stage, it was proposed that top strategic managers are involved since questions discussed in the early phase are on a tactical level and this was found appropriate. The ICs included product development, design, and sales. Only key IC managers were necessary at this point, and the majority of ECs were needed during this stage. Throughout the research, it was suggested that internet forums and social networking websites could be utilized to make the process more efficient for both ICs and ECs. Thus, the model has been revised to move the meetings between ICs and ECs into a virtual platform. Online surveys and online focus groups (e.g. Twitter Parties) could efficiently reach a large scope of collaborators and make this stage of the product development process convenient for ICs and ECs.

Throughout the case study, a nursing sports bra was developed as a benchmark product, or an innovative new product (Ulrich & Eppinger, 2003). The case study confirmed the idea that the CAPD Model is appropriate for the development of a benchmark product. Less complex garment designs may not benefit from this model due to the additional time for required collaboration. Although the ICs evaluated the model favorably in increasing perceived efficiency for a benchmark product, the CAPD Model may extend the product time cycle for less innovative products.

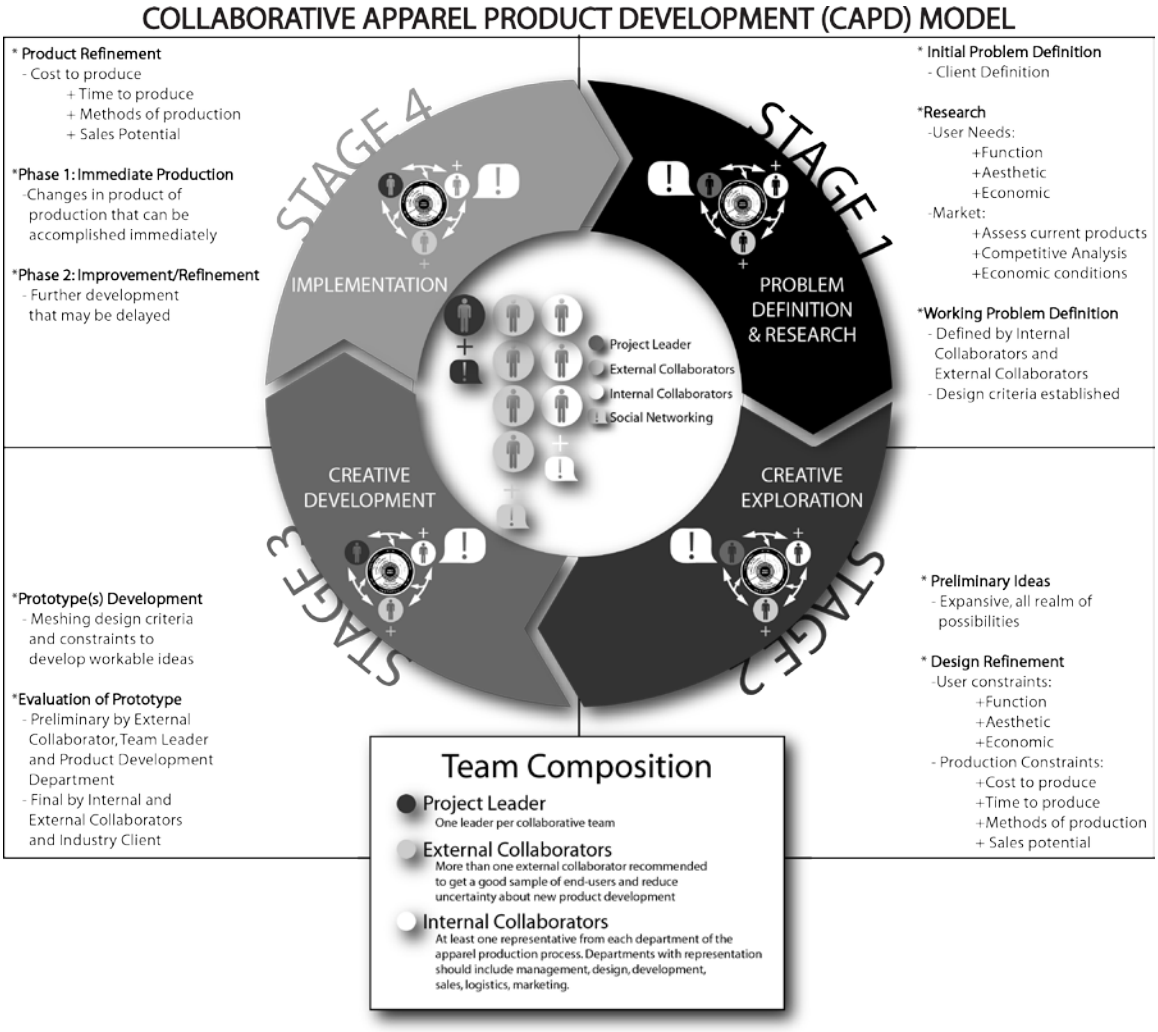


Figure 6.4
Descriptions of each function within the design process

Stage 2 – Creative Exploration:

In the creative exploration stage, it was proposed that the ICs were broadened to include other department managers including marketing, PR, and logistics, however due to resource limitations, the practicality of getting more ICs involved in the process was not feasible. If this model were to be tested in a larger corporation, expanding the ICs may be possible. In addition, the original model suggested only keeping the 'most impactful ECs' from stage one, however in order to obtain a larger sample size and more reliable results, all ECs should be

asked to remain on the project (with consideration to resource management). It was the objective to retain the same ECs throughout the process with the idea at each stage of the development process, their knowledge became more valuable (Nambisan, 2002), and this was successful in obtaining thoughtful evaluations of the prototype from the ECs.

As previously mentioned, stage two was split in order to balance the creative exploration and creative development processes. It was at this stage, where design requirements, obtained from ECs through focus group and survey were synthesized to create an initial prototype. Expansive use of ECs at this stage was not necessary because of the rich and detailed information gathered during stage one. However, input from ICs is necessary to define production parameters. Both design criteria (from ECs) and constraints (from ICs) were developed into workable ideas.

Stage 3 – Creative Development:

The initial model suggested it was necessary to meet daily with ICs on the progress of prototype development. In an industrial production setting, sample production may take place overseas and physical collaborations may not be possible. However, virtual communication through email and Skype could increase efficiency at this stage, when production questions arise. At the end of stage two, ECs had the opportunity to evaluate the prototype through wear trials. As was previously suggested in the original model, ECs should be utilized as fit models, however in an effort to increase efficiency, ECs measurements were communicated via email, and the prototype bras were mailed to the ECs. Future collaborations should include using ECs as fit models, to avoid some major fit problems, which are likely to affect prototype evaluations.

Stage 4 – Implementation:

The final stage has been revised from the original model where an additional virtual or physical focus group is suggested in order to disseminate final information between both groups of collaborators, and the final stage is looped back to stage one. The purpose of the final interaction would be to communicate feedback on the product testing results. The case study revealed disconnection between how ICs rated the prototype as compared to how ECs rated the prototype. A final meeting may eliminate this conflict in perceptions. Through the final meeting, ICs and ECs can discuss minor and major changes to the product before going into production ramp up.

At the conclusion of the wear trials, it was evident that future prototyping was necessary in order to satisfy consumer concerns. The revised model illustrates the cyclic process where stage four does not conclude the product development process, but marks the start of the process again. It is necessary that the CAPD process be viewed as a cycle, where if the prototype does not meet the consumer needs, the cycle can be repeated until a satisfactory prototype is achieved.

It was also suggested in the original model that after production, ECs might be broadened and utilized to test market acceptance of product and continue the refinement process for further development. This suggestion remains untested in the model, since the product has not reached the market.

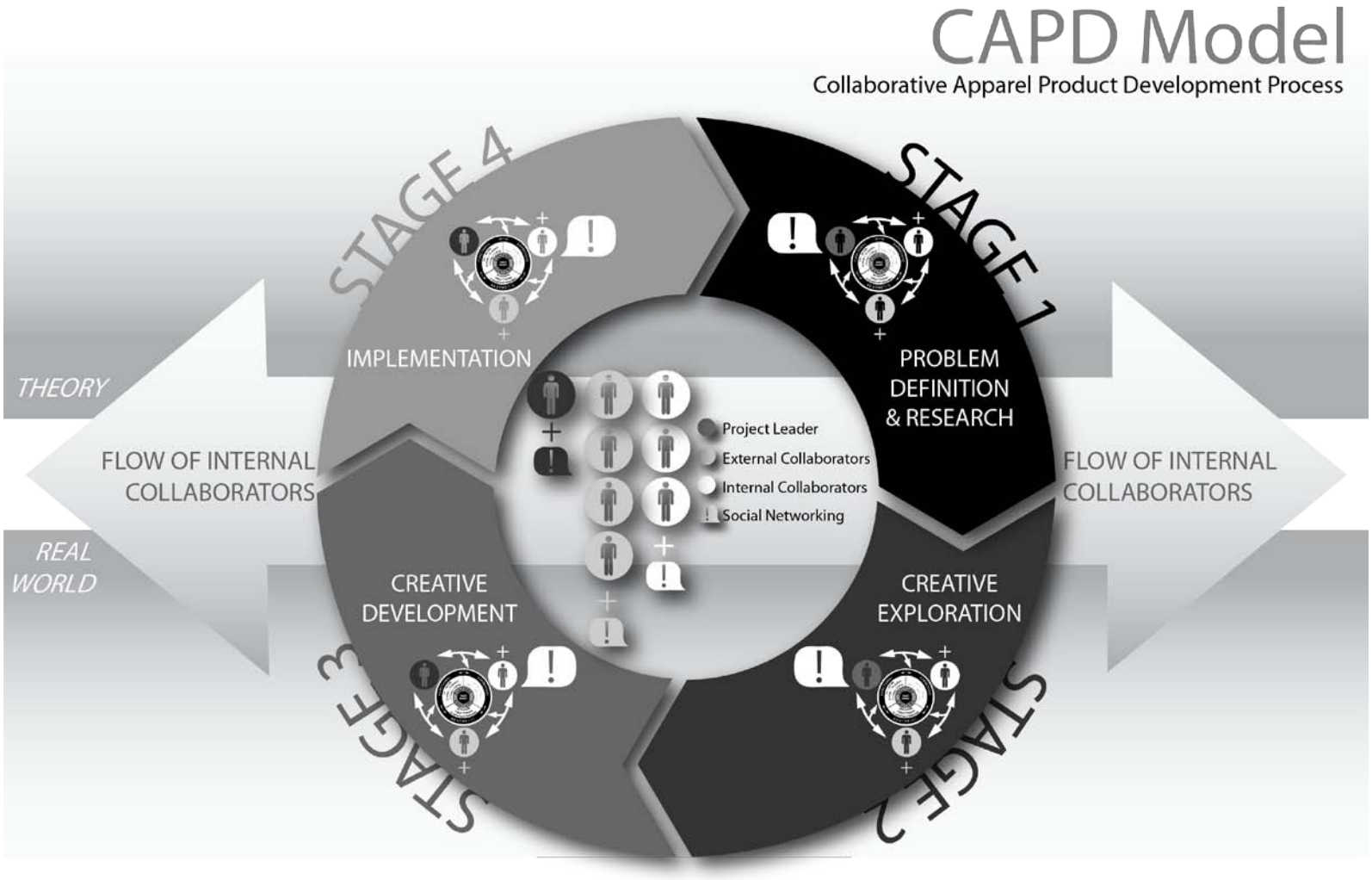


Figure 6.5
Revised CAPD Model

Presented in Figure 6.5 is the final revised CAPD Model (original model may be found in chapter three). The final model was revised from a linear three stage process to a cyclical four stage process to address future product refinement at the Implementation stage. They cyclical process may extend the product time cycle, but for benchmark products, the reduced risk and development of more on-point products may outweigh the extended time. The final model was also expanded to incorporate social networking into each stage of the design process. Throughout the research, it was found that internet platforms might be a useful tool in increasing efficiency and countering increased time associated with collaboration.

CHAPTER SEVEN

CONCLUSION

This research study examined the practicality and efficacy of the collaborative apparel product development process. Previous research found that the most successful innovative product development processes require great understanding of continually changing needs of the consumer (Hines & Quinn, 2007; Ng & Wang, 2007). Collaborative design is becoming an emerging avenue that can provide valuable information to the apparel development process, and could dramatically influence how apparel and other products are developed (May-Plumlee & Little, 2006; Sanders & Stappers, 2008). However, few research projects examined how to incorporate external and internal collaborators into the apparel product development process.

The purpose of this research was to develop a framework entitled 'Collaborative Apparel Product Development (CAPD) Model', which highlights collaboration between internal collaborators and external collaborators in the apparel product development process. The CAPD Model was used as the theoretical framework for an embedded single-case study design, and the model was revised based off findings from the case study. The influential models to the CAPD Model include the FEA Consumer Needs Model (Lamb and Kallal, 1992) and the Three Stage Design Process (LaBat and Sokolowski, 1999). The study design included both quantitative measures of participant perceptions of the success of the CAPD Model, and qualitative responses to develop a deep understanding of how the model performed. Critical evaluations of

the prototype developed in the case study coupled with information from entrance and exit surveys gauged the success of the model.

Analysis of results included the use of Statistical Package for the Social Sciences (SPSS) for quantitative data, and template analysis method for qualitative data. These revealed overall satisfaction of the CAPD Model; however, some revisions to the model were necessary. The model was expanded from a three stage process to a four stage process in order to address the creative exploration and the creative development stages. The model was also expanded to incorporate social networking and online forums as viable alternatives into physical interactions in an effort to increase efficiency throughout the process.

Results between the entrance and exit survey indicate a positive shift in the overall perception of efficiency by using the CAPD Model, however, the model did not show significant impacts on the other two factors of the importance of continued participation in collaborative design, and how successful the product development process was in addressing consumer needs. Evaluation of the mean scores indicate that ICs rated more favorable the experience working in the collaboration teams , the efficiency of the project, perception of process in addressing target market needs, and perception of product in addressing consumer needs, whereas the ECs saw more value in continued participation in collaborative design. These findings indicate interest within the ECs group, where as ICs may perceive the time commitment as challenge with continued participation.

Template analysis of the qualitative data supported the quantitative findings. Template analysis revealed three themes that helped to identify key factors needed for successful collaborative product development. The three themes are: *Advantages of Collaboration, Challenges of Collaboration, and Efficiency of the Process.*

Advantages: Advantages of collaboration, as expressed by collaborator comments at the conclusion of the study include a richer understanding of the consumer by creating communication channels to work directly with the consumer. Collaboration was perceived as a way to better satisfy the consumers, and decrease the risk of developing unsuccessful products. Internal Collaborators also viewed team building as a positive side-effect of collaboration, which speaks to the culture of the sponsor company.

Challenges: Challenges of collaboration arose from lack of time and personnel resources to effectively participate in all aspects of the design process. The CAPD process enabled communication between ICs and ECs, which was a previous challenge for the sponsor company; however, both ICs and ECs felt that a broader scope of participants were necessary to gather a wide range of opinions. Disconnects of communication were still prevalent at the conclusion of the research with an ICs and ECs expressing that they did not know enough about the process to comment on the effectiveness of the product.

Efficiency: Collaborators indicated increased organization as a positive outcome of the process. Internal Collaborators explained that prior to implementing the CAPD Model; there were lack of methods and procedures for their product development process. After the CAPD Model, the ICs felt that the format enabled *concise delivery.* Recommendations to further increase efficiency included moving parts of the collaboration process to an online format, which would be more convenient for both ICs and ECs.

RESEARCH QUESTIONS

At the start of the research study, two overarching research questions and four sub-questions were developed during the course of the research. All the research questions were answered through the research process. For this study, the following research questions were identified:

> Q1: What key factors may be identified and related to the efficient execution of collaborative product development projects?
>
> > Q1a: What challenges do companies experience when they adopt the collaborative apparel product development (CAPD) process?
> >
> > Q1b: What advantages do companies experience when they adopt the collaborative apparel product development (CAPD) process?
>
> Q2: Has the CAPD Model enabled successful product development in relation to increasing perceived efficiency in the product development process?
>
> > Q2a: What tools would aid in the management of CAPD to enhance the proposed framework?
> >
> > Q2b: How can interactions between internal and external collaborators be efficiently managed in order to support successful CAPD projects?

Research question Q1 was addressed through analysis of responses from ICs and ECs through the entrance and exit surveys. Key factors for successful execution of collaborative product development emerged as sub-themes from template analysis of the surveys. Concerning efficiency, organization is essential. Recommendations to improve efficiency included moving interactions between ICs and ECs to a virtual environment where a broader scope of ECs could be achieved.

Research question Q1a and Q1b were also addressed through analysis of responses from the entrance and exit surveys. Acquiring new and informative knowledge, understanding the consumer, and building teams were identified as advantages of working in the collaboration teams. Challenges were identified as lack of resources, organizing and soliciting communication feedback and overall skepticism of the process were identified.

Research question Q2 was addressed through analysis of ICs and ECs responses in the entrance and exit surveys. Overall, the proposed framework was favorably rated to increasing perceived efficiency of the collaborative process. Internal collaborators, especially, expressed satisfaction over the increased efficiency of the product development process.

Research questions Q2a and Q2b were also addressed through the entrance and exit surveys. The main tool, which would enhance the CAPD model management, is the use of internet and social networking platforms. Tools that help organize the communication process were also identified as needed. It was found through the research that interaction between ICs and ECs could efficiently be managed by clearly identifying roles within each stage of the product development process. Strict organization is necessary to best use ICs and ECs time, as it was found to be very valuable to both groups.

IMPLICATIONS

The results of this study provide implications for both industry and academia. The present study generated two general implications for industry. One is that the results of the CAPD Model can be of practical value for future development and testing of collaborative design projects. The revised model addresses the use of contemporary technology to enhance and create an efficient product development process. The systematic explanation of the steps of the model allow for industry adoption of the entire CAPD Model or individual components of the CAPD Model. Secondly, the information obtained from the case study could be a valuable *start* to developing a picture of user needs of breastfeeding women who wish to participate in high impact activities in relation to function, expressiveness, and aesthetics of a nursing sports bra.

The implication for academia is the advancement of the knowledge of collaborative design within the apparel industry. Understanding the impact of collaboration, both internally

and externally is integral to understanding collaborative design. Knowledge obtained about interactions between consumers and industry professionals is valuable in determining how consumers can be effectively involved within the research project. These results provided insights on some understudied areas with regard to general collaborative behavior in a small business. An important contribution of this study is a framework for which product development scholars may wish to test future co-design projects. The CAPD Model enhances the understanding of the effects external collaborators have on the design process, and this model will help further understanding of collaborative design.

LIMITATIONS & FUTURE RESEARCH

The quality of the process of research is important to evaluate. A research process, which utilizes a systematic approach and the use of accepted methods in order to trace the line of thought throughout the research process, is very important. The research has been performed in the way described in chapter four, and in accordance with the Colorado State University Internal Review Board (IRB). The process phases and activities have been documented using, for example, case study protocols, presentations, documentation, and scientific publications. The quality aspects of this research regarding reliability, internal validity, and external validity are further discussed in chapter four.

Because this research was framed around a single case study, the findings should be verified with a larger sample. Each case setting encompasses a unique set of factors that influence the success of the case study. Such factors may or may not be present in future studies, and the outcome may be different. By testing the model further in a variety of settings and incorporating the model revisions (e.g. location, company size, company organizations), would help the researchers better understand the impact of the model.

Another limitation of the research study was the small sample size of both the internal collaborators and the external collaborators. The sample of internal collaborators is dependent on the number of employees available to participate in the study. With the sponsor company, only one IC from each department was available to contribute to the research, and when their resources were already occupied, there was little time left for collaboration. A wide range of ECs, however, is possible via social networking and online forums. By using social networking platforms, a variety of ECs could participate in the process, and this would be an interesting topic for future research.

Although precautions were taken to limit the researcher's impact on the study, the limited ICs sample size was probably impacted by the researchers' role in the study. For example, the IC team did not have an objective designer present as an IC because the researcher was acting as the group leader. With the researcher's background and understanding of the phenomenon, the researcher may have had an impact on the analysis of the data and in turn the results of the research. However, because of multiple sources of documentation and testing, the results are viable for testing the CAPD Model. Future research would include case studies where the researcher truly had an objective role in the data collection, analysis, and interpretation process.

REFERENCES

American Association of Textile Chemists and Colorists (2009). *AATCC Technical Manual*. (Vol. 84). Research Triangle Park, NC.

Andersson, A. (2007). *A framework supporting the collaboration between the logistics and the product development process* (Master's thesis). Retrieved from Mälardalen University Library. (No. 70)

Binder, T., Brandt, E., & Gregory, J. (2008). Design participation (-s). *CoDesign, 4*(1), 1-3.

Bjorgvinsson, E.B. (2008). Open-ended participatory design as prototypical practice. *CoDesign, 4*(2), 85-99.

Bye, E., & Hakala, L. (2005). Sailing apparel for women: A design development case study. *Clothing and Textiles Research Journal, 23*, 45-55.

Carroll, K. E., (2001). *Innovations and Improvisations: A study in Specialized Product Development Focused on Business Clothing for Women with Physical Disabilities. Blackburg, VA.* Unpublished doctoral dissertation, Virginia Polytechnic Institute and State University, U.S.A.

Cassill, S. (2009, June 11). Real moms review their favorite nursing bras [Needs in a nursing bra]. Retrieved from http://www.breastfeedingmomsunite.com/2009/06/real-moms-review.

Chesbrough, H. (2006). New Puzzles and New Findings. In H. Chesbrough, W. Vanhaverbeke, & J. West (Eds.), *Open Innovation Researching a New Paradigm* (pp. 15-34). Oxford: Oxford University Press.

Cho, K.S. (2006). Redesigning hospital gowns to enhance end users' satisfaction. *Family and Consumer Sciences Research Journal, 34*, 332-349.

Cooper, R.G. (2008). What leading companies are doing to re-invent their NPD process? *Visions Magazine*, 6-10.

Cutcliffe, J. R. (2003). Reconsidering reflexivity: Introducing the case for intellectual entrepreneurship. *Qualitative Heath Research, 13*(1), 136-148.

Dickson, M., Loker, S., & Eckman, M. (2009). *Social Responsibility in the Global Apparel Industry*. New York: Farichild.

Eriksson, J. (2009). *Collaborative product development: A collaborative decision-making approach*. (Master's thesis). Retrieved from Mälardalen University Library. (No. 99)

Fraser, K. (2009). Labour flexibility: Impact of functional and localized strategies on team-based product manufacturing. *CoDesign, 5*(3), 143-158.

Griffin, A. (1997). PDMA research on new product development practices: Updating trends and benchmarking best practices. *Product Innovation Management, 14*, 429-458.

Griffin, A., & Hauser, J.R. (1993). The voice of the customer. *Marketing Science, 12*(1), 1-27.

Hines, A., Calder, J., & Abraham, D. (2009). Six catalysts shaping the future of product development. *Visions Magazine*, 20-23.

Hines, T., & Quinn, L. (2007). Segmenting fashion consumers: Reconstructing the challenge of consumer complexity. In T. Hines, & M. Bruce (2nd ed.), *Fashion marketing contemporary issues* (pp. 73-88). Oxford: Elsevier.

Hodge, A. (2009, June 9). Products breastfeeding moms actually need [User needs in a nursing bra]. Retrieved from http://www.breastfeedingmomsunite.com/2009/06/products-breastfeeding.

Hultink, E.J., & Robben, H.S.J. (1995). Measuring new product success: The difference that time perspective makes. *Product Innovation Management, 12*, 392-405.

Jordan, P.W., & Persson, S. (2007). Exploring users' product constructs: How people think about different types of product. *CoDesign, 3*(1), 97-106.

Kang, B. W. (2009). *Research and Theory Trends in Clothing and Textiles, 2000-2007*. (Unpublished master's thesis). Colorado State University, Ft. Collins, CO.

Kim, J., & Farrell-Beck, J. (2003). *Application of apparel design process in an experimental design course*. Paper presented at the meeting of the International Textile and Apparel Association, Iowa State University.

King, N. (1994). The Qualitative Research Interview. In C. Cassell, & G. Symon (Eds.), *Qualitative Methods in Organizational Research* (pp. 14-36). Thousand Oaks: SAGE Inc.

King, N. (2004). Using templates in the thematic analysis of text. In C. Cassell, & G. Symon (Eds.), *Essential Guide to Qualitative Methods in Organizational Research* (pp. 256-270). Thousand Oaks: SAGE Inc.

Koberg, D., & Bagnall, J. (1981). *The all new universal traveler* (6th ed.). Los Altos, CA: William Kaufmann, Inc.

Koen, P., Ajamian, G., Burkart, R., Clamen, A., Davidson, J., D' Amore, R., et al. (2001). Providing clarity and common language to the 'fuzzy front end.' *Research Technology Management,* 46-55

LaBat, K. L., & Sokolowski, S. L. (1999). A three-stage design process applied to an industry-university textile product design project. Clothing *and Textiles Research Journal, 17*(1), 11-20.

Lamb, J.M., & Kallal, M.J. (1992). A conceptual framework for apparel design. *Clothing and Textiles Research Journal, 10*(2), 42-47.

Lee, Y. (2008). Design participation tactics: The challenges and new roles for designers in the co-design process. *CoDesign, 4*(1), 31-50.

Lincoln, Y. S. & Guba, E. G. (1985). *Naturalistic Inquiry.* Thousand Oaks: SAGE Inc.

Littler, D., Leverick, F. & Bruce, M. (1995). Factors affecting the process of collaborative product development: A study of UK manufacturers of information and communications technology products. *Journal of Product Innovation Management, 12*(1), 16-32.

Mahajan, V., & Wind, J. (1992). New product models: Practice, shortcomings and desired improvements. *Journal of Product Innovation Management, 9*, 128-139.

Mangold, W. G., & Faulds, D. J. (2009). Social media: The new hybrid element of the promotion mix. *Business Horizons, 52*(4), 357-365.

Maxwell, D., Sheathe, W., & van der Vorst, R. (2006). Functional and systems aspects of the sustainable product and service development approach for industry. *Journal of Cleaner Production, 14*, 1466-1479.

May-Plumlee, T., & Little, T.J. (2006). Proactive product development integrating consumer requirements. *International Journal of Clothing Science and Technology, 18*(1), 53-66.

Merriam, S. B. (1998). *Qualitative Research and Case Study Applications in Education*. San Francisco: Jossey-Bass.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative Data Analysis*. Thousand Oaks: SAGE Inc.

Nambisan, S. (2002). Designing virtual customer environments for new product development: Toward a theory. *Academy of Management Review, 27*(3), 392-413.

Ng, M.C.F., & Wang X. (2007). *Collaborative decision-making: Design process toward integrated product design*. Paper presented at the meeting of the International Association of Societies of Design Research, The Hong Kong Polytechnic University.

Park, J., & DeLong, M. (2009). User perceptions of technology adoption and implementation: A case study of footwear production in a global market. *Fashion Practice, 1*(1), 87-108.

Patton, M. Q. (1987). *How to Use Qualitative Methods in Evaluation*. Thousand Oaks: SAGE Inc.

Pitimaneeyakul, U., LaBat, K.L., & DeLong, M.R. (2005) Knitwear product development process: A case study. *Clothing and Textiles Research Journal, 22*(3), 113-121.

Raymond, M. (2007). The making and marketing of a trend. In T. Hines, & M. Bruce (2nd ed.), *Fashion marketing contemporary issues* (pp. 297-307). Oxford: Elsevier.

Sanders, E.B.N, & Stappers, P.J. (2008). Co-creation in the new landscapes of design. *CoDesign, 4*(1), 5-18.

Sanders, E.B.-N. (2006). Design research in 2006. *Design Research Quarterly, 1* (1), 1-8.

Sawhney, M., Verona, G., & Prandelli, E. (2005). Collaboration to create: The internet as a platform for customer engagement in product innovation. *Journal of Interactive Marketing, 19*(4), 1-14.

Schilling, M. A., & Hill, C.W.L. (1998). Managing the new product development process: Strategic imperatives. *Academy of Management Executive, 12*(3), 67-81.

Scholz, R. W., & Tietje, O. (2002). *Embedded Case Study Methods. Integrating quantitative and qualitative knowledge*. Thousand Oaks: SAGE Inc.

Shen, X.X., Tan, K.C., & Xie, M. (2000). An integrated approach to innovative product development using Kano's model and QFD. *European Journal of Innovation Management, 3*(2), 91-99.

Smith, T. (2011). Global Web Index Annual Report 2011: Welcome to social entertainment. Retrieved from http://globalwebindex.net/annual-report-2011/

Social Media Week.(2011). About. Retrieved from http://socialmediaweek.org/about/

Stage-Gate International. (2009). Stage-gate process [Process model]. Retrieved from http://www.stage-gate.com/index.php

Stake, R. E. (1995). *The Art of Case Study Research*. Thousand Oaks: SAGE Inc.

Swigert, T. & Boyd, B. L. (2010). The impact of Boys & Girls Club/Keystone Club participation on alumni. *Journal of Leadership Education, 9*(1), 82-99.

Terwiesch, C. & Bohn, R. E. (2001). Learning and process improvement during production ramp-up. *International Journal of Production Economics*, 40(1), 1-19.

The American Heritage Dictionary of the English Language, Fourth Edition. (2003). Retrieved March 27 2010 from http://www.thefreedictionary.com/A.

The Conversation Prism. (2011). [Graph illustration of Social Media]. Retrieved from http://www.theconversationprism.com/

Trott, P. (2008). *Innovation management and new product development* (4th ed.). Essex, England: Prentice Hall.

Ulrich, K., & Eppinger, S. (2003). *Product Design and Development*. Irwin: McGraw-Hill.

Unger, D. W., & Eppinger, S. D. (2006). Improving product development process to manage development risk. Manuscript in preparation. MIT Sloan School of Management, Cambridge, Mass.

van Nes, N., & Cramer, J. (2005). Influencing product lifetime through product design. *Business Strategy and the Environment, 14*, 286-299.

von Hippel, E. (1988). *The sources of innovation* (1st ed.). New York: Oxford University Press.

von Hippel, E. (2001). User toolkits for innovation. *Journal of Product Innovation Management, 18*, 247-257.

Waddington, D. (2004). Participant Observation. In C. Cassell, & G. Symon (Eds.), *Qualitative Methods in Organizational Research* (pp. 154-164). Thousand Oaks: SAGE Inc.

Watkins, S.M. (1988). Using the design process to teach functional apparel design. *Clothing and Textiles Research Journal, 7*(1), 11-14.

Whitehead, J. L. (1996). *Consumer satisfaction and athletic bras: Product development* (Unpublished master's thesis). Colorado State University, Ft. Collins, CO.

Wu, J. (2010). Co-design communities online: Turning public creativity into wearable and sellable fashions. *Fashion Practice, 2*(1), 85-104.

Wynstra, F., Van Weele, A., & Weggemann, M. (2001). Managing supplier involvement in product development: Three critical issues. *European Management Journal*, 19(2), 157-167.

Yin, R. K. (2009). *Case Study Research: Design and Methods*. Thousand Oaks: SAGE Inc.

APPENDIX A

CASE STUDY BRIEF

CASE STUDY: BRIEF

COLLABORATIVE APPAREL PRODUCT DEVELOPMENT:

EXAMINING THE DEVELOPMENT OF A NURSING SPORTS BRA

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The purpose of this case study brief is to provide the sponsor company with concise findings from the case study. Findings from each instrument are presented, and raw data is included at the conclusion of the brief.

STAGE 1

PURCHASE HABITS & DEMOGRAPHICS

RESEARCH DESIGN

STAGE 1: MARKET RESEARCH
Demographics
Purchase Habits Survey
Focus Group

STAGE 2: CREATIVE EXPLORATION
Idea Generation

STAGE 3: CREATIVE DEVELOPMENT
Specifications
Wear Trials

STAGE 4: IMPLEMENTATION
Future Development

Special thanks to all the Internal and External Collaborators. Without you, this project would not have been a success. Thank you for taking time out of your hectic schedules to contribute to this body of knowledge. The researchers hope you find this information valuable and interesting!

Demographic characteristics of external collaborators

Characteristic	No.	%
No. of participants	5*	100.00%
Gender		
Male	0	0.00%
Female	100	100.00%
Age		
18-30 years	1	20.00%
31-40 years	4	80.00%
41-50 years	0	0.00%
> 51 years	0	0.00%
Education Level		
High School Graduate	0	0.00%
Some College	0	0.00%
College Graduate	1	20.00%
Graduate/Professional	4	80.00%
Combined Family Income		
< $69,000	1	20.00%
$70,000-$89,000	1	20.00%
$90,000 - $109,000	1	20.00%
> $ 110,000	2	40.00%
Given Birth in the Past Year		
Yes	3	60.00%
No	2	40.00%
Number of Total Children		
1	4	80.00%
2	1	20.00%
3 or more	0	0.00%
Number of Children Birthed During Most Recent Pregnancy		
1	5	100.00%
2 or more	0	0.00%
Age of Most Recent Child		
0-1 years	3	60.00%
1-2 years	1	20.00%
2-3 years	1	20.00%
> 3 years	0	0.00%
Anticipated Duration for Breastfeeding		
0-6 months	3	60.00%
7-12 months	2	40.00%
13-18 months	0	0.00%
19-24 months	0	0.00%

* The total number of external collaborators which participated to the end of the research study was 5; the figures in the table do not include information on participants who discontinued the research.

STAGE 1

PURCHASE HABITS & DEMOGRAPHICS

EXTERNAL COLLABORATOR PURCHASE HABITS AND DEMOGRAPHIC QUESTIONNAIRE

#	Characteristic	No.	%
		8	100.00%
Q4	When you do NOT have children who are nursing, how many times a week do you participate in high impact sports?		
	1-2 times/week	1	12.50%
	3-4 times/week	4	50.00%
	5-6 times/week	3	37.50%
Q5	When you have children who are nursing, how many times/week do you participate in high impact sports?		
	1-2 times/week	2	28.57%
	3-4 times/week	6	85.71%
	5-6 times/week	0	0.00%
Q6	How long after you gave birth did you start participating in exercise again?		
	1-2 weeks	2	25.00%
	3-4 weeks	0	0.00%
	5-6 weeks	4	50.00%
	7-8 weeks	2	25.00%
	>8 weeks	0	0.00%
Q7	When you do NOT have a child that is breastfeeding, do you typically experience breast soreness?		
	During exercise	0	0.00%
	After exercise	1	12.50%
	Any other time	0	0.00%
	None	7	87.50%
Q8	When you have a child that is breastfeeding, do you typically experience breast soreness?		
	During exercise	4	50.00%
	After exercise	1	12.50%
	Any other time	0	0.00%
	None	3	37.50%
Q9	Has nursing influenced your participation in exercise?		
	Yes	7	87.50%
	No	1	12.50%
Q10	Do you wear athletic bras during exercise when you are breastfeeding?		
	Yes	8	100.00%
	No	0	0.00%
Q10a	Do you wear athletic bras during exercise when you are NOT breastfeeding?		
	Yes	8	100.00%
	No	0	0.00%
Q13	What size of athletic bra do you usually buy when you are NOT breastfeeding?		
	X Small	0	0.00%
	Small	2	25.00%
	Medium	4	50.00%
	Large	1	12.50%
	X Large	0	0.00%
	XX-Large	0	0.00%
	Other	1	12.50%

STAGE 1

PURCHASE HABITS & DEMOGRAPHICS

EXTERNAL COLLABORATOR PURCHASE HABITS AND DEMOGRAPHIC QUESTIONNAIRE CONTINUED

Q14	What size of athletic bra do you usually buy when you are breastfeeding?		
	X Small	0	0.00%
	Small	0	0.00%
	Medium	1	12.50%
	Large	4	50.00%
	X Large	1	12.50%
	XX-Large	1	12.50%
	Other	1	12.50%
Q17a	How many athletic bras do you own?		
	1-2	2	25.00%
	3-4	1	12.50%
	5-6	2	25.00%
	7-8	1	12.50%
	>8	2	25.00%
Q17b	How many Nursing bras do you own?		
	1-2	1	12.50%
	3-4	2	25.00%
	5-6	5	62.50%
	7-8	0	0.00%
	>8	0	0.00%
Q18a	What would you consider to be a reasonable price for an athletic bra?		
	$0-$10	0	0.00%
	$11-20	0	0.00%
	$21-30	4	50.00%
	$31-40	2	25.00%
	$41-50	2	25.00%
	> $50	0	0.00%
Q18b	What would you consider to be a reasonable price for a NURSING bra?		
	$0-$10	0	0.00%
	$11-20	1	12.50%
	$21-30	2	25.00%
	$31-40	0	0.00%
	$41-50	5	62.50%
	> $50	0	0.00%
Q19	Where do you shop when looking to purchase a nursing bra?**		
	Online stores	3	33.33%
	Retail stores	6	66.67%
Q20	When you are purchasing a nursing bra, do you research products or find product information?		
	Yes	5	62.50%
	No	3	37.50%
Q21	When you shop for a nursing bra do you typically find what you are looking for?		
	Yes, I find exactly what I am looking for	3	37.50%
	Yes, but not the brand/size/color/etc.	1	12.50%
	I find a related product but not what I wanted	2	25.00%
	No, I do not find what I am looking for	2	25.00%

STAGE 1

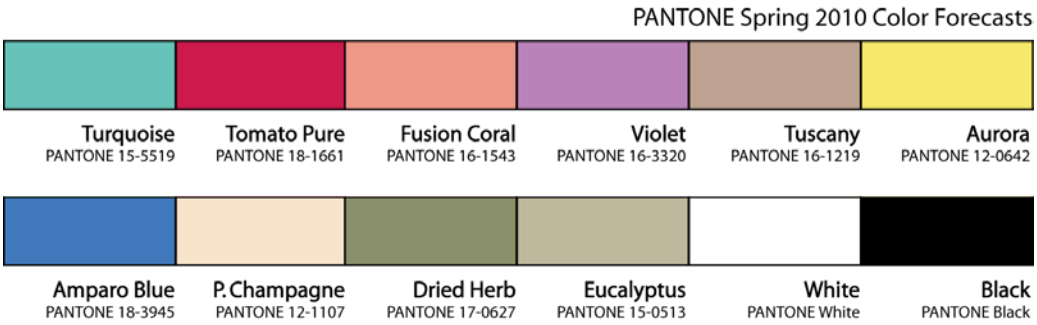
PURCHASE HABITS & DEMOGRAPHICS

EXTERNAL COLLABORATOR PURCHASE HABITS AND DEMOGRAPHIC QUESTIONNAIRE CONTINUED

Q21a	When you shop for a piece of athletic apparel, including sports bra, do you prefer solid colored fabric or printed fabric?		
	Solid colors	8	100.00%
	Printed fabric	0	0.00%
Q22	If you prefer solid colored fabric, what color do you typically purchase? ***		
	Black	5	29.41%
	White	4	23.53%
	Blue	4	23.53%
	Nude	2	11.76%
	Green	1	5.88%
	Gray	1	5.88%
Q31	How much did you spend on clothing purchases for yourself this past year?		
	< $499	0	0.00%
	$500-$999	4	50.00%
	$1,000-$1,999	2	25.00%
	$2,000- $2999	2	25.00%
	$3,000-$3,999	0	0.00%
	> $4,000	0	0.00%

* The total number of survey participants was 8; **One participant checked that they shopped at both locations.
***Participants provided more than one answer

COLOR



Participants were asked what colors they preferred for athletic apparel. Each color is ranked below by mean scores.

1. WHITE
2. BLACK
3. AMPARO BLUE
4. TURQUOISE
5. EUCALYPTUS
6. CHAMPAGNE
7. TOMATO PURE
8. VIOLET
9. DRIED HERB
10. FUSION CORAL
11. TUSCANY
12. AURORA

STAGE
1

FLORAL
Patterns which depict a floral garden.

GEOMETRIC
Textile designs which represent an abstract or non-representational motif.

NOVELTY
Patterns which depict a real creature or object.

ETHNIC
Any pattern or style with a foreign or exotic feeling.

ART MOVEMENT
Textile designs which are part of an art movement.

Participants were asked what print categories they preferred for athletic apparel. Each print category is ranked below by mean scores.

1. **FLORAL**
2. **NOVELTY**
3. **GEOMETRIC**
4. **ETHNIC**
5. **ART MOVEMENT**

RECRUITMENT PROCESS

A homogeneous purposeful sample selection process enabled the researcher to select an 'information-rich case' for in depth study (Patton, 1987). A homogeneous sample is particularly useful when researchers need in depth information and are able to bring together people of similar backgrounds and experiences to address issues that affect them (Patton, 1987). The recruitment channels were through the sponsor company's monthly newsletter, and posting the recruitment documents on the sponsor company's blog.

FOCUS GROUP PARTICIPANTS

Five local focus group participants were recruited through a purposeful sample selection process. One focus group session was necessary to accommodate all focus group participants. The focus group followed an agenda, and was audio-taped and transcribed. After the problems were identified through the focus group, the IC identified which problems could be addressed through product design.

STAGE 1

FOCUS GROUP FINDINGS

COMFORT

Support was the most important factor for the focus group participants'. Sports bras like, Moving Comfort and Danskin are supportive enough, but do not allow nursing.

Ease of movement was also very important. Participants expressed a range of concerns including ease of donning and doffing and unrestricted movement in order to nurse. Due to increased breast tenderness and swelling, the focus group participants explained that they have altered their normal exercise routines. Participants expressed that the fabric should be breathable and quick drying. Fabrics that were made of a heavier weight and had less spandex were preferred. The overall consensus was that the bra should be comfortably tight in order to support the breasts, and long enough to stay down when lifting arms above the head. The bra should also fit well over the chest so it does not flatten the chest or create an odd silhouette.

USER NEEDS

Participants expressed they preferred bras that closed with a hook-and-eye clasp than bras that pull over the head due to ease in donning and doffing. All participants agreed that adjustable straps were important to help with variations in breast size and participants explained that the straps should be comfortable and not cut into you. Participants addressed that there should not be an underwire. Easy, one-hand nursing clips were preferred by the focus group participants. All participants agreed that nursing should be easy and comfortable for both the wearer and the baby without fabric getting in the way. Participants also addressed removable pads in the bras. Many participants liked the idea of the pads as long as they were removable.

AESTHETICS

Participants expressed concern about design lines in a nursing sports bra. They agreed that no seams should be across the breast. Some participants expressed that the seam show through shirts, and other explained that the seams were uncomfortable. In regard to color, participants liked basic colors such as white, black, and nude. However, some participants did not like white because of staining, and some participants did not like black because you can see it under your shirt. Most participants expressed that color was not a big influence because they are interested in the function of the bra. Most participants said they prefer solid fabric over printed fabrics, and again concern of the print showing through light colored shirts was expressed.

PURCHASE HABITS

Participants explained that the best bra availability has come from online shopping.

Participants divulged that they use word of mouth, talk with store employees, and look at reviews online. Participants also look at blogs geared towards mothers. Among the focus group participants most participants referred to online product reviews and sales reps for technical information regarding the product. The need to compromise was constantly addressed. Focus group participants explained that in order to gain enough support to control breast movement during running, many of them wear two sports bras. All participants said the bras they currently use to work out in are sports bras and no participants work out in nursing bras. Brands of regular athletic bras that the focus group participants liked included, Adidas, Nike, Prana, Bally's, Champion, and Moving Comfort. Brands the participants liked of nursing bras included: Bravado and Elomi.

Presented above are key findings from the focus group transcriptions. Presented in Chapter Five is the complete template analysis of the focus group transcriptions.

CREATIVE EXPLORATION

Based off information from the focus group and EC Purchase Habit Survey, prototype development began. Initial design concepts were drawn up and reviewed with IC. From suggestions of IC, further design refinements took place and a final design was decided upon.

STAGE 2

DESIGN FEATURES

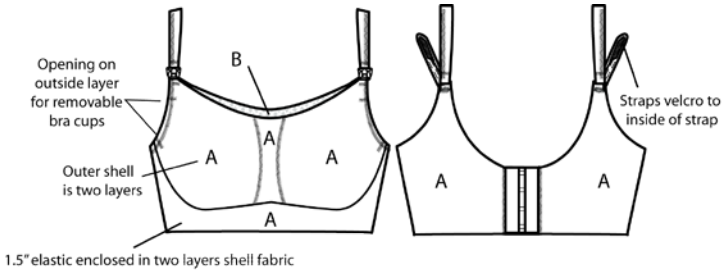
Support – Support was addressed by using a slightly heavier fabric which still had moisture wicking to help with the breathability. Ideas from the participants about wearing a sports bra over a nursing bra gave way to the idea of creating a bralette under a sports bra shell. The 'two' bra approach to support would be addressed in one bra.

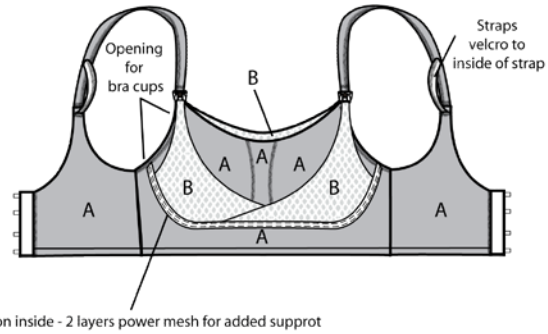
Fabric - Fabrics for the bras were sourced nationally, and a sueded wick away Lycra in an unknown weight. The wick away component was important for moisture management and breathability for the participants. A power mesh or tricot mesh was sourced as the interior bralette. This fabric was chosen in order to reduce bulk, increase breathability, and provide an extra level of support.

Fit – The fit of the bra was cut to be slightly snug, but not binding as based off BornFit's measurements for a sample size medium. Additional length was added at the sides for additional support and full coverage.

Straps– The straps are a unique feature of this bra. They are wider than traditional bra straps and slightly padded for extra comfort. The bra straps are also adjustable with Velcro at the back. This adjustability is important for variations in breast size across consumers and within consumers. Finally, the straps may be crossed in the back for additional support.

No Underwire – A faux underwire was created by using underwire channeling under the cups to create definition and additional support. Due to perceived negative effects of underwire during nursing, no wires were used in this bra.





A= Poly/Spandex Brushed Jersey with Moisture Management
B= Nylon/Spandex Tricot Mesh with Moisture Management

NURSING SPORTS BRA PROTOTYPE: DEVELOPED BY RESEARCH - TESTED BY RESEARCH

Removable Pads – Removable pads were included for users who were concerned about breast definition and nipple show through. However, the pads could be removed for users who did not care for them.

Clasps – The bra was designed with easy one-hand nursing bra clips, and the interior of the bra was created to efficiently allow the wearer to nurse. The bralette is a surplice design made of two layers of mesh. The mesh was chosen as to not make the bra hot. The surplice construction was chosen to allow easy access for nursing.

Design Lines – No seams cross over the bust for comfort reasons and so the line did not show through the wearer's top. On the interior bralette, no seams cross the bust. There are two seams on the outside panel to hold the removable pads in place.

Utility – Function was considered over color and fashionable design features in this bra.

RIGHT:
Outside front of prototype bra

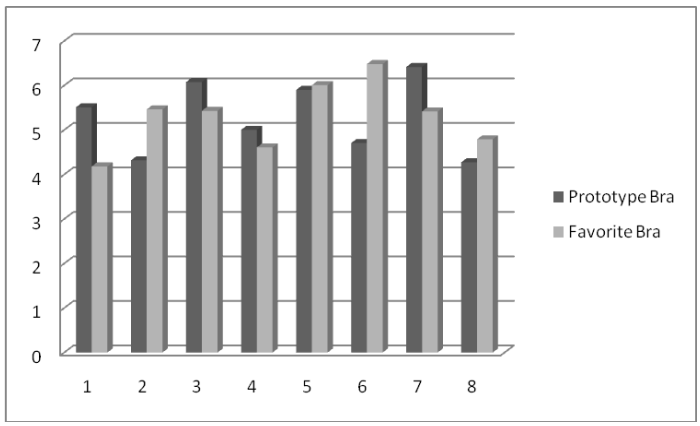
BELOW:
Top Left: Outside front with one cup dropped; Top Right: Inside front (bra shown inside out); Bottom Left: Outside back; Bottom Right: Outside back with straps crossed




CREATIVE DEVELOPMENT

WEAR TRIAL FINDINGS

STAGE
3



Evaluation of prototype bra and 'favorite' bra for high impact activities; 1= Support; 2= Fit; 3=Comfort; 4=Attractiveness; 5=Movement; 6=Don/Doff; 7= Breathability; 8= Ease of Nursing

Collaborators were asked to test the prototype bra for three trials and alternate their 'favorite' athletic bra or 'favorite' nursing bra for two trials. Each time a bra was tested, the ECs were asked to report the level of activity they participated in. Levels of activity ranged from medium or low impact (e.g. yoga, walking, cycling) to high impact (e.g. running, playing soccer). Collaborators evaluated the bras on a 7-point Likert scale in the Wear Trial Journal

STAGE 3

WEAR TRIAL FINDINGS

COMFORT

Comfort was addressed by the wear trial collaborators as a major theme for the evaluation of the prototype bra. Comments from the wear trial EC addressed: *Physiological Comfort, Physical Comfort, and Psychological Comfort.*

Physiological Comfort: In regard to *support*, the wear trial EC had mixed reviews, as one collaborator explained: "while [the bra] was comfortable, there was way too little support for me." Another collaborator expressed, "the bra was very comfortable to run in with good support."

Physical Comfort: Collaborators commented on the *fabric* of the bra, as one collaborator explained, "I did my son's school fun run. It was early, the day was hot, and the fabric is not as breathable when it was hot. It was easy to nurse after the run, though, and I didn't feel totally sweaty." Collaborators also addressed the *fit* of the prototype as one collaborator explained that, "the coverage was not adequate. The bra was cut too low in the front and not quite far back enough on the sides."

Psychological Comfort: One wear trial EC addressed the *negative perception of feeling exposed* or self conscious in regard to show through under a work out shirt, the EC explained, "with thinner, more sheer shirt fabric, the pads definitely helped [with showing through], however I was still self conscious and changed shirts."

USER NEEDS

User needs were also addressed by the wear trial collaborators as to specifically address *design features* and *ease of use*. The wear trial collaborators found the bra straps set to widely apart across the shoulders to be a consistent problem. Collaborators addressed this issue by crossing the straps into a racerback position, which seemed to help. Collaborators also addressed the fact that with the straps crossed in the racerback orientation, the bra was hard to take on and off. Another point of concern to the wear trial was the size of the hook and eye closure on the back of the bra as one EC explained, "the hooks on the back seem too small to attach behind your back; it takes a few tries to get it hooked."

The final *design feature* the wear trial collaborators addressed was the removable pads. Most EC were not satisfied with the pads although they thought it was a good idea. Other EC addressed the difficulty to nurse with the pads in the bra. One EC was pleased with the pads stating, "The padding offers good 'coverage' especially after pumping or nursing, but they do seem to be a little bulky." Wear trial collaborators found the prototype bra not *easy to use* for nursing. One EC expressed, "[I] had to take the bra off to nurse. Inside panels are too big and even when pulled down, it was difficult to nurse…plus when only one side was released the paned does not come down far at all."

AESTHETICS

Aesthetics were also addressed by the wear trial collaborators in regard to the look and functionality of the *design lines.* Overall collaborators found the prototype to be attractive, however, utility over fashion was still important to the collaborators as one EC explained, "The black material on the top of the bra looks nice, but I am not sure of its function; it looks a little 'bunchy' under a sheer, fitted workout shirt, but overall I like the design."

As compared with the 'favorite' bra, the prototype bra was rated more favorably on the variables of support, comfort, attractiveness, and fabric breathability. The 'favorite' was rated more favorably on fit, ease of movement, donning/doffing, and ease of nursing. Qualitative data analysis further explains these findings.

The prototype was developed off criteria established from EC during Stage One of the CAPD Model. Each theme was addressed through a unique design solution. The evaluation of the prototype through the wear trials provided great insight into the success or failure of each design solution. By using EC throughout the process, they are better able to analyze the product, based off discussion from the focus group.

STAGE
4

IMPLEMENTATION

Based off quantitative and qualitative information from the wear trials, it was found that further improvements to the prototype bra are necessary before entering production ramp-up.

1. Bring in the bra straps so they sit closer to the neck to improve fit and donning/doffing

2. Decreasing the armhole depth for coverage at sides

3. Make the interior bralette slightly smaller to allow for better ease of nursing

EVALUATION OF PROCESS

The process of holding a focus group to develop a product, and testing the product through a wear trial has enabled substantial information exchange on the necessary improvements of the prototype. Although this method of testing products has been used before, the use of the same EC throughout the research process has enabled a deep understanding as to why the product was successful or unsuccessful in meeting consumer needs. As Nambisan (2002) has also found, consumer involvement, although may have the potential to elongate the product time cycle, has the potential to develop more successful products.

RAW WEAR TRIAL DATA

Analysis of Variance for activity level and bra relationship

STAGE 2

Frequencies

Statistics

		Q1	Q3	Activity Level	Bra
N	Valid	41	41	34	34
	Missing	0	0	7	7

Frequency Table

Q1

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	41	100.0	100.0	100.0

Q3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		4	9.8	9.8	9.8
	A	18	43.9	43.9	53.7
	B	9	22.0	22.0	75.6
	C	7	17.1	17.1	92.7
	NA	3	7.3	7.3	100.0
	Total	41	100.0	100.0	

Activity Level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	19	46.3	55.9	55.9
	med-low	15	36.6	44.1	100.0
	Total	34	82.9	100.0	
Missing	System	7	17.1		
Total		41	100.0		

Bra

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	proto	18	43.9	52.9	52.9
	fav	16	39.0	47.1	100.0
	Total	34	82.9	100.0	
Missing	System	7	17.1		
Total		41	100.0		

Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
Activity Level	1.00	High	19
	2.00	med-low	15
Bra	1.00	proto	18
	2.00	fav	16
ID #	EC100		7
	EC101		4
	EC103		7
	EC105		8
	EC113		8

Tests of Between-Subjects Effects

Dependent Variable: SUPPORT

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	673.981	1	673.981	143.854	.000
	Error	19.533	4.169	4.685[a]		
Activity Level * Bra	Hypothesis	.740	1	.740	.368	.549
	Error	52.333	26	2.013[b]		
Activity Level	Hypothesis	11.809	1	11.809	5.867	.023
	Error	52.333	26	2.013[b]		
Bra	Hypothesis	12.079	1	12.079	6.001	.021
	Error	52.333	26	2.013[b]		
ID#	Hypothesis	19.277	4	4.819	2.394	.076
	Error	52.333	26	2.013[b]		

a. .952 MS(ID#) + .048 MS(Error)

b. MS(Error)

Expected Mean Squares[a,b]

	Variance Component		
Source	Var(ID#)	Var(Error)	Quadratic Term
Intercept	5.741	1.000	Intercept, Activity Level * Bra, Activity Level, Bra
Activity Level * Bra	.000	1.000	Activity Level * Bra
Activity Level	.000	1.000	Activity Level * Bra, Activity Level
Bra	.000	1.000	Activity Level * Bra, Bra
ID#	6.029	1.000	
Error	.000	1.000	

a. For each source, the expected mean square equals the sum of the coefficients in the cells times the variance components, plus a quadratic term involving effects in the Quadratic Term cell.

b. Expected Mean Squares are based on the Type III Sums of Squares.

Estimated Marginal Means

1. Activity Level

Estimates

Dependent Variable: SUPPORT

Activity Level	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High	5.576	.381	4.794	6.358
med-low	4.115	.421	3.250	4.981

Pairwise Comparisons

Dependent Variable: SUPPORT

(I) Activity Level	(J) Activity Level	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
High	med-low	1.461*	.603	.023	.221	2.700
med-low	High	-1.461*	.603	.023	-2.700	-.221

Based on estimated marginal means

*. The mean difference is significant at the .05 Activity Level.

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable: SUPPORT

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	11.809	1	11.809	5.867	.023
Error	52.333	26	2.013		

The F tests the effect of Activity Level. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

2. Bra

Estimates

Dependent Variable: SUPPORT

Bra	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
proto	5.509	.381	4.726	6.293
fav	4.181	.376	3.408	4.955

Pairwise Comparisons

Dependent Variable: SUPPORT

(I) Bra	(J) Bra	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
proto	fav	1.328*	.542	.021	.214	2.442
fav	proto	-1.328*	.542	.021	-2.442	-.214

Based on estimated marginal means

*. The mean difference is significant at the .05 Activity Level.

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable: SUPPORT

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	12.079	1	12.079	6.001	.021
Error	52.333	26	2.013		

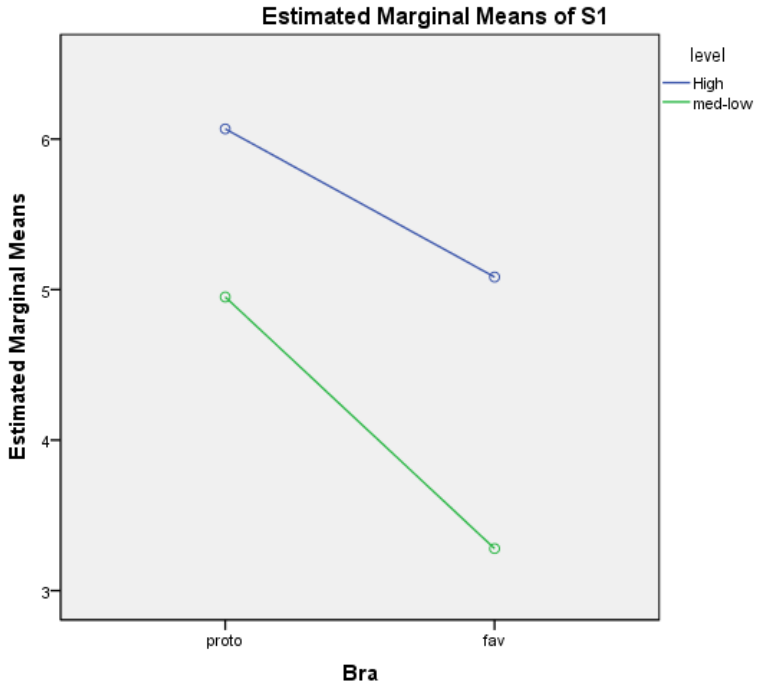
The F tests the effect of Bra. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

3. Bra * Activity Level

Dependent Variable: SUPPORT

Bra	Activity Level	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
proto	High	6.068	.443	5.157	6.978
	med-low	4.951	.689	3.535	6.367
fav	High	5.084	.600	3.851	6.316
	med-low	3.279	.478	2.296	4.263

Profile Plots



Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
Activity Level	1.00	High	19
	2.00	med-low	15
Bra	1.00	proto	18
	2.00	fav	16
ID #	EC100		7
	EC101		4
	EC103		7
	EC105		8
	EC113		8

Tests of Between-Subjects Effects

Dependent Variable: FIT

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	686.614	1	686.614	116.218	.000
	Error	24.300	4.113	5.908[a]		
Activity Level * Bra	Hypothesis	2.532	1	2.532	1.478	.235
	Error	44.534	26	1.713[b]		
Activity Level	Hypothesis	2.239	1	2.239	1.307	.263
	Error	44.534	26	1.713[b]		
Bra	Hypothesis	8.975	1	8.975	5.240	.030
	Error	44.534	26	1.713[b]		
ID#	Hypothesis	24.474	4	6.118	3.572	.019
	Error	44.534	26	1.713[b]		

a. .952 MS(ID#) + .048 MS(Error)

b. MS(Error)

Expected Mean Squares[a,b]

Source	Variance Component		
	Var(ID#)	Var(Error)	Quadratic Term
Intercept	5.741	1.000	Intercept, Activity Level * Bra, Activity Level, Bra
Activity Level * Bra	.000	1.000	Activity Level * Bra
Activity Level	.000	1.000	Activity Level * Bra, Activity Level
Bra	.000	1.000	Activity Level * Bra, Bra
ID#	6.029	1.000	
Error	.000	1.000	

a. For each source, the expected mean square equals the sum of the coefficients in the cells times the variance components, plus a quadratic term involving effects in the Quadratic Term cell.

b. Expected Mean Squares are based on the Type III Sums of Squares.

Estimated Marginal Means

1. Activity Level

Estimates

Dependent Variable: FIT

Activity Level	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High	5.209	.351	4.487	5.930
med-low	4.573	.388	3.774	5.371

Pairwise Comparisons

Dependent Variable: FIT

(I) Activity Level	(J) Activity Level	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound

High	med-low	.636	.556	.263	-.507	1.779
med-low	High	-.636	.556	.263	-1.779	.507

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable: FIT

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	2.239	1	2.239	1.307	.263
Error	44.534	26	1.713		

The F tests the effect of Activity Level. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

2. Bra

Estimates

Dependent Variable: FIT

			95% Confidence Interval	
Bra	Mean	Std. Error	Lower Bound	Upper Bound
proto	4.318	.352	3.595	5.041
fav	5.463	.347	4.749	6.177

Pairwise Comparisons

Dependent Variable: FIT

					95% Confidence Interval for Difference[a]	
(I) Bra	(J) Bra	Mean Difference (I-J)	Std. Error	Sig.[a]	Lower Bound	Upper Bound
proto	fav	-1.145*	.500	.030	-2.172	-.117
fav	proto	1.145*	.500	.030	.117	2.172

Based on estimated marginal means

*. The mean difference is significant at the .05 Activity Level.

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable: FIT

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	8.975	1	8.975	5.240	.030
Error	44.534	26	1.713		

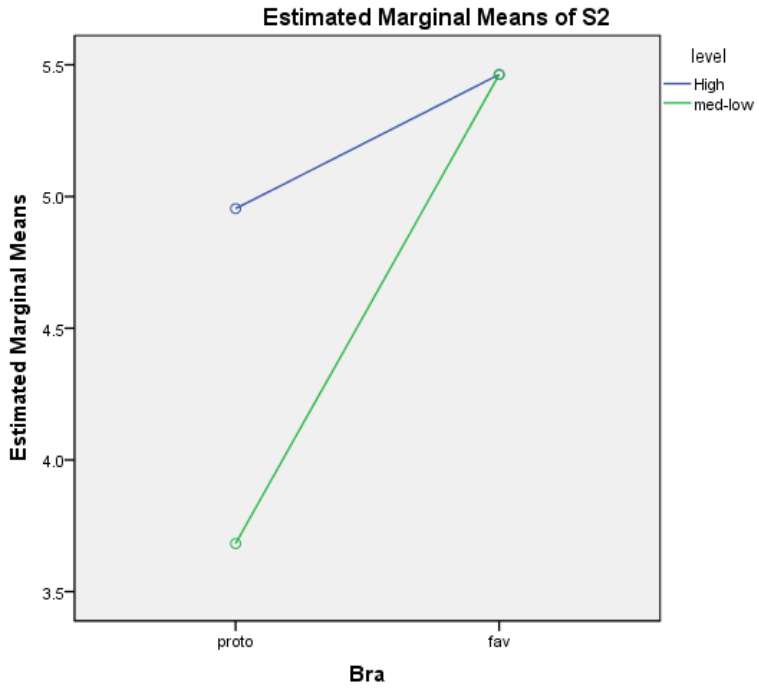
The F tests the effect of Bra. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

3. Bra * Activity Level

Dependent Variable: FIT

				95% Confidence Interval	
Bra	Activity Level	Mean	Std. Error	Lower Bound	Upper Bound
proto	High	4.954	.409	4.114	5.794
	med-low	3.682	.635	2.376	4.989
fav	High	5.463	.553	4.326	6.600
	med-low	5.463	.441	4.556	6.370

Profile Plots



Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
Activity Level	1.00	High	19
	2.00	med-low	15
Bra	1.00	proto	18
	2.00	fav	16
ID #	EC100		7
	EC101		4
	EC103		7
	EC105		8
	EC113		8

Tests of Between-Subjects Effects

Dependent Variable: COMFORT

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	950.117	1	950.117	311.455	.000
	Error	12.483	4.092	3.051[a]		
Activity Level * Bra	Hypothesis	.053	1	.053	.073	.789
	Error	18.787	26	.723[b]		
Activity Level	Hypothesis	2.636	1	2.636	3.648	.067
	Error	18.787	26	.723[b]		
Bra	Hypothesis	2.856	1	2.856	3.953	.057
	Error	18.787	26	.723[b]		
ID#	Hypothesis	12.670	4	3.167	4.384	.008
	Error	18.787	26	.723[b]		

a. .952 MS(ID#) + .048 MS(Error)

b. MS(Error)

Expected Mean Squares[a,b]

Source	Variance Component		
	Var(ID#)	Var(Error)	Quadratic Term
Intercept	5.741	1.000	Intercept, Activity Level * Bra, Activity Level, Bra
Activity Level * Bra	.000	1.000	Activity Level * Bra
Activity Level	.000	1.000	Activity Level * Bra, Activity Level
Bra	.000	1.000	Activity Level * Bra, Bra
ID#	6.029	1.000	
Error	.000	1.000	

a. For each source, the expected mean square equals the sum of the coefficients in the cells times the variance components, plus a quadratic term involving effects in the Quadratic Term cell.

b. Expected Mean Squares are based on the Type III Sums of Squares.

Estimated Marginal Means

1. Activity Level

Estimates

Dependent Variable: COMFORT

Activity Level	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High	5.408	.228	4.939	5.877
med-low	6.098	.252	5.580	6.617

Pairwise Comparisons

Dependent Variable: COMFORT

(I) Activity Level	(J) Activity Level	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
High	med-low	-.690	.361	.067	-1.433	.053
med-low	High	.690	.361	.067	-.053	1.433

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable: COMFORT

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	2.636	1	2.636	3.648	.067
Error	18.787	26	.723		

The F tests the effect of Activity Level. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

2. Bra

Estimates

Dependent Variable: COMFORT

Bra	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
proto	6.076	.228	5.606	6.545
fav	5.430	.226	4.967	5.894

Pairwise Comparisons

Dependent Variable: COMFORT

(I) Bra	(J) Bra	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
proto	fav	.646	.325	.057	-.022	1.313
fav	proto	-.646	.325	.057	-1.313	.022

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable: COMFORT

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	2.856	1	2.856	3.953	.057
Error	18.787	26	.723		

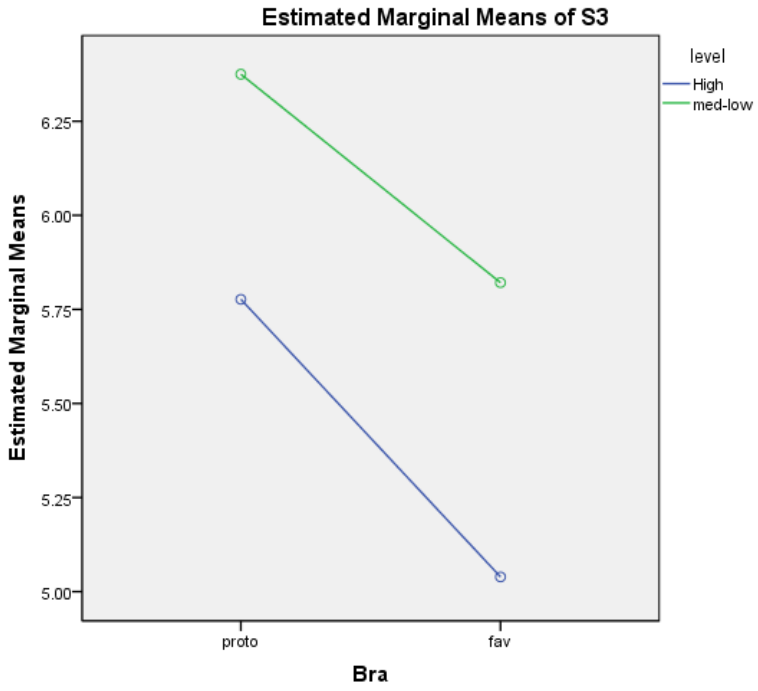
The F tests the effect of Bra. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

3. Bra * Activity Level

Dependent Variable: COMFORT

Bra	Activity Level	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
proto	High	5.777	.265	5.231	6.322
	med-low	6.375	.413	5.527	7.223
fav	High	5.039	.359	4.301	5.778
	med-low	5.821	.287	5.232	6.410

Profile Plots



Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
Activity Level	1.00	High	19
	2.00	med-low	15
Bra	1.00	proto	18
	2.00	fav	16
ID #	EC100		7
	EC101		4
	EC103		7
	EC105		8
	EC113		8

Tests of Between-Subjects Effects

Dependent Variable: ATTRACTIVENESS

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	662.830	1	662.830	52.506	.002
	Error	50.696	4.016	12.624[a]		
Activity Level * Bra	Hypothesis	.500	1	.500	.957	.337
	Error	13.567	26	.522[b]		
Activity Level	Hypothesis	2.003	1	2.003	3.839	.061
	Error	13.567	26	.522[b]		
Bra	Hypothesis	1.069	1	1.069	2.049	.164
	Error	13.567	26	.522[b]		
ID#	Hypothesis	52.925	4	13.231	25.356	.000
	Error	13.567	26	.522[b]		

Tests of Between-Subjects Effects

Dependent Variable: ATTRACTIVENESS

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	662.830	1	662.830	52.506	.002
	Error	50.696	4.016	12.624[a]		
Activity Level * Bra	Hypothesis	.500	1	.500	.957	.337
	Error	13.567	26	.522[b]		
Activity Level	Hypothesis	2.003	1	2.003	3.839	.061
	Error	13.567	26	.522[b]		
Bra	Hypothesis	1.069	1	1.069	2.049	.164
	Error	13.567	26	.522[b]		
ID#	Hypothesis	52.925	4	13.231	25.356	.000
	Error	13.567	26	.522[b]		

a. .952 MS(ID#) + .048 MS(Error)

b. MS(Error)

Expected Mean Squares[a,b]

Source	Variance Component		
	Var(ID#)	Var(Error)	Quadratic Term
Intercept	5.741	1.000	Intercept, Activity Level * Bra, Activity Level, Bra
Activity Level * Bra	.000	1.000	Activity Level * Bra
Activity Level	.000	1.000	Activity Level * Bra, Activity Level
Bra	.000	1.000	Activity Level * Bra, Bra
ID#	6.029	1.000	
Error	.000	1.000	

a. For each source, the expected mean square equals the sum of the coefficients in the cells times the variance components, plus a quadratic term involving effects in the Quadratic Term cell.

b. Expected Mean Squares are based on the Type III Sums of Squares.

Estimated Marginal Means

1. Activity Level

Estimates

Dependent Variable: ATTRACTIVENESS

Activity Level	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High	4.504	.194	4.106	4.903
med-low	5.106	.214	4.665	5.547

Pairwise Comparisons

Dependent Variable: ATTRACTIVENESS

(I) Activity Level	(J) Activity Level	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
High	med-low	-.602	.307	.061	-1.233	.030
med-low	High	.602	.307	.061	-.030	1.233

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable: ATTRACTIVENESS

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	2.003	1	2.003	3.839	.061
Error	13.567	26	.522		

The F tests the effect of Activity Level. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

2. Bra

Estimates

Dependent Variable: ATTRACTIVENESS

Bra	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
proto	5.003	.194	4.604	5.402
fav	4.608	.192	4.214	5.002

Pairwise Comparisons

Dependent Variable: ATTRACTIVENESS

(I) Bra	(J) Bra	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
proto	fav	.395	.276	.164	-.172	.962
fav	proto	-.395	.276	.164	-.962	.172

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable: ATTRACTIVENESS

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	1.069	1	1.069	2.049	.164
Error	13.567	26	.522		

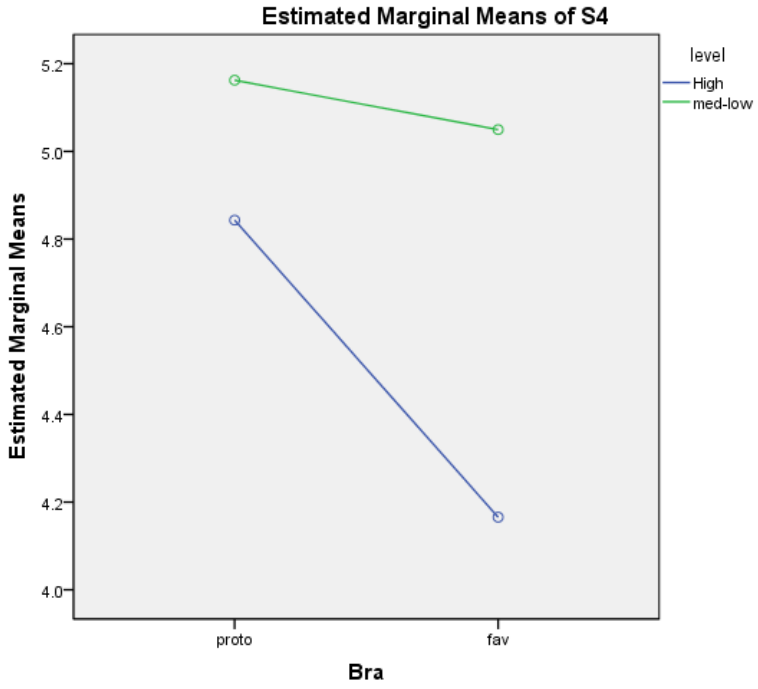
The F tests the effect of Bra. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

3. Bra * Activity Level

Dependent Variable: ATTRACTIVENESS

Bra	Activity Level	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
proto	High	4.843	.226	4.380	5.307
	med-low	5.162	.351	4.441	5.883
fav	High	4.166	.305	3.538	4.793
	med-low	5.050	.244	4.549	5.550

Profile Plots



Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
Activity Level	1.00	High	19
	2.00	med-low	15
Bra	1.00	proto	18
	2.00	fav	16
ID #	EC100		7
	EC101		4
	EC103		7
	EC105		8
	EC113		8

Tests of Between-Subjects Effects

Dependent Variable: MOVEMENT

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	1030.813	1	1030.813	260.681	.000
	Error	16.461	4.163	3.954[a]		
Activity Level * Bra	Hypothesis	.225	1	.225	.138	.714
	Error	42.528	26	1.636[b]		
Activity Level	Hypothesis	.774	1	.774	.473	.498
	Error	42.528	26	1.636[b]		
Bra	Hypothesis	.196	1	.196	.120	.732
	Error	42.528	26	1.636[b]		
ID#	Hypothesis	16.283	4	4.071	2.489	.068
	Error	42.528	26	1.636[b]		

a. .952 MS(ID#) + .048 MS(Error)

b. MS(Error)

Expected Mean Squares[a,b]

Source	Variance Component		
	Var(ID#)	Var(Error)	Quadratic Term
Intercept	5.741	1.000	Intercept, Activity Level * Bra, Activity Level, Bra
Activity Level * Bra	.000	1.000	Activity Level * Bra
Activity Level	.000	1.000	Activity Level * Bra, Activity Level
Bra	.000	1.000	Activity Level * Bra, Bra
ID#	6.029	1.000	
Error	.000	1.000	

a. For each source, the expected mean square equals the sum of the coefficients in the cells times the variance components, plus a quadratic term involving effects in the Quadratic Term cell.
b. Expected Mean Squares are based on the Type III Sums of Squares.

Estimated Marginal Means

1. Activity Level

Estimates

Dependent Variable: MOVEMENT

Activity Level	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High	5.805	.343	5.100	6.511
med-low	6.179	.380	5.399	6.959

Pairwise Comparisons

Dependent Variable: MOVEMENT

(I) Activity Level	(J) Activity Level	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
High	med-low	-.374	.544	.498	-1.491	.743
med-low	High	.374	.544	.498	-.743	1.491

Based on estimated marginal means
a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable: MOVEMENT

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	.774	1	.774	.473	.498
Error	42.528	26	1.636		

The F tests the effect of Activity Level. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

2. Bra

Estimates

Dependent Variable: MOVEMENT

Bra	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
proto	5.908	.344	5.201	6.614
fav	6.077	.339	5.379	6.774

Pairwise Comparisons

Dependent Variable: MOVEMENT

(I) Bra	(J) Bra	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
proto	fav	-.169	.489	.732	-1.174	.835
fav	proto	.169	.489	.732	-.835	1.174

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable: MOVEMENT

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	.196	1	.196	.120	.732
Error	42.528	26	1.636		

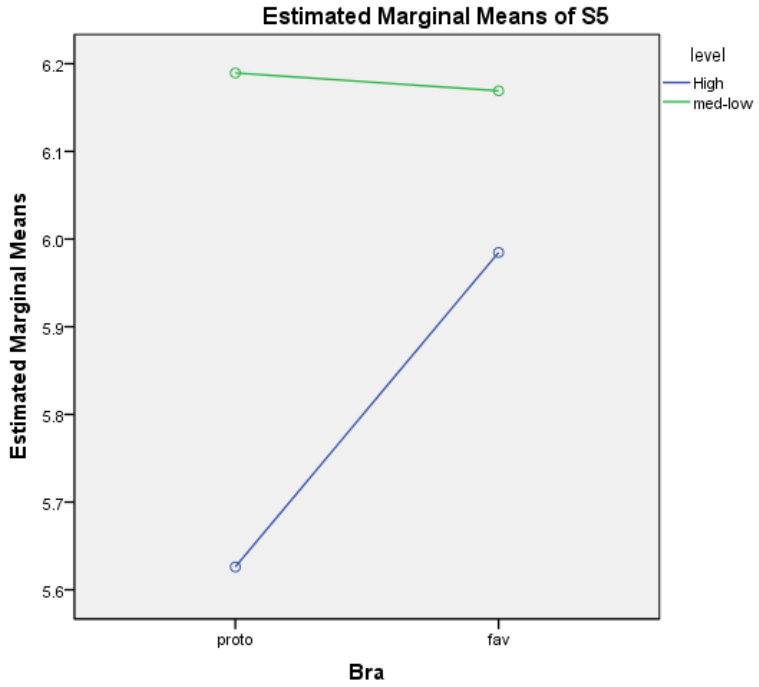
The F tests the effect of Bra. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

3. Bra * Activity Level

Dependent Variable: MOVEMENT

Bra	Activity Level	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
proto	High	5.626	.399	4.805	6.447
	med-low	6.189	.621	4.913	7.466
fav	High	5.985	.541	4.873	7.096
	med-low	6.169	.431	5.283	7.055

Profile Plots



Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
Activity Level	1.00	High	19
	2.00	med-low	15
Bra	1.00	proto	18
	2.00	fav	16
ID #	EC100		7
	EC101		4
	EC103		7
	EC105		8
	EC113		8

Tests of Between-Subjects Effects

Dependent Variable: DON/DOFF

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	898.335	1	898.335	65.149	.001
	Error	55.635	4.035	13.789[a]		
Activity Level * Bra	Hypothesis	.146	1	.146	.117	.735
	Error	32.396	26	1.246[b]		
Activity Level	Hypothesis	6.789	1	6.789	5.449	.028
	Error	32.396	26	1.246[b]		
Bra	Hypothesis	21.566	1	21.566	17.308	.000
	Error	32.396	26	1.246[b]		
ID#	Hypothesis	57.673	4	14.418	11.572	.000
	Error	32.396	26	1.246[b]		

a. .952 MS(ID#) + .048 MS(Error)

b. MS(Error)

Expected Mean Squares[a,b]

Source	Variance Component		
	Var(ID#)	Var(Error)	Quadratic Term
Intercept	5.741	1.000	Intercept, Activity Level * Bra, Activity Level, Bra
Activity Level * Bra	.000	1.000	Activity Level * Bra
Activity Level	.000	1.000	Activity Level * Bra, Activity Level
Bra	.000	1.000	Activity Level * Bra, Bra
ID#	6.029	1.000	
Error	.000	1.000	

a. For each source, the expected mean square equals the sum of the coefficients in the cells times the variance components, plus a quadratic term involving effects in the Quadratic Term cell.

b. Expected Mean Squares are based on the Type III Sums of Squares.

Estimated Marginal Means

1. Activity Level

Estimates

Dependent Variable: DON/DOFF

Activity Level	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High	5.040	.299	4.425	5.656
med-low	6.148	.331	5.467	6.829

Pairwise Comparisons

Dependent Variable: DON/DOFF

(I) Activity Level	(J) Activity Level	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
High	med-low	-1.107*	.474	.028	-2.083	-.132
med-low	High	1.107*	.474	.028	.132	2.083

Based on estimated marginal means

*. The mean difference is significant at the .05 Activity Level.

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable: DON/DOFF

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	6.789	1	6.789	5.449	.028
Error	32.396	26	1.246		

The F tests the effect of Activity Level. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

2. Bra

Estimates

Dependent Variable: DON/DOFF

Bra	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
proto	4.707	.300	4.090	5.324
fav	6.481	.296	5.872	7.090

Pairwise Comparisons

Dependent Variable: DON/DOFF

(I) Bra	(J) Bra	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
proto	fav	-1.774*	.426	.000	-2.651	-.898
fav	proto	1.774*	.426	.000	.898	2.651

Based on estimated marginal means

*. The mean difference is significant at the .05 Activity Level.

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable: DON/DOFF

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	21.566	1	21.566	17.308	.000
Error	32.396	26	1.246		

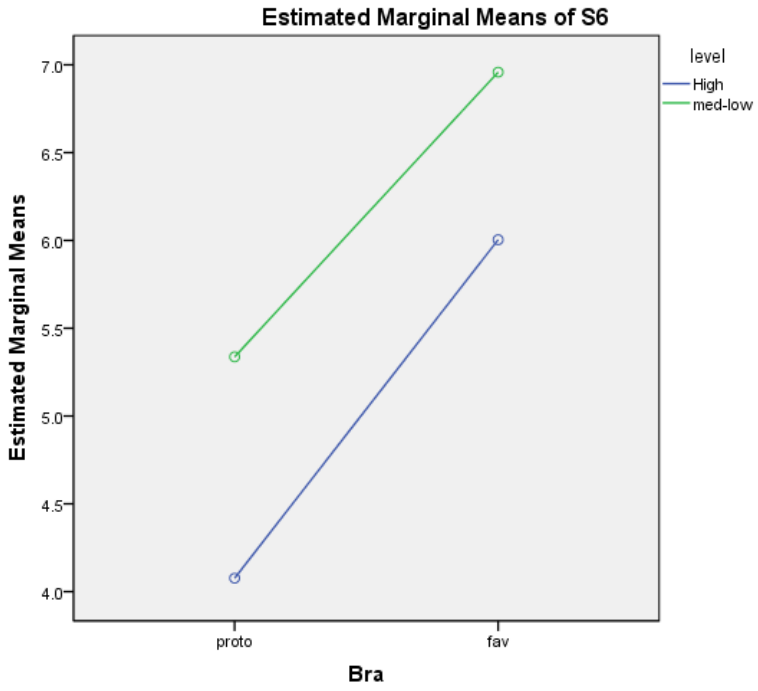
The F tests the effect of Bra. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

3. Bra * Activity Level

Dependent Variable: DON/DOFF

Bra	Activity Level	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
proto	High	4.077	.348	3.360	4.793
	med-low	5.337	.542	4.223	6.451
fav	High	6.004	.472	5.034	6.974
	med-low	6.959	.376	6.185	7.732

Profile Plots



Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
Activity Level	1.00	High	19
	2.00	med-low	14
Bra	1.00	proto	17
	2.00	fav	16
ID #	EC100		7
	EC101		3
	EC103		7
	EC105		8
	EC113		8

Tests of Between-Subjects Effects

Dependent Variable: BREATHABILITY

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	878.021	1	878.021	234.249	.000
	Error	16.124	4.302	3.748[a]		
Activity Level * Bra	Hypothesis	4.498	1	4.498	4.793	.038
	Error	23.465	25	.939[b]		
Activity Level	Hypothesis	.010	1	.010	.010	.921
	Error	23.465	25	.939[b]		
Bra	Hypothesis	6.285	1	6.285	6.696	.016
	Error	23.465	25	.939[b]		
ID#	Hypothesis	16.868	4	4.217	4.493	.007
	Error	23.465	25	.939[b]		

Tests of Between-Subjects Effects

Dependent Variable: BREATHABILITY

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	878.021	1	878.021	234.249	.000
	Error	16.124	4.302	3.748[a]		
Activity Level * Bra	Hypothesis	4.498	1	4.498	4.793	.038
	Error	23.465	25	.939[b]		
Activity Level	Hypothesis	.010	1	.010	.010	.921
	Error	23.465	25	.939[b]		
Bra	Hypothesis	6.285	1	6.285	6.696	.016
	Error	23.465	25	.939[b]		
ID#	Hypothesis	16.868	4	4.217	4.493	.007
	Error	23.465	25	.939[b]		

a. .857 MS(ID#) + .143 MS(Error)

b. MS(Error)

Expected Mean Squares[a,b]

Source	Variance Component		
	Var(ID#)	Var(Error)	Quadratic Term
Intercept	5.017	1.000	Intercept, Activity Level * Bra, Activity Level, Bra
Activity Level * Bra	.000	1.000	Activity Level * Bra
Activity Level	.000	1.000	Activity Level * Bra, Activity Level
Bra	.000	1.000	Activity Level * Bra, Bra
ID#	5.854	1.000	
Error	.000	1.000	

a. For each source, the expected mean square equals the sum of the coefficients in the cells times the variance components, plus a quadratic term involving effects in the Quadratic Term cell.

b. Expected Mean Squares are based on the Type III Sums of Squares.

Estimated Marginal Means

1. Activity Level

Estimates

Dependent Variable: BREATHABILITY

Activity Level	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High	5.937	.261	5.400	6.475
med-low	5.895	.310	5.257	6.533

Pairwise Comparisons

Dependent Variable: BREATHABILITY

(I) Activity Level	(J) Activity Level	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
High	med-low	.043	.422	.921	-.827	.912
med-low	High	-.043	.422	.921	-.912	.827

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable: BREATHABILITY

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	.010	1	.010	.010	.921
Error	23.465	25	.939		

The F tests the effect of Activity Level. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

2. Bra

Estimates

Dependent Variable: BREATHABILITY

Bra	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
proto	6.415	.288	5.822	7.009
fav	5.417	.257	4.887	5.947

Pairwise Comparisons

Dependent Variable: BREATHABILITY

(I) Bra	(J) Bra	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
proto	fav	.999*	.386	.016	.204	1.793
fav	proto	-.999*	.386	.016	-1.793	-.204

Based on estimated marginal means

*. The mean difference is significant at the .05 Activity Level.

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable: BREATHABILITY

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	6.285	1	6.285	6.696	.016
Error	23.465	25	.939		

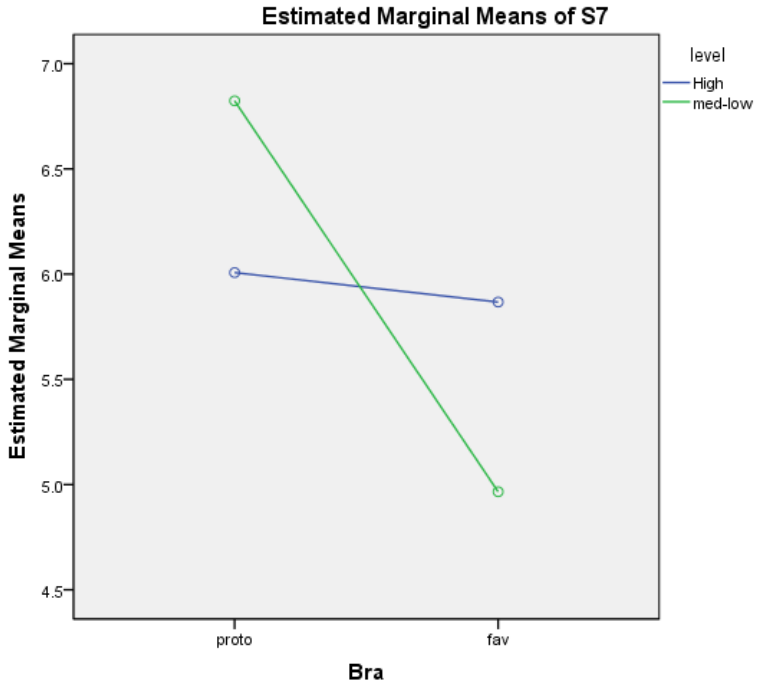
The F tests the effect of Bra. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

3. Bra * Activity Level

Dependent Variable: BREATHABILITY

Bra	Activity Level	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
proto	High	6.007	.306	5.378	6.637
	med-low	6.824	.512	5.769	7.878
fav	High	5.868	.410	5.024	6.711
	med-low	4.966	.328	4.291	5.641

Profile Plots



Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
Activity Level	1.00	High	19
	2.00	med-low	14
Bra	1.00	proto	17
	2.00	fav	16
ID #	EC100		7
	EC101		4
	EC103		7
	EC105		7
	EC113		8

Tests of Between-Subjects Effects

Dependent Variable: EASE OF NURSING

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	544.127	1	544.127	43.174	.002
	Error	52.800	4.189	12.603[a]		
Activity Level * Bra	Hypothesis	17.965	1	17.965	5.901	.023
	Error	76.107	25	3.044[b]		
Activity Level	Hypothesis	13.051	1	13.051	4.287	.049
	Error	76.107	25	3.044[b]		
Bra	Hypothesis	1.687	1	1.687	.554	.464
	Error	76.107	25	3.044[b]		
ID#	Hypothesis	54.418	4	13.605	4.469	.007
	Error	76.107	25	3.044[b]		

Tests of Between-Subjects Effects

Dependent Variable: EASE OF NURSING

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	544.127	1	544.127	43.174	.002
	Error	52.800	4.189	12.603[a]		
Activity Level * Bra	Hypothesis	17.965	1	17.965	5.901	.023
	Error	76.107	25	3.044[b]		
Activity Level	Hypothesis	13.051	1	13.051	4.287	.049
	Error	76.107	25	3.044[b]		
Bra	Hypothesis	1.687	1	1.687	.554	.464
	Error	76.107	25	3.044[b]		
ID#	Hypothesis	54.418	4	13.605	4.469	.007
	Error	76.107	25	3.044[b]		

a. .905 MS(ID#) + .095 MS(Error)

b. MS(Error)

Expected Mean Squares[a,b]

Source	Variance Component		
	Var(ID#)	Var(Error)	Quadratic Term
Intercept	5.299	1.000	Intercept, Activity Level * Bra, Activity Level, Bra
Activity Level * Bra	.000	1.000	Activity Level * Bra
Activity Level	.000	1.000	Activity Level * Bra, Activity Level
Bra	.000	1.000	Activity Level * Bra, Bra
ID#	5.854	1.000	
Error	.000	1.000	

a. For each source, the expected mean square equals the sum of the coefficients in the cells times the variance components, plus a quadratic term involving effects in the Quadratic Term cell.

b. Expected Mean Squares are based on the Type III Sums of Squares.

Estimated Marginal Means

1. Activity Level

Estimates

Dependent Variable: EASE OF NURSING

Activity Level	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High	3.732	.468	2.768	4.697
med-low	5.331	.556	4.187	6.475

Pairwise Comparisons

Dependent Variable: EASE OF NURSING

(I) Activity Level	(J) Activity Level	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
High	med-low	-1.598*	.772	.049	-3.188	-.008
med-low	High	1.598*	.772	.049	.008	3.188

Based on estimated marginal means

*. The mean difference is significant at the .05 Activity Level.

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable: EASE OF NURSING

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	13.051	1	13.051	4.287	.049
Error	76.107	25	3.044		

The F tests the effect of Activity Level. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

2. Bra

Estimates

Dependent Variable: EASE OF NURSING

Bra	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
proto	4.274	.506	3.232	5.315
fav	4.790	.463	3.836	5.743

Pairwise Comparisons

Dependent Variable: EASE OF NURSING

(I) Bra	(J) Bra	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
proto	fav	-.516	.693	.464	-1.944	.912
fav	proto	.516	.693	.464	-.912	1.944

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable: EASE OF NURSING

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	1.687	1	1.687	.554	.464
Error	76.107	25	3.044		

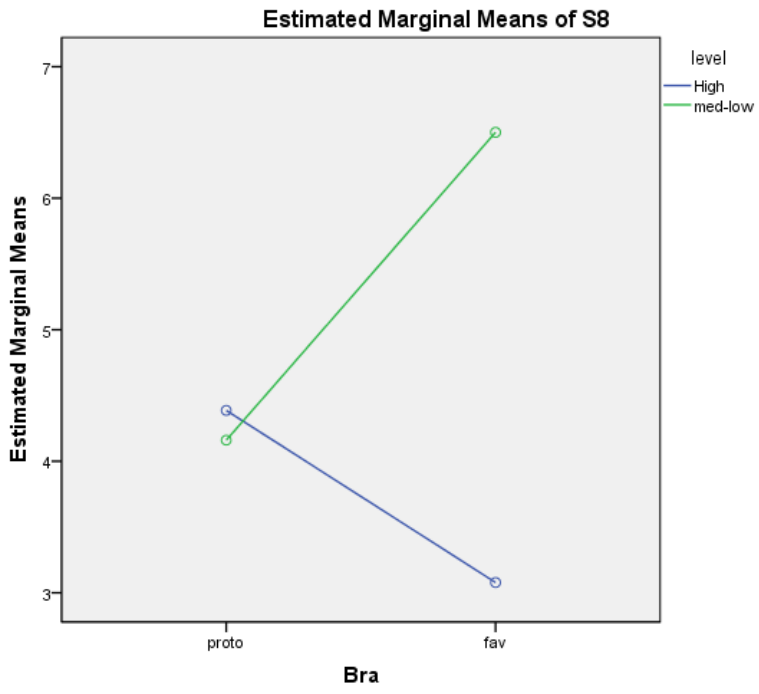
The F tests the effect of Bra. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

3. Bra * Activity Level

Dependent Variable: EASE OF NURSING

Bra	Activity Level	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
proto	High	4.387	.548	3.258	5.515
	med-low	4.161	.953	2.198	6.123
fav	High	3.078	.738	1.558	4.599
	med-low	6.501	.589	5.288	7.715

Profile Plots



APPENDIX B

CONSENT FORMS

Collaborative Apparel Product Development Research Study

Certification of Informed Consent -External Collaborator
Focus Group

Project Title: *Collaborative Apparel Product Development: Examining the Development of a Nursing Sports Bra*

Principal Investigator: *Ajoy Sarkar*, Ph.D., Colorado State University; 970-491-6740; Sarkar@cahs.colostate.edu

Co-Investigator: Juyeon Park, Ph.D., Colorado State University; 970-491-4104.Juyeon.Park@colostate.edu

Kristen Morris, B.S.; Masters of Science candidate at Colorado State University; 970-217-0526; Kristen.Morris@colostate.edu

Why am I being invited to take part in this research? You are being invited to participate in this focus group because the research team feels you could provide valuable insight to topic of producing a nursing sports bra. Your participation in this focus group is valuable because we feel that as a consumer of products similar to the one under development, you have the best understanding of the requirements of a nursing sports bra and you will be able to provide us with insightful market research.

Who is doing the study? The study is supported by Colorado State University, the Department of Design and Merchandising, and BornFit. The research will be conducted by the research team listed above.

What is the purpose of this study? The purpose of this research is to work with a team of manufacturers of apparel product and those who buy and wear the apparel. A product development process that highlights collaboration between the Client Company and end-users will be developed. The proposed process will be tested via a case study with BornFit. The case study will follow the process of the model through development of a sports bra designed for nursing women.

Where is the study going to take place, and how long will it last? The study will take place at the BornFit Headquarters in Wheatridge, and the questionnaire is expected to take 20 minutes. The focus group will be limited to 70 minutes, for a total participation time of one hour and thirty minutes.

What will I be asked to do? As a participant of this study, you will be asked to complete a questionnaire. After the questionnaire is competed you will be asked for your opinions and experiences with exercise and nursing, and the bras you wear during both activities. The format will be a focus group.

*Are there reasons why I should **not** take part in this study?* If you are under 25 years of age, if you are not active in moderate to high impact sports (i.e. running/jogging, soccer, dance, and aerobics) on a weekly basis, and if you are not planning to breastfeed for the duration of this research (three months), you should not participate in this study.

What are the possible risks and discomforts?

- Due to the nature of the focus group questions concerning personal experiences, there may be personal discomfort in answering specific questions. If you are uncomfortable with a question they are asked to tell the researcher of their discomfort. You may at any time suspend the focus group for any reason.
- If you wish to not disclose certain information on the survey, they are asked to skip the question.
- It is not possible to identify all potential risks in research procedures, but the researcher(s) have taken reasonable safeguards to minimize any known and potential, but unknown, risks.

Are there any benefits for partaking in this study? Participants of the focus group will be offered a summary of the focus group findings. The findings may help end-users of the product being developed understanding of the production process.

Do I have to take part in the study? Your participation in this research is voluntary. If you decide to participate in the study, you may withdraw your consent and stop participating at any time without penalty or loss of benefits to which you are otherwise entitled.

Who will see the information that I give? Any information that is shared with the researcher during the interview process will be treated as strictly confidential. Only the researchers identified on page one of this consent form will have access to the information you provide. We will keep private all research records that identify you, to the extent allowed by law. Your information will be combined with information from other people taking part in the study. When we write about the study to share it with other researchers, we will write about the combined information we have gathered.

In the instance where specific profiles are addressed, you will be assigned numeric codes and referred to by the code. An example of the coding to be used is *EC001* where no identifying information will be revealed. The research team will be the only people who will have access to the key of numeric codes. Upon competition of this research, the list of numeric codes will be destroyed. We may publish the results of this study; however, we will keep you name and other identifying information private.

We will make every effort to prevent anyone who is not on the research team from knowing that you gave us information, or what that information is. For example, your name will be kept separate from your research records and these two things will be stored in different places under lock and key.

Will I receive any compensation for taking part in this study?
You will receive a free BornFit tank top, and a coupon for 50% off one item on BornFit.com.

What happens if I am injured because of this research? The Colorado Governmental Immunity Act determines and may limit Colorado State University's legal responsibility if an injury happens because of this study. Claims against the University must be filed within 180 days of the injury.

What if I have questions? Before you decide whether to accept this invitation to take part in the study, please ask any questions that might come to mind now. Later, if you have questions about the study, you can contact any of the investigators from page one. If you have any questions about your rights as a volunteer in this research, contact Janell Barker, Human Research Administrator at 970-491-1655. We will give you a copy of this consent form to take with you.

Participation: Your participation in this research is voluntary. If you decide to participate in this study, you may withdraw your consent at any time. During the focus group process, you may request to skip any questions that you do not wish to answer. If you have any questions about your rights as a volunteer in this research, contact Janell Barker, Human Research Administrator at 970-491-1655.

What else do I need to know? This focus group is part of a large research strategy. The focus group is the initial start of the research, and you will be asked if you would like to participate further in the research process. Another consent form will addresses future research opportunities. It is also important that you know the focus group will be audiotape for transcription purposes.

I would like to be approached about continuing with the second stage of this research.
(Check one)

YES_____ NO_____

Participant Signature

Your signature acknowledges that you have read the information stated and willingly sign this consent form. Your signature also acknowledges that you have received, on the date signed, a copy of this document containing two pages. *Your signature also acknowledges that you have received, on the date signed, a copy of this document containing three pages.*

_____
Participant name (printed)

_____ _____
Participant signature *Date*

_____ _____
Name of person providing information to participant (printed) *Date*
Signature of Research Staff

Collaborative Apparel Product Development Research Study

Certification of Informed Consent -External Collaborator
Wear Trials

Project Title: *Collaborative Apparel Product Development: Examining the Development of a Nursing Sports Bra*

Principal Investigator: *Ajoy Sarkar*, Ph.D., Colorado State University;
970-491-6740; sarkar@cahs.colostate.edu

Co-Investigator: Juyeon Park, Ph.D., Colorado State University;
970-491-4104.Juyeon.Park@colostate.edu

Kristen Morris, B.S.; Masters of Science candidate at Colorado State University;
970-217-0526; Kristen.morris@colostate.edu

Why am I being invited to take part in this research? You are being invited to participate in the prototype evaluation of a nursing sports bra because both the research team and BornFit feel you could provide valuable insight to the usability of the prototype bras. Your participation in these wear trials are valuable because we feel that as a consumer of products similar to the one under development, you have the best understanding of the requirements of a nursing sports bra and you will be able to provide us with insightful user requirements.

Who is doing the study? The study is supported by Colorado State University, the Department of Design and Merchandising, and BornFit. The research will be conducted by the research team listed above.

What is the purpose of this study? The purpose of this research is to work with a team of manufacturers of apparel product and those who buy and wear the apparel. A product development process that highlights collaboration between the Client Company and end-users will be developed. The proposed process will be tested via a case study with BornFit. The case study will follow the process of the model through development of a sports bra designed for nursing women.

Where is the study going to take place, and how long will it last? The fittings and measurements will take place either in a private room at the Colorado State University campus, or in your private residence, whichever is most comfortable for you. You will be provided with a private space to change into the prototype bra. The fitting is expected to last 30 minutes. The wear trials will take place at your home over six trial periods, lasting no longer than a two week time span. The duration of each trial will be 60 minutes, and journaling about the wear trial should take no longer than 15 minutes.

What will I be asked to do? As a participant of the wear trials and fittings, you will be asked to meet with members of the client company no less than three times over the three month research period to express opinions and evaluate prototypes of the athletic nursing bra. One of these meetings will be to gather upper body measurements and fit the prototypes. You will then be asked to take a prototype bra home and evaluate the bra through a journal process while conducting moderate to high impact exercises for 60 minutes. The wear trial will take the course over six trial sessions within a two week time span. After the trial concludes, you will be asked to return the prototype bra and fill-out a survey where your opinions will be asked of your experience working as collaborators.

*Are there reasons why I should **not** take part in this study?* If you are under 18 years of age, if you are not active in moderate to high impact sports (i.e. running/jogging, soccer, dance, and aerobics) on a weekly basis, and if you are not planning to breastfeed for the duration of this research (three months), you should not participate in this study.

What are the possible risks and discomforts?

- If you do not feel comfortable participating in the fittings and wear trial, or experiences any mental of physical discomfort during the wear trial, you are asked to suspend the trial, and contact the researchers about their discomforts.
- Due to the nature of the wear trial questions concerning personal experiences, there may be personal discomfort in answering specific questions. If you are uncomfortable with a question they are asked to tell the researcher of their discomfort. You may at any time suspend the focus group for any reason.
- If you wish to not disclose certain information on the survey, you are asked to skip the question.
- It is not possible to identify all potential risks in research procedures, but the researcher(s) have taken reasonable safeguards to minimize any known and potential, but unknown, risks.

Are there any benefits for partaking in this study? You will be offered a summary of the research findings. The findings may help users of the product being developed understand the production process. The findings may help industry professionals understand their target market more clearly.

Do I have to take part in the study? Your participation in this research is voluntary. If you decide to participate in the study, you may withdraw your consent and stop participating at any time without penalty or loss of benefits to which you are otherwise entitled.

Who will see the information that I give? Any information that is shared with the researcher during the wear trial and survey process will be treated as strictly confidential. Only the researchers identified on page one of this consent form will have access to the information you provide. We will keep private all research records that identify you, to the extent allowed by law. Your information will be combined with information from other people taking part in the study. When we write about the study to share it with other researchers, we will write about the combined information we have gathered.

In the instance where specific profiles are addressed, you will be assigned numeric codes and referred to by the code. An example of the coding to be used is *EC001* where no identifying information will be revealed. The research team will be the only people who will have access to the key of numeric codes. Upon competition of this research, the list of numeric codes will be destroyed. We may publish the results of this study; however, we will keep you name and other identifying information private.

During the fitting process, it may be necessary to take photographs of the prototype on the body. The photographs will not be published, and no distinguishing features of the participant will be recognizable. The photographs will only be used to communicate with the manufacturer fit problems of the prototype. The photographs will in no way be used in the public domain and will be destroyed at the conclusion of the research.

We will make every effort to prevent anyone who is not on the research team from knowing that you gave us information, or what that information is. For example, your name will be kept separate from your research records and these two things will be stored in different places under lock and key.

Will I receive any compensation for taking part in this study?
You will receive a $50.00 gift certificate to BornFit.com at the conclusion of the wear trials. You must complete the research process (fittings, wear trials, exit survey) to receive the gift certificate.

What happens if I am injured because of this research? The Colorado Governmental Immunity Act determines and may limit Colorado State University's legal responsibility if an injury happens because of this study. Claims against the University must be filed within 180 days of the injury.

What if I have questions? Before you decide whether to accept this invitation to take part in the study, please ask any questions that might come to mind now. Later, if you have questions about the study, you can contact any of the investigators from page one. If you have any questions about your rights as a volunteer in this research, contact Janell Barker, Human Research Administrator at 970-491-1655. We will give you a copy of this consent form to take with you.

Participation: Your participation in this research is voluntary. If you decide to participate in this study, you may withdraw your consent at any time. During the focus group process, you may request to skip any questions that you do not wish to answer. If you have any questions about your rights as a volunteer in this research, contact Janell Barker, Human Research Administrator at 970-491-1655.

What else do I need to know? The wear trials are part of a large research strategy. The wear trial is the mid-point of the research, and participants of this portion of the research will be asked if they may be contacted at the conclusion of the wear trials for clarification of information presented during the research process. It is also important that you know the wear trial conversations may be audiotape for transcription purposes, and photographs of the fittings may be necessary to communicate with the manufacturer construction problems of the prototype. All photographs of the participants wearing the prototype will not show the face, and will not be published at the conclusion of this research.

I will participate in the fittings. (Check one)

YES_____ NO_____

I will allow the researcher to photograph me during the fittings. (Check one)

YES_____ NO_____

I will participate in wear trials. (Check one)

YES_____ NO_____

I may be contacted after the conclusion of the data collection for clarification. (Check one)

YES_____ NO_____

Participant Signature

Your signature acknowledges that you have read the information stated and willingly sign this consent form. Your signature also acknowledges that you have received, on the date signed, a copy of this document containing two pages. *Your signature also acknowledges that you have received, on the date signed, a copy of this document containing four pages.*

_____
Participant name (printed)

_____ _____
Participant signature *Date*

_____ _____
Name of person providing information to participant (printed) *Date*
Signature of Research Staff

Collaborative Apparel Product Development Research Study

Certification of Informed Consent -Internal Collaborator

Project Title: *Collaborative Apparel Product Development: Examining the Development of a Nursing Sports Bra*

Principal Investigator: *Ajoy Sarkar*, Ph.D., Colorado State University; 970-491-6740; sarkar@cahs.colostate.edu

Co-Investigator: Juyeon Park, Ph.D., Colorado State University; 970-491-4104.Juyeon.Park@colostate.edu

Kristen Morris, B.S.; Masters of Science candidate at Colorado State University; 970-217-0526; Kristen.morris@colostate.edu

Why am I being invited to take part in this research? You are being invited to participate in this research project because both the research team and BornFit feel you can provide valuable insight to the manageability of products using the Collaborative Apparel Product Development process. Your participation in these this research is valuable because we feel that as an employee of an apparel manufacturer, you have the best understanding of the requirements of producing a nursing sports bra and you will be able to provide us with insightful producer requirements.

Who is doing the study? The study is supported by Colorado State University, the Department of Design and Merchandising, and BornFit. The research will be conducted by the research committee listed above.

What is the purpose of this study? The purpose of this research is to work with a team of manufacturers of apparel product and those who buy and wear the apparel. A product development process that highlights collaboration between the Client Company and end-users will be developed. The proposed process will be tested via a case study with BornFit. The case study will follow the process of the model through development of a sports bra designed for nursing women.

Where is the study going to take place, and how long will it last? The study will take place during BornFit meetings and collaborator meetings at locations, depending on proximity of participants. The total data collection period will take place over a three month period. Each collaborative design meeting will last about 60-90 minutes. It is anticipated that over the course of the research the collaborative design team will meet four times.

What will I be asked to do? As a participant of this study, you will be asked to complete a questionnaire, which will be completed in a 15 minute time period. After you complete the questionnaire you will be asked to meet with potential buyers and/or users no less than four times over the three month research period during the development of the athletic nursing bra. After the research concluded, you will be asked to fill out a survey where opinions will be asked of your experience working as collaborators.

*Are there reasons why I should **not** take part in this study?* If you are not employed by the client company you should not participate in this research.

What are the possible risks and discomforts?

- Due to the nature of the survey questions concerning personal experiences, there may be personal discomfort in answering specific questions. If you are uncomfortable with a question you are asked to tell the researcher of your discomfort. You may at any time suspend the focus group for any reason.
- If you wish to not disclose certain information on the survey, they are asked to skip the question.
- It is not possible to identify all potential risks in research procedures, but the researcher(s) have taken reasonable safeguards to minimize any known and potential, but unknown, risks.

Are there any benefits for partaking in this study? You will be offered a summary of the research findings. The findings may help you, as industry professionals; understand your target market more clearly.

Do I have to take part in the study? Your participation in this research is voluntary. If you decide to participate in the study, you may withdraw your consent and stop participating at any time without penalty or loss of benefits to which you are otherwise entitled.

Who will see the information that I give? Any information that is shared with the researcher during the research process will be treated as strictly confidential. Only the researchers identified on page one of this consent form will have access to the information you provide. We will keep private all research records that identify you, to the extent allowed by law. Your information will be combined with information from other people taking part in the study. When we write about the study to share it with other researchers, we will write about the combined information we have gathered. Results from the surveys will not be presented to BornFit as individual results. All information will be given as a summary of averages of all the research findings. For example, results will be presented as mean scores and summaries.

In the instance where documents, specific to individual participants are necessary, the participant will be assigned numeric codes and referred to by the code. An example of the coding to be used is *EC001* where no identifying information will be revealed. The research team will be the only people who will have access to the key of numeric codes. Upon competition of this research, the list of numeric codes will be destroyed. We may publish the results of this study; however, we will keep you name and other identifying information private.

What happens if I am injured because of this research? The Colorado Governmental Immunity Act determines and may limit Colorado State University's legal responsibility if an injury happens because of this study. Claims against the University must be filed within 180 days of the injury.

What if I have questions? Before you decide whether to accept this invitation to take part in the study, please ask any questions that might come to mind now. Later, if you have questions about the study, you can contact any of the investigators from page one. . If you have any questions about your rights as a volunteer in this research, contact Janell Barker, Human Research Administrator at 970-491-1655. We will give you a copy of this consent form to take with you.

Participation: Your participation in this research is voluntary. If you decide to participate in this study, you may withdraw your consent at any time. During the focus group process, you may request to skip any questions that you do not wish to answer. If you have any questions about your rights as a volunteer in this research, contact Janell Barker, Human Research Administrator at 970-491-1655.

What else do I need to know? All interaction between the collaboration teams will be observed and audio taped for transcription purposes. You will be asked if they may be contacted at the conclusion of the research to clarify information presented during the research process.

I may be observed during this research. (Check one)

YES_____ NO_____

I may be contacted after the conclusion of the data collection for clarification. (Check one)

YES_____ NO_____

Participant Signature

Your signature acknowledges that you have read the information stated and willingly sign this consent form. Your signature also acknowledges that you have received, on the date signed, a copy of this document containing two pages. *Your signature also acknowledges that you have received, on the date signed, a copy of this document containing three pages.*

_____
Participant name (printed)

_____ _____
Participant signature *Date*

_____ _____
Name of person providing information to participant (printed) *Date*
Signature of Research Staff

APPENDIX C

SURVEY INSTRUMENTS

Department of Design and Merchandising
1150 Aylesworth Hall SE
Fort Collins, Colorado 80523-1574
(970) 491-1629
FAX: (970) 491-4855
http://www.cahs.colostate.edu/dm

Collaborative Apparel Product Development Research Study

Dear Participant,

This questionnaire is designed to assess collaborator and demographic information, and information regarding your perceptions on your current product development and collaborative product development process. This information will be used in a project as partial completion for a Master's of Science Thesis. Participant codes will be assigned to each participant, and no names will be used during the study.

Please take a few minutes to respond to the questions as accurately as possible. If you are not certain of an exact answer, please estimate as closely as possible. If you feel uncomfortable answering any question, please skip that question.

Thank you for participating in this study. Your help is valuable as a tool for this and future work in the area of functional design.

Sincerely,

Kristen Morris, Graduate Student
Co-Principal Investigator

Ajoy Sarkar, Ph.D., Professor
Principal Investigator

Internal Collaborator
Collaboration and Demographics Questionnaire (Entrance Survey)

Participant code # _____

Collaboration Questions

Please check the most appropriate answer:

1. On a scale of 1-7 what is the sponsor company's current interaction level with the target consumer?

1	2	3	4	5	6	7
Very Low	Low	Somewhat Low	Neutral	Somewhat High	High	Very High

2. On a scale of 1-7 how important, do you consider it that the sponsor company participates in collaborative design?

1	2	3	4	5	6	7
This will not Benefit our Company	Not important	Somewhat Not important	Neutral	Somewhat important	Very important	Incredibly important

Please explain why:

_____
_____
_____
_____
_____

3. On a scale of 1-7 how do you perceive the sponsor company's current product development process for efficiency?

1	2	3	4	5	6	7
Very Inefficient	Inefficient	Somewhat Inefficient	Average	Somewhat efficient	Efficient	Very efficient

Please explain why:

_____
_____
_____
_____
_____

4. On a scale of 1-7 how do you perceive the sponsor company's current product development process for addressing your target markets needs?

1	2	3	4	5	6	7
Very Inefficient	Inefficient	Somewhat Inefficient	Average	Somewhat efficient	Efficient	Very efficient

Please explain why:

_____
_____
_____
_____
_____

5. On a scale of 1-7 how do you perceive efficiency of current design collaboration with consumers?

1	2	3	4	5	6	7
Very Inefficient	Inefficient	Somewhat Inefficient	Average	Somewhat efficient	Efficient	Very efficient

Please explain why:

_____
_____
_____
_____
_____

6. What do you perceive as benefits to the sponsor company by using consumers in collaboration teams?

_____
_____
_____
_____
_____

7. What do you perceive as limitations to the sponsor company by using consumers in collaboration teams?

_____
_____
_____
_____
_____

Demographic Questions

8. Age: _____

9. Please check all that apply to the department for which you work within the sponsor company.
   _____Accounting
   _____Design
   _____Development
   _____Logistics
   _____Marketing
   _____ Sales
   _____Other
   _____

10. How many years have you worked in the field described above?
    _____years (please round to the nearest year)

11. Please check your relationship with the sponsor company
    _____Owner
    _____Full-Time Employee
    _____Part –Time Employee
    _____Contract/Freelance
    _____Other

12. How long have you worked with the sponsor company?
    _____years (please round to the nearest year)

13. On average, how many hours per week do you spend working for the sponsor company?
    _____ hours

Please note any additional comments:
_____
_____
_____
_____
_____

THANK YOU FOR YOUR TIME!

External Collaborator
Purchase Habits Survey

Participant code # _____

Please check the most appropriate answer

Family Questions

1. Have you given birth in the past year?
   _____YES _____NO

2. For your most recent birth, how many children did you give birth to?
   _____One Baby _____Two Babies (Twins) _____Three or more (Triplets or more)

3. Starting with your youngest child, please fill in the information below:

Number of Children	As of today, what is the age of the child?	How long did they nurse/how long do you plan to nurse?
1		
2		
3		
4		
5		
6		
7		
8		
I've had more than 9 children		

Nursing and Exercise Questions

4. When you do ***not*** have children who are nursing, how many times per week do you participate in high impact form of exercise such as running, aerobics, soccer, etc.?
   _____Less than 1 time per week
   _____1-2 times/weeks
   _____3-4 times/weeks
   _____5-6 times/weeks
   _____7-8 times/weeks
   _____8+ times/weeks

5. When you have a child who ***is*** nursing, how many times per week do you participate in high impact form of exercise such as running, aerobics, soccer, etc.?
   _____Less than 1 time per week
   _____1-2 times/weeks
   _____3-4 times/weeks
   _____5-6 times/weeks
   _____7-8 times/weeks
   _____8+ times/weeks

6. How long after you gave birth did you start participating in exercise again?
   _____
   _____

7. When you do ***not*** have a child that is breastfeeding, do you typically experience breast soreness
   _____ during exercise
   _____after exercise
   _____Any other time
   _____

8. When you have a child who ***is*** breastfeeding, do you typically experience breast soreness
   _____ during exercise
   _____after exercise
   _____Any other time
   _____

9. Has nursing influenced your participation in exercise, sports, and other activities?
   _____YES _____NO

   Please explain:
   _____
   _____

Bra Satisfaction Questions

10. Do you wear athletic bras during exercise?

When you are breastfeeding	_____YES	_____NO
When you are not breastfeeding	_____YES	_____NO

    If NO, please explain what you do wear:
    _____

11. What is your ***pre-pregnancy*** bra size?
    _____Cup Size _____Circumference

12. What is your ***current (while breastfeeding)*** bra size?
    _____Cup Size _____Circumference

13. What size athletic bra do you usually buy when you do ***not*** have a child that is breastfeeding?
    _____XSmall _____Small _____Medium _____Large _____XLarge _____XXLarge _____Other

14. What size athletic bra do you usually buy when you ***do*** have a child that is breastfeeding?
    _____XSmall _____Small _____Medium _____Large _____XLarge _____XXLarge _____Other

15. Please evaluate the ***athletic*** bra you use most often for high impact activities, If you do not use an athletic bra; please rank the bra you indicated for question 12. Circle One.

	Lowest Score			**Neutral**			**Highest Score**	
Inadequate support	1	2	3	4	5	6	7	Great Support
Terrible fit	1	2	3	4	5	6	7	Great Fit
Uncomfortable	1	2	3	4	5	6	7	Very Comfortable
Bra is unattractive	1	2	3	4	5	6	7	Bra is Attractive
Bra restricts movement	1	2	3	4	5	6	7	Bra allows full movement
Bra is hard to put on and take of	1	2	3	4	5	6	7	Bra is easy to put on and take off
Fabric gets wet and clammy	1	2	3	4	5	6	7	Fabric is breathable and keeps me cool and dry

16. Please evaluate the ***nursing*** bra you use most often. Circle One.

	Lowest Score			**Neutral**			**Highest Score**	
Inadequate support	1	2	3	4	5	6	7	Great Support
Terrible fit	1	2	3	4	5	6	7	Great Fit
Uncomfortable	1	2	3	4	5	6	7	Very Comfortable
Bra is unattractive	1	2	3	4	5	6	7	Bra is Attractive
Bra restricts movement	1	2	3	4	5	6	7	Bra allows full movement
Bra is hard to put on and take of	1	2	3	4	5	6	7	Bra is easy to put on and take off
Fabric gets wet and clammy	1	2	3	4	5	6	7	Fabric is breathable and keeps me cool and dry

Purchase Habits

17. How many bras do you own?
    Athletic Bras _____
    Nursing Bras _____

18. What do you consider to be a reasonable price for a bra?
    Athletic Bras $_____
    Nursing Bras $_____

19. Where do you shop when looking to purchase a nursing bra?
    _____ Online Stores _____Retail Stores

    What is your favorite retail or online store for nursing bras?
    _____
    _____

20. When you are purchasing a nursing bra, do you research products, or find product information?
    _____YES _____NO

    If yes, please explain where you go for product referrals (i.e. word of mouth, internet, and publications/blogs):
    _____
    _____

21. When you shop for a nursing bra, do you typically find what you are looking for?
    _____Yes, I find exactly what I am looking for
    _____Yes, but not the brand/size/color/etc.
    _____I find a related product but not what I wanted
    _____No, I don't find what I am looking for

    If you typically do not find exactly what you want, please explain what you are looking for in a nursing bra:
    _____
    _____

21. When you shop for a piece of athletic apparel, including a sports bra, do you prefer solid colored fabrics or printed fabrics?
    _____Solid Colored Fabrics _____Printed Fabrics

22. If you prefer solid colored fabric, what color do you typically purchase?
    _____

PANTONE Spring 2010 Color Forecasts

23. To what extent to you consider each color (below) attractive for athletic apparel?

	Very Unattractive			Neutral			Very Attractive
Turquoise	1	2	3	4	5	6	7
Tomato Pure	1	2	3	4	5	6	7
Fusion Coral	1	2	3	4	5	6	7
Violet	1	2	3	4	5	6	7
Tuscany	1	2	3	4	5	6	7
Aurora	1	2	3	4	5	6	7
Amparo Blue	1	2	3	4	5	6	7
P. Champagne	1	2	3	4	5	6	7
Dried Herb	1	2	3	4	5	6	7
Eucalyptus	1	2	3	4	5	6	7
White	1	2	3	4	5	6	7
Black	1	2	3	4	5	6	7

24. Of all the individual colors, which three do you believe are most attractive for athletic apparel? (Write down the name of the color by each choice below)

Most attractive
(Color name) _____

Second most attractive
(Color name) _____

Third most attractive
(Color name) _____

FLORAL
Patterns which depict a floral garden.

GEOMETRIC
Textile designs which represent an abstract or non-representational motif.

NOVELTY
Patterns which depict a real creature or object.

ETHNIC
Any pattern or style with a foreign or exotic feeling.

ART MOVEMENT
Textile designs which are part of an art movement.

25. Based upon your perceptions of the five print categories (below), to what extent do you consider each print category as attractive for athletic apparel?

	Very Unattractive			Neutral			Very Attractive
Floral	1	2	3	4	5	6	7
Geometric	1	2	3	4	5	6	7
Novelty	1	2	3	4	5	6	7
Ethnic	1	2	3	4	5	6	7
Art Movement	1	2	3	4	5	6	7

26. Of the categories of patterns, which one do you believe is most attractive for athletic apparel? (Write down the name of the pattern by each choice below)

Most attractive
(Pattern group name) _____

Why?_____
_____
_____
_____
_____
_____

Demographic Questions

27. Age: _____

28. Please check the best answer for your education level.
    _____Some High School
    _____High School Diploma
    _____Some College
    _____Certificate Degree
    _____Associates Degree
    _____Bachelors Degree
    _____ Masters Degree
    _____PhD

29. What is your occupation?
    _____
    _____

30. Please check the best answer for your combined family income.
    _____Less $10,000
    _____$10,000 -$29,000
    _____$30,000 - $49,000
    _____$50,000 - $69,000
    _____$70,000 - $89,000
    _____$90,000- $109,000
    _____$110,000 +

31. Approximately how much did you spend on clothing purchases for yourself in the year 2009?
    _____$499 or less
    _____$500-999
    _____$1,000-1,999
    _____$2,000-2,999
    _____$3,000-3,999
    _____$4,000-4,999
    _____$5,000 +

THANK YOU FOR YOUR TIME AND CONSIDERATION!

Department of Design and Merchandising
1150 Aylesworth Hall SE
Fort Collins, Colorado 80523-1574
(970) 491-1629
FAX: (970) 491-4855
http://www.cahs.colostate.edu/dm

Dear Participant,

This final questionnaire is designed to assess both internal and external collaborators experiences throughout the research process, regarding your perceptions on the current product development process. This information will be used in a project as partial completion for a Master's of Science Thesis. Participant codes will be assigned to each participant, and no names will be used during the study.

Please take a few minutes to respond to the questions as accurately as possible. If you are certain of an exact answer, please estimate as closely as possible. If you feel uncomfortable answering any question, please skip that question.

The completion of this survey concludes the research process. On behalf of the entire research team, we would like to sincerely thank you for participating in this study. Your help has been a valuable as a tool for this and future work in the area of functional design.

Sincerely,

Kristen Morris, Graduate Student
Co-Principal Investigator

Ajoy Sarkar, Ph.D., Professor
Principal Investigator

Collaborator Experience Survey (Exit Survey)

Participant code # _____

Participant Type: ☐ Internal Collaborator ☐ External Collaborator

Please check the most appropriate answer

Personal Experience

1. On a scale of 1-7 how would you rate your experience working in the collaboration teams?

1	2	3	4	5	6	7
Very unpleasant	Unpleasant	Somewhat unpleasant	Neutral	Somewhat enjoyable	Enjoyable	Very enjoyable

Please explain why:

_____
_____
_____

2. On a scale of 1-7 how important do you consider it to be that this company continues participate in collaborative design?

1	2	3	4	5	6	7
This will not Benefit our Company	Not important	Somewhat Not important	Neutral	Somewhat important	Very important	Incredibly important

Please explain why:

_____
_____
_____

Efficiency of Process

3. On a scale of 1-7 how do you perceive the efficiency of development on this project?

1	2	3	4	5	6	7
Very Inefficient	Inefficient	Somewhat Inefficient	Average	Somewhat efficient	Efficient	Very efficient

Please explain why:

_____
_____
_____

4. What tools/documents/instruments would be helpful in improving efficiency in collaborative product development?

_____
_____
_____
_____
_____

Effectiveness of Process

5. On a scale of 1-7 how did you perceive this form of collaboration for addressing the target markets needs?

1	2	3	4	5	6	7
Very Inefficient	Inefficient	Somewhat Inefficient	Average	Somewhat efficient	Efficient	Very efficient

Please explain why:

_____
_____
_____

6. On a scale of 1-7 do you feel the product developed in the case study meets the needs of the consumers?

1	2	3	4	5	6	7
Did not meet the needs	Unwell	Somewhat unwell	Average	Somewhat well	Well	Very Well

Please explain why:

_____
_____
_____

7. Now that the research has concluded, what do you perceive as benefits to your company by using consumers in collaboration teams?

_____
_____
_____
_____
_____

8. Now that the research has concluded, what do you perceive as limitations to your company by using consumers in collaboration teams?

_____
_____
_____
_____
_____

Please note any additional comments:

_____
_____
_____
_____
_____

This questionnaire concludes this research!
THE WHOLE RESEARCH TEAM THANKS YOU FOR YOUR TIME AND INSIGHT!

APPENDIX D

WEAR TRIAL JOURNAL

Department of Design and Merchandising
1150 Aylesworth Hall SE
Fort Collins, Colorado 80523-1574
(970) 491-1629
FAX: (970) 491-4855
http://www.cahs.colostate.edu/dm

Wear Trial Journal

External Collaborator

Participant code # _____

Proto # _____

To ensure that your efforts are utilized in the most effective manner, please use the following guidelines to help you fill out this wear test journal.

- You will be asked to wear and evaluate the prototype bra for 3 days and alternate the prototype bra with your 'favorite bra' for 2 days.
- You will also be asked to fill out an evaluation form for the bra you wear for non-athletic activities for two days.
- Seven total wear trials will occur over the course of two weeks.
- Day 1 is the first occasion you wear and test the bra. Day 2 is the second time, and so on.
- Under comments, include anything unusual regarding the garment or any deviation from its original status that you have noticed.
- Please be as specific and complete as possible.

Thank you again, for participation in this study. Your help is valuable as a tool for this and future research in the area of product development.

Sincerely,

Kristen Morris, Graduate Student
Co-Principal Investigator

Ajoy Sarkar, Ph.D., Professor
Principal Investigator

Wear Trial Journal

DAY ___

Date: _____

Type of Activity: _____

Level of Activity: ☐ High impact (i.e. running, playing soccer) ☐ Medium impact (i.e. hiking, cycling) ☐ Low impact (i.e. yoga, walking)

Bra Tested: ☐ Prototype Bra ☐ 'Favorite Bra' ☐ Non-athletic bra

What type of bra is the 'favorite bra'?

☐ Sports Bra ☐ Nursing Bra ☐ Nursing Sports Bra

☐ Other_____

Please rate the bra on the following scale as to how the prototype felt today and for how the bra performed. (Circle the number that best evaluates your experience)

	Lowest Score			**Neutral**			**Highest Score**	
Inadequate support	1	2	3	4	5	6	7	Great Support
Terrible fit	1	2	3	4	5	6	7	Great Fit
Uncomfortable	1	2	3	4	5	6	7	Very Comfortable
Bra is unattractive	1	2	3	4	5	6	7	Bra is Attractive
Bra restricts movement	1	2	3	4	5	6	7	Bra allows full movement
Bra is hard to put on and take of	1	2	3	4	5	6	7	Bra is easy to put on and take off
Fabric gets wet and clammy	1	2	3	4	5	6	7	Fabric is breathable and keeps me cool and dry
Nursing is difficult	1	2	3	4	5	6	7	Nursing is easy in this bra

Comments:

_____

_____

_____

_____

_____

Wear Trial Journal

Washing Instructions

Please follow the below washing recommendations when laundering the prototype bra.

Variables	What to do
Load Size	Wash prototypes with a small load of laundry; like colors
Wash Cycle	Delicate Cycle
Water Temperature	Cotton Setting, or cold wash/cold rinse
Detergent	Your normal detergent; recommended amount by detergent manufacturer
Softener	No softener
Drying	Lay flat to dry, do not blow air on the prototype

You may wash the bra as frequently as you feel necessary!!

1. *Did you notice any changes after you washed and dried the bra for fit, comfort, usability?*

   Wash 1: _____
   Wash 2: _____
   Wash 3: _____
   Wash 4: _____
   Wash 5: _____

2. *Did you notice any changes to the fabric, elastics, construction after you washed and dried the bra?*

   Wash 1: _____
   Wash 2: _____
   Wash 3: _____
   Wash 4: _____
   Wash 5: _____

3. In total, how many times was the prototype bra washed and dried? _____

APPENDIX E

RECRUITMENT POSTER

nursing Moms

you can be the DESIGNER

in the development of a NURSING SPORTS BRA

Colorado State University

RESEARCH STUDY

THIS RESEARCH IS APPROVED BY THE HUMAN RESEARCH COMMITTEE

criteria:

1. FEMALE AGE 20-40
2. CURRENTLY BREASTFEEDING
3. PARTICIPATE IN RUNNING JOGGING OR SPORTS LIKE SOCCER & BASKETBALL WHILE BREASTFEEDING
4. PLAN TO BREASTFEED FOR AT LEAST 3 MORE MONTHS

SHARE YOUR THOUGHTS, EXPERIENCES, & IDEAS

WHEN:
MAY 31, 2010
6:PM

WHERE:
CSU CAMPUS
Gifford 336

WHY:
MARKET RESEARCH

HOW:
FOCUS GROUP
90 MINUTES LONG
Light refreshments will be provided

WHO:
RESEARCH TEAM FROM COLORADO STATE DEPARTMENT OF DESIGN AND MERCHANDISING

WHAT:
PURPOSE IS TO DEVELOP A NURSING SPORTS BRA SUPPORTIVE ENOUGH TO WORKOUT IN

Further design opportunities will be available at the end of the focus group Including testing prototypes and fittings.

EACH PARTICIPANT RECIEVES A FREE BORNFIT TANK
AND A 50% OFF COUPON TO BORNFIT.COM