

INNOVATIONS AND IMPROVISATIONS: A STUDY IN SPECIALIZED PRODUCT
DEVELOPMENT FOCUSED ON BUSINESS CLOTHING FOR WOMEN WITH PHYSICAL
DISABILITIES

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Clothing and Textiles

ABSTRACT

Clothing manufacturers and distributors in the current business climate need to become more flexible and willing to adapt to consumers' changing needs and preferences in order to satisfy the market (Kincade, 1995). Clothing consumers who have special needs, such as working women with physical disabilities, comprise a group who would benefit from research into specialized products focused on a small target market (Reich & Otten, 1991). However, research shows that consumers with physical disabilities do not want to be treated as a specialized group, but the same as any other consumer group (Freeman, Kaiser & Wingate, 1986). The concept of Universal Design, typically applied to spatial and product design, provides a framework within which an item of clothing could be produced to satisfy many consumers, regardless of their physical ability. If a universally-designed clothing product can be successfully produced and marketed to many types of consumers, potential benefits could exist for manufacturers, distributors and consumers.

The dissertation topic originated from the researcher's questioning the lack of easily accessible ready-to-wear clothing for consumers with physical disabilities, and was based on preliminary conversations with a few working women who encountered difficulty finding business clothing that was both functional and visually appealing. Considerable needs assessment research had already been completed in the clothing/disability area using data collected from small samples of subjects with disabilities similar in nature, but none had extended the research to include the opinions of clothing manufacturers and distributors of end-use products. The researcher envisioned a study that would encompass all parties involved in decision-making processes for a clothing product.

The qualitative research process employed multiple data collection and analysis strategies in two Phases. In Phase A, detailed information was obtained about the physical limitations, clothing needs and preferences, and clothing acquisition preferences from a group of nine working women with various upper body limitations. A prototype for an upper body garment suitable for working situations was developed and wear-tested with the original group, and with a group of working women ($n=6$) without any known physical limitations. The second part of the study, Phase B, consisted of semi-structured interviews with clothing industry personnel ($n=6$) relating to issues involved in manufacturing and distributing the prototype within the existing ready-to-wear system.

A framework for manufacturing clothing for a specific target market was explored and revised in the study. The framework demonstrated the need for in-depth user information to generate ideas for the study, and included an industry feasibility component in order to assess not only consumer but also industry issues. Both the principles of Universal Design and a framework for systemic change in the current business methodology acted as guideposts at various steps of the process. Results indicated that (a) a clinical definition of disability is not needed to collect user information for clothing product development, rather a categorization of disability's effect on the body can be used; (b) working women with a variety of disabilities can have similar clothing needs and preferences; (c) Universal Design can be a successful strategy for clothing product development; (d) constricting styles and fastenings present the greatest clothing problems regardless of subjects' disabilities; (e) a universally-designed clothing product can be visually appealing, functional, and easily manufactured within the existing clothing system; (f) marketing the product will prove to be the most challenging aspect of putting this product into the ready-to-wear system; and (g) although other distribution channels exist, consumers with physical disabilities prefer to use existing 'brick-and-mortar' retail stores to shop for their clothing. The researcher concluded that although the product development process used in this study was successful, more work could be done with clothing manufacturers and distributors to encourage them to consider this target market, and to use Universal Design as a strategy that can be applicable to all consumers, regardless of their physical abilities.

DEDICATION

This work is dedicated to my two sons, Nicholas and Thomas, who have endured a little over three stressful years of mother-as-graduate-student. Also to my husband, my mother and father in England, my 'little' brother Nick, and my godmother Pam, I also dedicate this work. Finally, to all whose lives are affected with a disability, in the hope that the positive results of this work will benefit them in some way.

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CHAPTER ONE

Introduction

The clothing product development process is a lengthy one involving many steps, from initial understanding of the potential consumer, to the final acquisition of the product by that consumer. Within the product development lifecycle, numerous decisions are made (e.g., how the product will look, what special features it will possess, how it will be manufactured, how it will be distributed to the consumer). In every case of clothing product development, two constraints exist – those of the consumer and those of the clothing industry. This study proposed to examine how the needs and preferences of a specific type of consumer could be translated into a satisfactory product and how industry decisions impacted the ultimate realization of that product. This introductory chapter provides a general background for the focused population for the study, together with an outline of purpose and objectives. Also included are the assumptions, limitations, delimitations and operational definitions that provide clarity to the text.

Background

As of the year 2000, 276,136,955 people live in the United States, and of this number, approximately 20.6%, or 54 million of them have some type of disability (U.S. Census Bureau, 2000). Physical disability, comprising just one segment of all disabilities, affects millions of people on a national level and ranges in severity from minor problems with occasional pain to incapacitation involving the loss of use of one or more limb(s).

Whatever the type of disability with which a person is affected, the surrounding environment can either positively or adversely affect quality of life. Clothing is an important facet of the human constructed environment surrounding an individual and, therefore, has bearing on quality of life (Bubolz, Eicher and Sontag, 1979). Clothing is required for three reasons: protection, comfort, and dignity. People who are affected with a physical disability might be ‘differently-abled’ (E. Braaten, personal communication, November 28, 2000), but they need clothing for the same three reasons. In spite of these needs, a review of the literature and personal experiences of the researcher have shown that, for many reasons, a person with a physical disability often finds the acquisition of suitable, ready-to-wear clothing to be

problematic and in some cases impossible. The purpose of this study was to explore the possibilities of making suitable clothing more readily available to people with physical disabilities. The objectives were to obtain information about clothing needs and preferences from a group of women with physical disabilities, use this information to test a Universal Design method of clothing product development, evaluate the women's satisfaction with a prototype, explore the ready-to-wear manufacturing and distribution issues for the prototype, and suggest further research strategies for product development and marketing. In addition, a new framework was developed, which guided the research process and provided progress in theory development for specialized product development in the clothing and textiles field.

The problem of finding suitable clothing for individuals with physical disabilities has been a topic of concern for clothing, medical, and rehabilitation researchers in the United States for over half a century. Beginning in the 1940s, clothing and medical professionals started to examine the relationship between clothing and physical disability (Cardwell, 1947; Dillingham, 1948). The bulk of this research resulted in publication of various self-help guides for the 'handicapped' and their caregivers, designed primarily to ease daily processes such as dressing and undressing. These guides also provided practical clothing solutions for other situations (e.g., wheelchair confinement, mobility using assistive devices). Self-help guides were developed for people who wished to alter existing ready-to-wear clothing, including features such as front bodice closures and neck openings, and assessment of ease for specific areas (e.g., waistband). Some of these guides also provided patterns. Subsequent research in the latter part of the 20th Century explored the psychological issues of 'functional' clothing, as clothing for people with disabilities came to be known, primarily by assessing the importance of clothing as an appearance management tool (Caldwell, 1999; Freeman, Kaiser & Wingate, 1986; Kaiser, Freeman & Wingate, 1985; Liskey-Fitzwater, Moore & Gurel, 1993). The appearance management aspect of clothing has become more important as people with disabilities have become mainstreamed into society due to federal legislation such as the Americans with Disabilities Act (ADA) of 1990.

In spite of the usefulness of this research, the formulation of a comprehensive and complete theory base for researchers in this area has not materialized and the body of work is fragmented. No consistent framework exists within which to organize and disseminate research findings and, in some cases, deficiencies exist in some areas and overlap occurs in others

(Newton, 1984-1985). Since the 1960s, researchers have investigated clothing solutions that address multiple problems (Hallenbeck, 1966; Phipps, 1977; Schwab & Sindelar, 1973), but they concluded that the nature of individually distinct disabilities appeared to defy general solutions. Researchers concluded that the development of a single method of producing clothing to satisfy a broad spectrum of physical needs is impossible (Frescura, 1963; Schwab & Sindelar, 1973; Warden & Dedmon, 1975). However, recently, new technologies in the clothing industry and new ways of approaching design problems for disability (i.e., Universal Design), suggest a re-evaluation of the view that one solution is impossible. Although the difficulty in addressing multiple needs is considerable, the formulation of a standard framework for product development for this population is still needed.

Previous research established comprehensive lists of functional attributes for specific clothing items. However, research has not placed as much emphasis on stylistic change and fashion influence on clothing for people with physical disabilities. Few studies have considered the symbolic (appearance) aspects when gathering data for product development of functional clothing. To compound this problem of styling vs. functionality, many self-help guides that were made available to the public through university extension services made their final appearance in the 1970s. The clothing in these guides is certainly functional but no longer stylish for people who are trying to fit into today's cultural milieu. Lack of current styling causes clothing symbolically to represent people with disabilities as somehow deviant from the norm, before the visual impact of disability is even considered (Lamb, 1993). Evidence exists that people, with all but the most severe physical disabilities, place value on the stylishness and fashionability of their clothing (Caldwell, 1999; Thoren, 1997). Additional research has demonstrated that many functionally designed garments are attractive but lack fashion appeal, aesthetic appeal, and situational appropriateness (Freeman, Kaiser & Wingate, 1985-1986).

In addition, many people with physical disabilities are unaware of the existence of research that can help them, and, if they are aware, putting the suggestions into practice can be burdensome for them and their caregivers. Finding a service to alter existing clothing can be time-consuming and expensive, especially if mobility is limited (E. Braaten, personal communication, November 28, 2000). Some companies manufacture specially designed functional clothing, but the people most in need of these products are sometimes the most unaware of their existence due to poor marketing methods (Schwab & Sindelar, 1973). With the

prospect not only of more people with physical disabilities being mainstreamed into American society, but also the aging of the American population, many of whom might have some form of physical disability, a need exists to improve the availability of well-fitting, stylish, ready-to-wear clothing to accommodate a group of consumers who have not traditionally been well-served by the clothing industry.

Changing Needs of the Population

During the latter part of the 20th Century, federal mandates to improve access to employment, public services, transportation, accommodations, and telecommunications resulted in a progressive integration of Americans with physical disabilities into mainstream society. The Rehabilitation Act of 1973 and the Americans with Disabilities Act (ADA) of 1990 were both signed into law with the objectives of mainstreaming Americans with disabilities, eliminating social and cultural barriers, and ending disability-based discrimination in many areas of public life (Dell Orto & Marinelli, 1995). Due to passage of the Rehabilitation Act and then the ADA, a higher percentage of Americans with physical disabilities became employed. For example, in 1991/92, 75.1 percent of people with a disability between the ages of 21 and 64 were employed. By 1997, that percentage had grown to 78.2 (McNeil, 2000). Women with physical disabilities accounted for about 19 percent of this group. In 1995, 18.1 percent of women between the ages of 21 and 64 years who used a wheelchair, were employed. Women in the same age group, needing assistance with one or more Activities of Daily Living or ADL's, e.g., dressing, had an employment rate of 21.5 percent (US Census Bureau, 1994-95). These figures, although not reflective of the total population of women with physical disabilities, suggest that a substantial population of women with disabilities (almost one quarter) was in the work force. Given the ongoing progress made by passage of the ADA, it is likely these percentages will increase. These disabled and working women are faced with a double dilemma in their search for functional and appropriate clothing. They not only encounter problems in acquiring suitable clothing from retail distributors but must also ensure that it reflects typical prescriptives for the work environment.

As a productive member of the work force, a worker with physical disabilities benefits in many ways from being employed for monetary compensation, (e.g., increased financial security and self-esteem, interaction with non-disabled co-workers, and interaction with the public)

(Kilsby & Beyer, 1996). In addition, computer-based, sedentary jobs have helped lessen the impact of mobility limitation on careers, thereby giving wage-earners with disabilities an opportunity to increase income (Kruse, Krueger, and Drastal, 1995). Accommodations have been made for workers, including the elimination of physical and non-physical barriers, which prevent them from carrying out their jobs to the best of their ability. These accommodations could also include provision and easy access to appropriate professional clothing.

Much effort has focused on improving the work environment for people with physical disabilities. Since 1990, the law requires companies of a certain size to ‘reasonably’ accommodate workers with a disability. Ergonomically designed chairs, desks, and computer workstations are becoming part of the normal working environment, not just for those covered by the ADA, but also as preventative measures for able-bodied workers, to prevent repetitive injuries such as carpal tunnel syndrome. With new legislation and employee awareness, many measures are being taken to make the workplace as ergonomically sound as possible in order to provide a comfortable working environment for both disabled and non-disabled people. Yet the concept of ‘ergonomically-sound’ clothing does not seem to have held the attention of designers. Architects, interior designers and other designers and manufacturers of products are adopting a socially responsible approach to the working environment. Clothing designers and manufacturers should also feel challenged to develop and produce suitable and comfortable business clothing for workers affected with a physical disability. Added benefits for the clothing industry might include increased profitability from a new target market and increased exposure.

Clothing for Working Women with Physical Disabilities

Facilitated by legislation (e.g., the ADA), women with physical disabilities are entering and staying in the work force (McNeil, 2000). Within the work environment, employers are mandated to make reasonable accommodations for their employees with disabilities. Typically, these accommodations include buildings that are accessible, furniture that is compliant with user needs and technological interfaces that are helpful in allowing an individual to function better on the job. Clothing is another and often overlooked facet of the work environment. Of all the environments that surround a person, clothing is in closest proximity to the body and potentially has the most impact on a person’s immediate bodily comfort (Watkins, 1984). Clothing that is appropriate for the work environment adds another dimension to the problem for women because

of the importance of professional appearance. Typically, professional or business clothing is formal in character, tailored in construction and cut to fit closer to the body than basic casual clothing (Brown & Rice, 1998). Formal tailoring of clothing has not been traditionally associated with 'functional' clothing.

Currently, limited ready-to-wear clothing choices exist in the form of websites and some catalogs for women with physical disabilities, and the choice of professional clothing is further limited. The ready-to-wear clothing industry has had difficulty addressing the basic needs of this segment of the population while maintaining profit margins due to (a) the uniqueness of almost every type of physical disability and (b) the difficulties in producing clothing to fit body types that vary from industry standards (Thoren, 1997). Clothing companies traditionally remain profitable from economies of scale (large product runs) not economies of scope (diversity of products). "Economies of scale [breadth] drive mass marketers to compete for market share, but economies of scope [depth] drive the battle for share of customer in a 1:1 environment" (Peppers & Rogers, 1997, p.140). The 1:1 environment (clothing manufacturer provides product or service to satisfy a single consumer) is not a traditional part of the US apparel industry. Clothing manufacturers typically produce large quantities of standardized products in various sizes (Solinger, 1988).

In past years, research has shown that the ready-to-wear clothing industry was not technologically advanced enough to cope with the variety of problems that people with physical disabilities presented to manufacturers and retailers (Warden & Dedmon, 1975), and that clothing companies were not interested in exploring this target market because of the limited numbers of potential consumers. However, more recently, technology in product development, manufacturing and marketing has improved the ability to address a wide variety of consumer needs. In addition, retail executives interviewed about the future of retailing generally recommended that a focus on niche markets backed by strong product development are the future of competition in the retail end of the clothing industry (Yoh & Gaskill, 1999). The number of potential consumers for the prototype developed in this study is increasing because of the ADA and the growing population of elderly people. These factors could lead to an increasing number of consumers with physical disabilities, who are in need of a wide variety of clothing solutions.

Potential Solutions

To address with any positive effect the needs of the individual with physical disabilities, the entire ready-to-wear clothing system, from design to distribution, would have to place this target consumer (hereafter referred to as the User) at the heart of the system and emerge with a product that is satisfactory to all parties involved in its development and use (Thoren, 1997). To do this, Thoren suggests that clothing companies responsible for design, production and distribution of such a product need to improve the quality of several aspects of the system, including: (a) provision of sufficient choice of suitable clothing products for a variety of situations, including work, (b) development of a system that will produce affordable and satisfactory clothing for the physically disabled consumer at both a symbolic (psychologically comfortable) and functional (easy to use) level, (c) cost-effectiveness in production and marketing, and (d) communication about available clothing products (Thoren, 1997). To address this system change, the industry must become consumer-centric and agile. Variety of choice, systemic change satisfying functional and symbolic needs, production and marketing cost efficiency, and increased communication (Thoren, 1997) are becoming familiar concepts to the U.S. clothing industry as it struggles to find niche markets to increase profitability in the face of import competition (Regan, 1997; Jones, 1999).

This study will explore the concept of Universal Design, or design for all people, as a way for companies to undertake specialized product development for the niche market of people with physical disabilities. In Universal Design, there are seven principles that should be used to guide the design and evaluation of a product. These principles are (a) equitable use, (b) flexibility in use, (c) simple and intuitive use, (d) perceptible information, (e) tolerance for error, (f) low physical effort, and (g) size and space for approach and use (Center for Universal Design, 1997). This list of guiding principles was prepared by architects, product designers and environmental design researchers, but the principles could also apply to a clothing product. In addition to these points, Null and Cherry (1996) add that a universally-designed product should be adaptable, accessible, affordable, supportive, marketable, and aesthetically pleasing, which are standards that somewhat parallel Thoren's (1997) four points for change within the clothing system. Universal Design has become a strategic research area for designers and manufacturers of the built environment (Harrison & Parker, 1998), which is also part of the human constructed

environment (Bubolz, Eicher & Sontag, 1979). As clothing products constitute another facet of this environment, their development and marketing deserve to be approached with similar sensitivity to diversity. One goal of this project is to discover whether clothing products for a specific group of Users can be efficiently designed and manufactured using this Universal Design approach.

Purpose of the Study

This study directly addresses a specialized product development problem as faced by a specific group of individuals or target consumers. These consumers are working women with physical disabilities. The women, in becoming included in a productive society, need to have comfortable and appropriate clothing to facilitate optimum job performance. Currently, limited choice exists for them in the retail environment. This study in specialized product development examines the challenges of developing a clothing product, which will satisfy their needs within the ready to wear clothing industry. The constraints of the clothing industry are explored in order to complete the total process of the product lifecycle. Within the study, Thoren's (1997) four points of systemic change are addressed because these points provide coverage of the entire product lifecycle, including increased clothing choice, development of clothing that addresses symbolic and functional levels, cost-effectiveness in production and marketing, and communication about available choices. Within the framework of assessing User needs and applying systemic change, the concept of Universal Design is explored to determine if this might be a suitable product development method for obtaining optimum satisfaction from both customer and industry. This resulting framework for specialized product development is intended to serve as a model, which could extend to a broader range of future specialized products within the ready-to-wear industry.

The specific objectives are as follows (with designation of Thoren's [1997] four aspects of systemic change in parentheses):

1. Gather detailed information about specific physical limitations, professional clothing needs, preferences and current acquisition options from a sample of working women who are affected by a variety of physical disabilities (clothing choice, functional and symbolic needs, communication).

2. Universally design an upper body clothing product using data gathered in interviews with women to produce a prototype (functional and symbolic needs).
3. Assess the success of the product with the women using wear-testing and survey evaluation (functional and symbolic needs).
4. Explore the issues embedded in production and distribution potential of the clothing product with appropriate personnel at a variety of clothing companies (cost-effectiveness in production and marketing, communication).

Assumptions, Delimitations, and Limitations

Assumptions

The researcher assumes that:

1. All participants in the study are capable of determining suitability of clothing for their work, are capable of communicating their needs and preferences to a third party, and can evaluate a finished product either by oral or written communication.
2. The information given during interviews with clothing company personnel is as accurate and truthful as possible in projecting manufacturing and distribution issues in the ready-to-wear industry for specialized clothing product development.

Delimitations

1. Physical disability in this study is only described with respect to mobility and its impact on clothing product development. Full clinical descriptions of types of disabilities are beyond the scope of this study.
2. The group of women acting as subjects in this study is representative of only the physical disabilities with which each woman is personally affected.
3. The companies used in this study are representative of themselves only as a specific segment of clothing manufacturing and marketing operations in the United States.

Limitations

1. This study does not attempt to exhaustively explore the product development, manufacturing and distribution problems of clothing for all individuals with physical disabilities.

2. Due to the small, purposive sample of Users in this study, the results are only applicable to this sample or to others with similar characteristics and are not generalizable to any larger group of individuals with physical disabilities.
3. Due to the small purposive sample of Manufacturers in this study, the results from interviews cannot be generalized further than other clothing companies within the same demographic group, which shall be defined by gross sales per annum and product characteristics.

Operational Definitions

Accessible:	Any area where physical and attitudinal barriers are removed (Null & Cherry, 1996)
A.D.L.:	Activities of Daily Living. These include: Bathing, Dressing, Feeding, Toileting, Transferring from bed or chair, Walking (Beamish, 1999).
Business Clothing:	Clothing which establishes a level of respect and authority and is suitable for professional employment (Bellinger, 1996).
Clothing Industry:	The entire clothing production and distribution system, from textile manufacture to market consulting (Diamond & Diamond, 1997).
Don:	To put on; dress in (Morris, 1975).
Doff:	To remove or take off (Morris, 1975).
Ease:	Ease is a way of facilitating clothing fit by allowing extra room at a certain point. "Ease refers to the amount of roominess in a garment...Ease is the difference between the measurements of the garment and the measurements of the body of the intended wearer" (Brown & Rice, 1998, p.144).
Functional clothing:	Clothing that has as a special feature specific utility for a particular population, (e.g., protection, thermal comfort, fit, ease of movement) (Lamb & Kallal, 1992).
Health:	The state of fitness of the body or of the mind (Webster's, 1987)

- Mobility: The state or quality of being capable of moving or being moved (Webster's, 1987)
- Physical disability: "A condition that impairs or imposes restrictions on a person's ability to function at normal or expected levels of...physical activity" (Dell Orto & Marinelli, 1995, p.257)
- Quality of life: A concept that has been viewed in several ways, including: (a) self-actualization, (b) personal utility (pleasure, happiness or desire fulfillment), (c) opulence (wealth, real income), (d) standard of living, and (e) meeting of basic needs (having, loving, being) (Sirgy & Samli, 1995).
- Ready-to-wear: Clothing that is mass-produced, also called 'Off the rack'. "Ready-to-wear (RTW) refers to clothing produced in factories to standardized measurements" (Stone, 1999, p.179).
- Universal Design: Design suitable for all people. Includes the design of built spaces and products that can adapt to the changing needs of people as individuals, leading to their increased independence (Null & Cherry, 1996).
- Working woman: A woman employed outside the home who is in regular contact with other employees and/or other individuals, including customers and clients. This contact with the public necessitates business clothing (Cassill, 1986). The work in question here is 'bureaucratic' as opposed to 'manual' (Sahlins, 1976).

CHAPTER TWO

Review of Literature

This chapter will outline previous research in areas pertinent to specialized clothing product development. Initially, the review of literature covers the specific consumer constraints, which represent the challenge of this study. These are physical disability and working status. The chapter begins with a brief overview of disability, both general and physical. Specific classification schemes that have been used to describe disability are explained. Clarification is made about various types of physical disabilities as they apply to clothing needs. The disability description is followed by a review of clothing literature on people with physical disabilities. A brief historical perspective of research focusing on clothing as a rehabilitation and self-help tool is followed by a social/psychological perspective. This perspective is important, given the symbolic as well as functional aspects of clothing, which are highlighted in Thoren's (1997) proposal for systemic change. Research on clothing in the business/professional workplace, both for the general population and for people with disabilities, is then addressed, followed by an analysis of the fundamentals of clothing product development, manufacture and distribution for both the general population and for people with disabilities. This section addresses the product choice, production, marketing and communications aspects of Thoren's suggested changes. Finally, predictions are made incorporating potential solutions generated as a result of the literature search.

Physical Disability

General Information

Definition of physical disability.

Disability as a concept is very difficult to define or measure specifically, due to the diverse nature of its various manifestations in the human body; therefore, conceptual clarity is fundamental to the development of a working theoretical base for clothing research. In general, medical and rehabilitation literature refers to disability as "the various impacts of chronic and acute conditions on the functioning of specific physiologic systems, on basic human performance, and on people's functioning in necessary, usual, expected, and personally desired roles in society" (Jette, 1994, p.380). This definition appears to imply that disability begins with

an effect at the organ level, then at the body level, expands to affect broad aspects of human performance, and finally, impacts an individual's interaction with society.

According to the 2000 U.S. Census, 20.6% of the U.S. population, or 54 million Americans, had one or more conditions resulting in disability, leading to annual economic costs exceeding \$170 billion (U.S. Census Bureau, 2000). Physical disability is one aspect of the overall disability problem. The Americans with Disabilities Act (ADA) of 1990 defines disability as “(1) a physical or mental impairment that substantially limits one or more major life activities, (2) a record of having such an impairment, or (3) being regarded as having such an impairment” (Dell Orto & Marinelli, 1995, p.51). The vague language of the ADA demonstrates the degree of openness for variance in interpretation.

Types of physical disability.

Physical disability can manifest itself in many forms at many body levels, and can be very visible or not at all visible to outsiders. Three major origins of disability exist including congenital, developmental, and acquired, but noticeable overlaps and ambiguities exist. For example, an amputation can be caused by a developmental disease or by some type of accident (acquired disability). Table 1 demonstrates each of the three classifications and gives some common examples in each group with main characteristics and physical impacts upon the body (Dell Orto & Marinelli, 1995). Within each of the three classifications a variety of disabilities exist which affect the body in various ways.

Table 1. The Three Classifications of Disability

Condition	Definition	Physical limitations
Classification 1: Congenital origins stemming from hereditary genetic factors		
Spina bifida	Abnormal intrauterine development of the lower portion of the spinal cord	Partial or complete lower extremity paralysis and an inability to develop bowel and bladder control
Scoliosis	Lateral deviation in the normally straight vertical line of the spine	Deviations in appearance – S-curve in spine, sagging shoulders, noticeable asymmetry to upper part of body in one or more areas
Classification 2: Developmental origins diagnosed from specific symptoms that increase in severity		
Cerebral palsy	Nonprogressive malfunction of the central nervous system due to brain damage	Abnormal motor control affecting the musculoskeletal system, limited mobility and self-care skill
Rheumatoid & osteoarthritis	Inflammation of joints	Rheumatoid-chronic pain, stiffness, fatigue, appearance changes Osteo-limitations in joints of fingers, neck and lower back, hips, knees, and toes
Multiple sclerosis	Disease of the central nervous system	Motor impairment including difficulty walking, and increased fatigue
Muscular dystrophy	An inheritable chromosome-based disease with many different forms	Progressive muscular weakness and atrophy
Polio	Disease of the central nervous system	Involves stiff neck and possible paralysis, atrophy in groups of muscles, contraction and possible deformity
Hemiplegia	Stroke	Usually results in paralysis on one side of the body
Fibromyalgia	Musculoskeletal aches in the soft tissues	Decrease in muscle strength, occasional muscle spasms, chronic pain, fatigue
Classification 3: Acquired disability, occurring through accident, disease or injury		
Partial or complete paralysis	Paraplegia: paralysis of the lower limbs, part or whole of trunk - usually a result of injury to back Quadriplegia: paralysis of all four limbs and trunk - usually a result of injury to neck	Loss of use and sensation in lower body and part of trunk Loss of use and sensation in all four limbs
Amputation	Loss of one or more limbs	Loss of part of the body affected by the amputation

Note. Definitions obtained from Encyclopedia of Disability and Rehabilitation by A. E. Dell Orto, and R. P. Marinelli, (1995).

Government research and legislation on disability.

As outlined above, there are many types and causes of disability. In the United States, several government bodies exist to organize and fund treatment, rehabilitation and research. The National Institutes of Health have established the National Center for Medical Rehabilitation Research, the Department of Education funds the National Institute of Disability and Rehabilitation Research, and the U.S. Public Health Service oversees the Agency for Health Care Policy and Research. Through these, and private organizations, much time and money is devoted to improving the lives of Americans with all types of disabilities.

In the United States, many pieces of legislation have been passed to help integrate people with disabilities. Of all the pieces of legislation passed, the Acts that had the most far-reaching effects for employment issues were the Rehabilitation Act of 1973 and the Americans with Disabilities Act (ADA) of 1990. The Rehabilitation Act prohibited discrimination in federally funded programs and mandated affirmative action plans by the federal government and its contractors. This early act was a major building block for the ADA, which was signed into law with the objective of prohibiting discrimination against Americans with disabilities in “virtually every aspect of society...the ADA called for the re-creation of society over time, so that all aspects of public life are accessible to and inclusive of people with disabilities” (Dell Orto & Marinelli, 1995, p.47). The ADA is the most recent broad-reaching legal reform passed by the U.S. government, and it impacts many areas of public life.

Schemes used to explain disability.

Before exploring the interaction of clothing with disability, clarification is necessary to determine the various types of classification systems that are used to organize disability research. In order to understand the problems of the User of the clothing product, one must understand the way in which physical disability is viewed as a departure from the normal realm of functionality or as a limitation to the normal course of life events. By understanding the differences in daily living caused by disability, a clearer picture of clothing problems can be obtained.

According to Jette (1994), four schemes exist to guide research and address the whole spectrum of disability from the individual body system to social roles. These schemes seek to “delineate the major pathways from disease or active pathology to various types of functional consequences” (Jette, p.381). The four schemes were developed by Nagi (1965), the World Health Organization (WHO) (1980), the National Center for Medical Rehabilitation Research

(NCMRR) (1992), and Pope and Tarlov (1991) whose scheme was developed as a modifier to the Nagi scheme.

The first scheme, formulated by Saad Nagi (1965), begins at the level of active pathology, moves through impairment and functional limitation and ends with disability (Table 2). In the Nagi scheme, the active pathology/disease occurs at the cellular level leading to an interruption in the body's normal physiologic function. Impairment refers to loss or abnormality at the tissue, organ or body system level. Functional limitation focuses on restrictions in performance at the whole person level, while disability usually implies restrictions on a social/cultural level. These restrictions include basic activities of daily living (ADL's), (e.g., dressing and undressing), instrumental activities of daily living (e.g., shopping, light housework, managing money, using the telephone, transportation, preparing meals), social roles, social activities, and leisure activities (Jette, 1994). As dressing is considered a basic ADL, clothing factors become important to the individual at this final, social/cultural level, termed disability by Nagi (Stage Four, Table 2). Using the Nagi scheme, limitations in functioning on a social/cultural level, not the origin of the disability itself, are therefore the cause of dissatisfaction with clothing products among Users (MacDonald, Majumder & Bua-Iam, 1994).

Table 2.

Classification Schemes Showing Differences in Terminology of Stages

Scheme	Stage One	Stage Two	Stage Three	Stage Four	Stage Five
Nagi (1965)	Active pathology	Impairment	Functional limitation	Disability	
ICIDH (1980)	Disease	Impairment	Disability	Handicap	
NCMRR (1992)	Pathophysiology	Impairment	Functional limitation	Disability	Societal limitation
Pope & Tarlov (1991)	Active pathology	Impairment	Functional limitation	Disability	Quality of life

The second scheme used to guide and organize research is known as the International Classification of Impairments, Disabilities and Handicaps (ICIDH), and was developed in 1980

by Philip Wood for the World Health Organization (WHO). The stages in the ICIDH scheme conclude with handicap as the final stage (see Table 2). Handicap is a state which is generally seen as a disadvantage for a given individual and which results from an impairment or disability. The handicap limits or prevents fulfillment of a role that is normal for that individual (relative to other people). The dimensions of the handicap stage in the ICIDH include orientation, physical independence, mobility, occupation, social integration, and economic self-sufficiency (Jette, 1994). Using the ICIDH scheme, clothing could be seen as playing a part in at least three of these dimensions: physical independence, mobility, and social integration. Clothing for work, which leads to economic self-sufficiency, can also be indirectly considered a dimension of handicap as defined in the ICIDH. One problem with the ICIDH scheme is that handicap is a term currently in disfavor because of its negative connotations. However, handicap as defined in the ICIDH scheme could be alternatively defined and characterized as a quality of life limitation (Pope & Tarlov, 1991). If this revised conceptualization is an acceptable alternative, then clothing, both everyday and work clothing, could be considered a dimension of quality of life for an individual with a physical disability.

The third scheme was developed by the National Center for Medical Rehabilitation Research (NCMRR) in 1992. It extends beyond disability to include a final stage of societal limitation, which describes the impact of disability upon an individual's functioning in society (see Table 2). This societal limitation stage incorporates restrictions caused by society, or by barriers restricting achievement of a role (inadequate clothing could be seen as one such barrier). Once an individual interacts with, and becomes limited by, his or her functioning in society, the disability moves from the personal to the environment. In this case, any feelings of limitation would, therefore, emanate from the environment rather than the disability. In the NCMRR scheme, power or control over the environment (with clothing being a dimension of the near environment) should result in a diminished feeling of disability in relation to that particular role in society. If appropriate clothing can empower individuals, this should result in reduced feelings of limitation.

In each of these three schemes, major pathways lead from the disease or active pathology to the various types of functional consequences (see Table 2). In a fourth scheme, Pope and Tarlov (1991) modified the Nagi scheme (1965) by adding quality of life as an outcome, encompassing functional limitation and disability at the personal/social level. According to Pope

and Tarlov, quality of life corresponds to total well-being both in a physical and psychological sense. Their dimension of quality of life includes the following: performance of social roles, physical status, emotional status, social interactions, intellectual functions, economic status, and self-perceived or subjective health status. Used in this sense, quality of life seems to overlap the last two dimensions of Nagi's scheme, functional limitation and disability, as these tend to be measured in terms of social integration. In this case, clothing and work issues certainly have a place in a quality of life framework for individuals with physical disabilities. Clothing can be seen as a part of the quality of life component, as it operates as a facilitator of social functioning.

Using Nagi's scheme (1965) with Pope and Tarlov's quality of life adaptation (1991) or the NCMRR scheme (1992) in its original form, the disability can be traced from its pathological origin to the point where inadequate clothing impacts an individual's role. Thus, one outcome of disability is the perceived restrictions of society on the individual, or the individual's role in society described by quality of life, including aspects of employment.

Employment for People with Physical Disabilities

Much attention has been paid to the topic of employment for people with all types of disabilities since passage of the ADA. Title I of the ADA was designed to prevent employers from discriminating against people with disabilities who are qualified for a specific job. All conditions of employment were covered, including job recruitment, the hiring process, job advancement and termination. In addition, employers became bound by law to provide reasonable accommodations for the employee unless it would impose an undue burden on the employer's business operations (Dell Orto & Marinelli, 1995). The vague wording of this and many other components of the ADA has left fulfillment of many aspects of this act in the hands of the judicial systems, with many court cases between individuals and industry, and local, state and federal government (American Bar Association, 2001). Despite the legal disputes, much progress has been made for workers with disabilities in the United States since the ADA, and public awareness of the challenges faced by both employers and employees has increased.

For many years before ADA was passed, state and private rehabilitation programs in the United States trained and placed people with many levels of disability in various jobs. Today, many people with disabilities are capable of being fully employed. There are an estimated 31.1 million working-age people with disabilities, of whom only 160,000 can clearly be ruled out of

employment participation because of incapacitation (Kruse, 1997). The employment rate for people with non-severe disabilities is almost as high as for those without any disabilities (74.1 percent compared with 74.8 percent). However, for those with severe disabilities, this figure drops to 24.5 percent. Within the general category of disability, employment rates are much lower for people with mobility impairments, which may come under the category of severe disability when considering employment (Kruse). A severe disability is defined when the person: (a) uses a wheelchair, (b) has used a cane, crutches, or walker for more than six months, (c) receives Supplemental Security Income (SSI) or is covered by Medicare, (d) is unable to perform a functional activity, (e) needs assistance with an ADL, (f) reports being prevented from work or housework, (g) has mental retardation, Alzheimer's, senility, dementia, or (h) has a developmental disability such as autism or cerebral palsy. Differences also exist between the types of jobs in which people with disabilities are employed. About 50 percent of this demographic group is likely to be employed in white-collar jobs (i.e., managerial, professional, technical, sales, and clerical categories) compared with 58.7 percent of people without disabilities. The percentage difference between disabled and non-disabled is greatest in the professional category (Kruse).

The benefits of employment for individuals with physical disabilities can be counted in both economic and social/psychological terms. Job placement takes people with disabilities off Social Security, and increases tax revenues generated from their income. An unfortunate drawback to employment among people with disabilities is the threat of losing federal medical benefits once full-time employment and, therefore, 'living wages' are gained. To combat this perception, in November of 1999, President Clinton signed into law the Work Incentives Improvement Act (Williams, 2000). This Act provides millions of people with disabilities the right to Federal health insurance and removes any benefits problems that had previously kept them from seeking full-time employment. These problems included not earning enough money to participate in an employee benefit scheme or having pre-existing conditions that an insurance carrier would not cover. President George W. Bush, in his second week of office, asked Congress to spend \$880 million over a five-year period to fund development of new technologies and low-interest loan programs to buy equipment to help Americans with disabilities improve their lives and create new job opportunities. Bush said of his proposals; "We must speed up the day when the last barrier has been removed to full and independent lives for every American

with or without disability” (McQuillan, 2001, p.8). These efforts demonstrate real attempts to combat a variety of challenges that might otherwise keep a person with a disability from looking for employment.

Social/psychological benefits to employment include a feeling of dignity and independence (Feinberg, 1980). Through work, people are given a chance to accomplish their goals and exercise control over their lives. The ADA is designed to give people power to improve their quality of life through employment and give them a fuller range of choices (Parent, 1993). Parent, in summarizing results of several studies measuring job satisfaction among disabled workers, concluded that, overall, disabled workers were satisfied with their working situation. Further, they appreciated the consistent income and consistency of work and tasks but also noted some areas that still needed improvement, one of which was the work environment. Parent found that employment for people with disabilities is important for economic self-esteem, independence, social relationships, self-worth and personal identity. These findings relate to Pope and Tarlov’s (1991) dimensions of quality of life for people with disabilities, demonstrating that working leads to some increased quality of life dimensions for this demographic group. In addition, selective ‘matching’ to a job is an important factor (i.e., any job for a person with a disability is not necessarily a good job).

Employment integration for individuals with disabilities is largely a function of the cultural environment, business and otherwise, and occurs slowly as cultural views change (Taylor & Bogdan, 1993). Large corporations pioneer work in developing and implementing diversity programs to employ disabled people. A survey by the Society for Human Resource Management (Williams, 2000) found that 68 percent of Fortune 500 companies are actively seeking to recruit employees with disabilities. In the fall of 1999, one such company, Microsoft, sponsored an ‘Able to Work’ conference in Redmond, WA, to lead a group of 21 major North American corporations in hiring people with disabilities and to share strategies aimed at finding jobs for people with disabilities. The US Chamber of Commerce and the President's Committee on Employment of People with Disabilities (PCEPD) co-sponsor the Business Leadership Network (BLN), an organization of roughly 500 business leaders who have been successful in hiring people with disabilities and are willing to share successes with other employers. The US government has vigorously promoted the hiring of federal employees with disabilities throughout the United States. A new federal program, known as ‘Accessing Opportunities’, will focus on

“increasing the employment of people with disabilities by the federal government - the largest U.S. employer with nearly 1.8 million workers” (Williams, 2000, paragraph 11). These types of efforts suggest a greater need for suitable clothing for the workplace.

Obviously, although employer participation varies in its compliance with ADA regulations, people with physical disabilities are now actively taking part in the total economic productivity of the United States in large numbers. They are entitled by law to every reasonable accommodation, including the elimination of barriers, both physical and non-physical, so that they can carry out their job and improve their quality of life. This entitlement should also include improving choices for appropriate business clothing, a part of the environment closest to them and, therefore, a dimension of quality of life.

The Impact of Physical Disability on Clothing

Physical disability affects the type of clothing that can be worn. The extent of the effect depends on the type of disability, the degree of physical limitation, and the body part(s) affected by the disability. Due to the numerous variations of physical disability that exist, identifying a framework within which clothing issues might be clearly defined and organized is a complex but necessary process. Newton (1984-85) developed a system for classifying existing research based on Bloom's (1956) domain taxonomy, which groups research into three domains: cognitive, affective and psychomotor. However, no attempt was made to further define motor concepts within the latter category to provide a systematic breakdown of limitations. In fact, Newton placed the fewest existing studies into this category, perhaps showing unwillingness on the part of clothing researchers to address the multiple challenges that motor skill assessment presents. Newton had reservations about the clarity of research on clothing solutions, and highlighted repetitive and overlapping research as drawbacks to a consistent system of research and application. A significant outline of diseases or injuries related to disabling conditions was prepared by Yep (1976). Yep specified the disabling conditions related to clothing for several types of situations. For example, the disabling conditions for multiple sclerosis were listed as: limited sense of balance, large muscle incoordination, excess movement (tremor), limited strength and endurance, incontinence, sensory loss and visual impairment.

One significant effect of disability is to restrict or impede mobility. Mobility is also a significant issue for clothing product development. A certain amount of ease in clothing is

necessary for donning and doffing, manipulating fasteners, adjusting clothing once it is on the body, and comfortable movement, so that the individual does not have to work against their clothing (Watkins, 1984). This study will not address additional clothing-related mobility issues (e.g., doing laundry, folding clothes, reaching into closets), which are peripheral to the process of product development, but can be considered as post-consumption phases of the clothing product life-cycle.

Body mobility is a complex chain of events involving the nervous and musculoskeletal systems, which work together to produce movement in various parts of the body (Watkins, 1984). Movement of the body takes place around freely movable joints, and involves a multitude of lever systems using bones, muscles, tendons and ligaments. Physical disability can affect any part of this or the central nervous system resulting in a restraint in range of motion. Clothing must work with the body's movements during the course of a day, expanding and contracting in a similar way to the body. If clothing impedes the normal range of body movements, physical and mental fatigue can result (Watkins). Clothing can be made more mobile in relation to an individual's specific needs by either varying the construction or by using materials that facilitate certain kinds of movement.

All individuals, with or without a physical disability, have a slightly different range of gross motor skills necessary for donning and doffing clothing and small motor skills impacting dexterity in manipulating fasteners (e.g., zippers, buttons). Watkins (1984) suggests that when starting to design clothing that will aid mobility, the designer should "gather all the available information possible about the individuals and the activity involved. Then the body movements that are observed can be translated into garment specifications" (p.183).

In order to organize the wide variety of mobility issues affecting people with physical disabilities to aid in clothing research, a dedicated classification system is necessary which directly addresses these mobility issues. The U.S. Census Bureau (2000) uses a taxonomy that categorizes data collected about disabilities in the national census, where physical disability is classified within a general *Disability* grouping, under the subheading of *Motor*. However, some of the subcategories used under the Motor subheading overlap, the wording is ambiguous, and there are no clear definitions to determine mobility issues for clothing research. The system does not address mobility any further than 'activity limitations'. A more concise, distinct classification system is needed to help clothing designers and manufacturers systematically

group physical limitations into manageable and mutually exclusive segments. Systems have been developed by Yep (1977), Reich and Shannon (1980), and Newton (1984-85) to address the clothing needs of the population and to guide and organize research in this area.

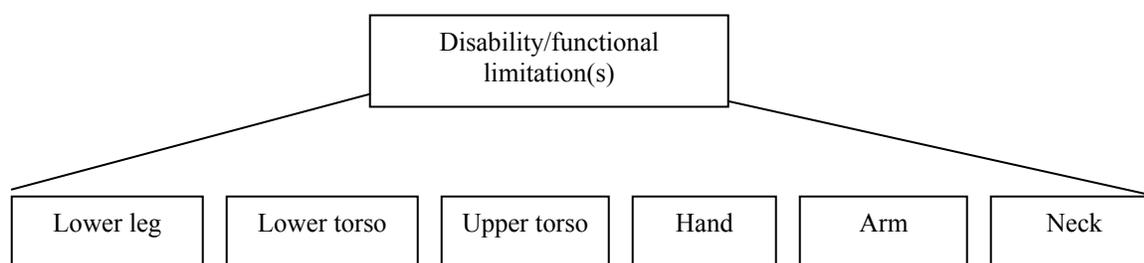
In the late 1970s, data describing the specific disabilities of distinct groups was collated for use in the broader context of disability (Yep, 1977). For example, Yep (1977) thought it prudent to review conditions present in the nature of several disabilities, to identify commonalities and thereby form groups with similar needs. Home economists and rehabilitation professionals (i.e., the primary researchers in this area at the time) would be able to categorize individuals with similar needs and distribute information on clothing solutions according to individual needs. Yep's classification system was based on a refinement of the psychomotor domain taxonomy (Harrow, 1972). The psychomotor domain taxonomy addresses motor ability, extending from basic gross fundamental movements to skilled fine motor control. This taxonomy was reworked by Yep to suit clothing issues as follows:

1. Basic fundamental movements based upon reflex movements, including resistance to movement or body stiffness, large motor movement, and simple small motor movement. In addition, conditions of special movement, such as wheelchair confinement, wearing of braces, and use of crutches.
2. Perceptual abilities enabling the individual to interpret stimuli and adjust to task or environment. This includes body awareness, sense of balance and visual discrimination, all of which have implications for dressing.
3. Physical abilities including endurance and strength, both needed for dressing, and control over incontinence and drooling.
4. Skilled movements involving complex motor manipulation, leading to complex dressing techniques such as shoe lacing.

Nevertheless, this system has been criticized because it creates "...complex groups of dissimilar handicapping conditions which do not create similar clothing and dressing needs" (Reich & Shannon, 1980, p.438). Categories created by Yep do not appear to be mutually exclusive (e.g., category one and category three could overlap) which suggests that further clarity could improve Yep's system. Reich and Shannon (1980) proposed a simpler system based on empirical data obtained from approximately 300 Arizona residents with some type of physical disability (see Figure 1). The researchers developed a grouping of six common physical

limitations (CPL's) across disabilities that would help address the clothing needs of a physically handicapped population. The causes of physical disability involved in this research were varied and included: arthritis (osteo and rheumatoid), congenital disabilities, trauma-related nerve damage and spinal cord injury. The information gathered about clothing and daily living needs led the researchers to believe that their classification system should span a number of disease categories that afflicted similar areas. One of the objectives for the study, to establish a database for the classification of groups of handicapped persons with similar CPL's across disabilities, resulted in six groups being developed. The six groups were: (a) lower leg, (b) lower torso, (c) upper torso, (d) hand, (e) arm, and (f) neck (see Figure 1).

Figure 1. Reich and Shannon's (1980) grouping of common physical limitations for clothing research.



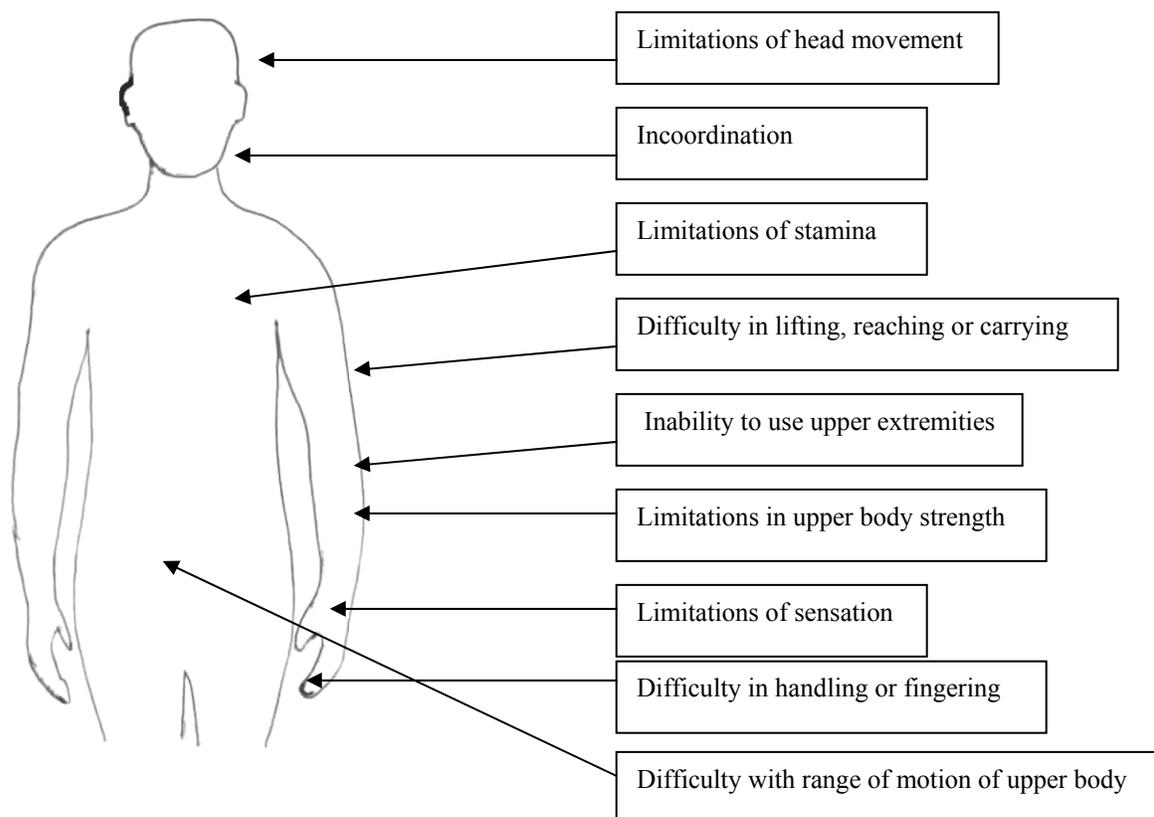
Another objective of this study was to identify clothing and dressing needs of the individuals in each group. Common problems existed in the following areas: donning and doffing, the need for assistance, manipulation of fasteners (e.g. small buttons, snaps, hooks and eyes, ties in conjunction with eyelets and lacing, belts and loops), inadequate fit in ready-to-wear, and shopping obstacles. Individual groups exhibited specific problems within these categories. Reich and Shannon suggested that the most effective categorization for clothing design is not one that defines groups by the cause of disability, but one that classifies the limitations by parts of the body affected, so that common solutions to a problem can be found. Two people might exist with different disabilities, for example, yet have similar functional limitations, and thus benefit from one clothing solution. The Reich and Shannon solution was a positive step forward for clarifying areas of concern, not only because it related mobility to clothing in a direct way, but also because it addressed other non-mobility issues (e.g., fabric

problems, shopping problems). This appeared to be a more effective solution than Yep's (1977), which grouped by mobility only, because problems other than mobility might exist (e.g., fabric type). Limitations included: (a) few types of disabilities were used to generate the categories, (b) the categories might be too broad for clothing application, and (c) some areas of the body might be left out.

Newton (1984-85) developed taxonomy for independent living to classify previous clothing research. The post-hoc research method served to organize existing work into three domains but did not attempt to provide a framework for an in-depth analysis. Newton adapted Bloom's (1956) domain taxonomy which groups research into three categories or domains; the cognitive, which contained preferences and needs, awareness, education, design and sizing; the affective, which contained attitudes, body image, and self-concept, and the psychomotor, which covered motor skills, but with little expansion useful to clothing studies. This taxonomy provided a good starting point to classify existing research. Whereas Yep (1977) and Reich and Shannon (1980) provided extensive segmentations to relate to clothing solutions, Newton's was better suited for categorizing the body of research as it is carried out. Newton admits, "The three taxonomies, cognitive, affective and psychomotor, would merit additional examination for identifying principles to develop a true taxonomy" (p. 47). The disability scheme put forward by Reich and Shannon (1980) appeared to have some merit for use in addressing clothing problems and solutions, as it placed areas of the body and limitation problems into separate distinct categories, easily understood by designers and product development personnel with little medical background or in-depth understanding of specific types of disability.

Another possibility of classifying disability for use with clothing research is presented by the Enabler system (Mueller, 1996) (see Figure 2), a Universal Design instrument that defines disabilities as combinations of limitations in various parts of the body. This system has been in existence since the 1970s for use in ergonomic design, architectural design, changes to built environments and other type of product design, but has not yet been used for clothing. The purpose of the Enabler is to simplify the medical aspects of disability and make them more comprehensible to designers. The Enabler system is an effective way of defining specific limitations in an initial data gathering phase to determine extent of limitations within the body.

Figure 2. The Enabler figure adapted to this study



Note. Adapted from “Universal Design Strategy” by James L. Mueller, 1996, in Universal Design: Creative solutions for ADA compliance p.107, by Null, R. L. and Cherry, K. F. (eds.).

Clothing Research for People with Physical Disabilities

This section reviews existing research on clothing for individuals with physical disabilities to date. An historical overview is given for studies carried out in the 20th Century in the United States. Initially clothing was first used as a self-help or rehabilitation tool for young children by medical and rehabilitation professionals and the User base was expanded to include adults with many different needs. Much of this early research was conducted by physical therapists, caregivers and the individuals themselves. The pattern of literature after about 1970 (the Rehabilitation Act was passed in 1973) is refined from a general overview to more distinct conceptual categories, as researchers shifted focus to the social and psychological needs of the Users (affective domain) and acquisition problems (cognitive domain).

Historical Overview of Clothing Literature

The origins of research on clothing for people with physical disabilities in the 20th Century are entrenched in the ideas of rehabilitation and self-help. Rehabilitation of individuals describes a process whereby an individual participates in improving a quality of life that has been diminished in some way by a disability. Today, during a patient's rehabilitation, a rehabilitation team including occupational therapists, rehabilitation nurses, physical therapists and counseling psychologists work together to ensure reintegration of the individual as a complete human being (Kottke, 1982) and to improve quality of life. Counseling psychologists, work evaluators, and teachers help to reintegrate the individual into society and then train or retrain individuals for a productive life. During rehabilitation, the individual is encouraged to participate in ADL's (e.g., self-care, self-transfers, dressing, bathing, eating). Ruston (1977) identified clothing as an important tool in the rehabilitation process because it facilitated the mobilization of joints and muscles, and provided practical goals in the process.

The idea of clothing as a rehabilitative tool dates to the 1930s. In children's hospitals for 'crippled' children, doctors, therapists, and nurses found that the acts of dressing and undressing improved the physical and cognitive skills of children with disabilities (Hoffman, 1979). As rehabilitation gained momentum as a necessary component of integrating a person into society, more sophisticated studies were carried out. The incorporation of clothing into a rehabilitative program was found to increase mobilization of joints and muscles. Training had been given in the 1930s to caregivers and hospital staff working with hospitalized children to assist them with donning and doffing of clothing as part of their hospital treatment. Many of these children were polio victims, and patients at purpose-built facilities, such as the Woodrow Wilson Rehabilitation Center, near Charlottesville, Virginia, the first comprehensive rehabilitation center in the nation, opened in 1947. In the 1940s, a change in philosophy involved an increase in the teaching of independence skills (Cardwell, 1947; Dillingham, 1948), and clothing was a key factor for independence training. Research focus was changing from dependence to independence.

In the 1950s, charts were used as teaching aids for handicapped children in hospitals to show them how to dress independently. Concurrent with these efforts, Mary E. Brown (1951) conducted independent research on the therapeutic value of clothing for teaching self-help skills, and started to work on special clothing designs for children with cerebral palsy to aid in skills development. Her ideas came from experiences in her mother's Montessori school in New York

City, which she had attended as a child (Hoffman, 1979). At the University of Connecticut, Eleanor Boettke investigated the development of self-help clothing for children (1956) and their parents (1957). Researchers then turned from using existing clothing as an independence tool to addressing the specific clothing problems of people with physical disabilities. In addition, during this decade, a call for increased research in Home Economics in general was made by the U.S. Department of Agriculture for extension purposes (Hallenbeck, 1966). Some investigators in clothing extension services committed themselves to exploring the needs of adult hospital and rehabilitation patients. They did this by identifying and developing aids for patient comfort, grooming, and dressing. Appropriate clothing for a broader range of 'groups', including handicapped homemakers and people with varying body types, was investigated,. The identification of 'good' functional features in ready-to-wear clothing became an important research topic, and many instructional booklets were issued by extension agencies advising how to choose and alter commercial clothing and patterns (Boettke, 1957; Davis, 1955; Scott, 1959).

The thrust of research by the end of the 1950s was still to achieve independence through clothing by developing new types of clothing. A pioneering organization in this research was the Institute of Physical Medicine and Rehabilitation in New York, where Helen Cookman was appointed to investigate clothing problems of handicapped patients (Hallenbeck, 1966). Cookman's objectives, however, went further than just helping people achieve independence. She was concerned about producing good quality and fashionable clothing for this group of adults and wanted to see items developed and tested prior to potential ready-to-wear distribution. The result of her research, after a three-year period, was a specialized line of clothing for men and women with physical disabilities. The line consisted of 17 garments, which were trial tested and then redesigned. Fabrics were mostly easy-care nylon, and the clothing items were constructed with durable techniques. Six of the designs were subsequently produced by a non-profit organization, Clothing Research, Inc., of New York City. Cookman's research, instead of changing the focus to fashion concerns in this area, resulted in the development of another self-help booklet, Functional Fashions for the Physically Handicapped (Cookman & Zimmerman, 1961), which included detailed clothing adaptations and the rationale of each adaptation to the overall design.

In the late 1950s, Clarice Scott of the U.S. Department of Agriculture Research Service conducted an in-depth survey on clothing with 70 homemakers with various types of physical

disability (Scott, 1959). Their primary disability was ambulatory, but hands, arms and shoulders were involved. The survey resulted in a compilation of the respondents' clothing likes and dislikes with respect to various styles and design features. Important factors used as guides in Scott's survey were comfort, convenience, safety, protection, serviceability, fabric and attractiveness. A government bulletin was published (Scott, 1961) that contained designs for approximately 20 women's garments, with pictures, and pertinent details about clothing construction. Three dresses, three blouses, three skirts, an indoor wrap, a bolero jacket, slacks, shorts and pedal pushers, four aprons, a dress protector and two pockets were described in detail. This was probably the first attempt to target a specific group of women in a 'functional' role and develop new clothing styles for them. All of the garments in the booklet were appropriate for the 1950s homemaker and her daily activities (e.g., cleaning, doing laundry and preparing meals).

In the early 1960s, extension home economists pioneered much research, with the focus still centered on independent living and self-help through functional clothing. Some states published extension bulletins to provide information to assist physically handicapped individuals. One of these was the Clothing News and Research Findings bulletin developed by Bernice Tharp (1964) at the Pennsylvania State University. Apart from extension services, small businesses started to focus on production of clothing for specific needs. For example, Mrs. Van Davis Odell founded Fashion-Able in New York in 1965, a business that designed and marketed undergarments for ambulatory women with disabilities. The line of undergarments came in standard sizes and included bras, girdles, slips, robes and pajamas. The business was founded on the personal needs of Mrs. Odell, who had suffered a cerebral aneurysm, which had paralyzed her left side. She subsequently had difficulty finding suitable underwear products. When she started the business, she could find no marketing research about her target customers, so she concentrated on her own needs, discovering that many others had similar problems. The business was successful, and was later expanded into a full line of women's clothing and other items to assist with ADL's, with all products available by catalogue.

Much pioneering work was completed in Cleveland, Ohio during the 1960s, at the Vocational Guidance and Rehabilitation Services, a local rehabilitation agency (Hallenbeck, 1966). The head of the sewing department, Dorothy Behrens, at the request of nursing home administrators, began producing special back opening dresses so that elderly patients would not always have to wear hospital-type gowns. In 1964, a 'Specially Designed Clothing Service'

became a permanent part of the Vocational Guidance and Rehabilitation Service with Behrens as director and designer. A mail-order catalogue was eventually produced, including a measuring chart and a price list for over 40 garments for women, men and children. The items included dresses, skirts, blouses, coats, slacks and shorts. Behrens' designs could be seen as the first 'universally' designed garments, as several special needs features were incorporated in one basic garment to serve more than one type of physical disability. For example, a dress originally designed for older incontinent women was found to be equally suitable for people confined to a wheelchair because of its full cut and overlapping skirt panel (Hallenbeck, 1966). Behrens' work is reported in more detail in this chapter in the section on suggestions for functional designs.

In addition, during the 1960s, there were an increased number of national seminars and conferences focused on clothing needs for individuals with physical disabilities. The unique aspect of these group sessions was their interdisciplinary nature. Home economists, rehabilitation workers, social service workers, as well as professionals from the U.S. Department of Health, Education and Welfare, gathered for the first time as teams with a common goal of "...restoring the handicapped to productive family and community life and to define the need for research and education programs" (Hoffman, 1979, p.30).

In the 1970s, continued interest in research in clothing as a rehabilitation tool, coincided with the passage of the Rehabilitation Act in 1973. An increase in output of theses and dissertations from major research universities focused on specific needs of individuals with varying levels of physical limitations. For example, some groups that were the subjects of study included: handicapped children (Friend, Zaccagnini & Sullivan, 1973; White & Dallas, 1977), elderly people (Phipps, 1977), homemakers with disabilities (Schwab & Sindelar, 1973), and young people with curvature of the spine (Warden & Dedmon, 1975). A percentage of this work, following the Rehabilitation Act, focused on helping therapists use clothing as a rehabilitation tool. The latter part of the 1970s included research papers of reflection and self-evaluation, as well as new directions for home economists who practiced research in the field of clothing for the physically disabled. Two conferences, one held at Virginia Polytechnic Institute and State University in 1976 and the other at the University of Alabama in 1977, provided forums for an interdisciplinary audience to explore not just the physical but also the psychological and social aspects of their work. Position statements were written evaluating current research and projecting future directions for study. The focus was towards a more in-

depth view of the problem of ‘functional’ clothing, which would provide a theoretical basis for future research.

This section presented an overview of clothing research in the United States from the 1930s to the 1970s. To summarize, initial research focused on rehabilitation aspects of clothing for the physically disabled, their care-givers and medical and rehabilitation workers, concentrating on improving skills in dressing and personal appearance. Research efforts moved beyond clothing as a self-help tool to developing more functional and stylish specialized garments, or adaptations of ready-to-wear clothing. In the latter part of this period, the trend shifted again to a reconsideration of the idea of the affective aspects of functional clothing.

Social and Psychological Aspects of Clothing (Affective Domain of Newton [1984-85])

Newton’s taxonomy (1984-85) provides a framework for classifying previous clothing-related research, but due to some overlap of information, the categories (i.e., cognitive, affective, motor) are too general. However, some social/psychological clothing research can be placed into the affective domain, probably the most clear-cut section of Newton’s framework.

Chapter One mentioned that people with physical disabilities wear clothing for the same reasons as those without disabilities. Susan Kaiser (1990), in her landmark book, The Social Psychology of Clothing, elucidates four established theories of why people wear clothes: (a) for *modesty*, to conceal parts of the body, (b) for *immodesty*, or sexual attraction, (c) for *protection* and (d) for *adornment*, which she describes as “appearance modification for purposes of display, attraction, or aesthetic expression” (p.16). In a 1985 study (reviewed below in more detail), Kaiser, Freeman and Wingate examined the reasons why clothing and personal appearance plays an important role in the daily lives of a small sample of students ($n=36$) with physical disabilities. The findings of this study are reflected in Kaiser’s later (1990) text (see Table 3). Reasons found by Kaiser et al. included: (a) concealment, (b) deflection (to another body attribute less discrediting than their disability), (c) compensation (“expressing mastery in an area usually closed to disabled persons” [p.216]), and (d) emphasis of the social uniqueness of the subjects’ situation (uniqueness of disability). An obvious parallel exists between reasons (a) in both works. *Modesty* (Kaiser) parallels *concealment* in the disability study. However, *immodesty* (reason (b) in Kaiser) does not seem to have a parallel in the earlier work, unless *deflection* or *compensation* (Kaiser et al.) in emphasizing a “working” part of the body, could

somehow be oriented towards sexual attraction. Interestingly, *protection* (reason (c) in Kaiser) is not mentioned as an overt reason in the disability study. The final reason, *adornment* (Kaiser), could be paralleled in the disability study by *deflection* (emphasizing a ‘working’ part of the body), *compensation* (emphasizing an unusual skill through decoration), or *emphasis* of situational uniqueness (using decoration or adornment to “play up” the disability situation and turn it into a positive aspect).

Table 3.

Reasons for wearing clothing

	Kaiser (1990) (textbook) non-disability	Kaiser, Freeman & Wingate (1985) (research study, $n=36$, with disability)
1	Modesty	Concealment
2	Immodesty	Deflection
3	Protection	Compensation
4	Adornment	Emphasis

The adornment or decoration theory is generally accepted as the primary reason why people of most cultures first wore clothing (Tortora & Eubank, 1998). Clothing as adornment can be used as a mechanism to lessen the effects of visible differences in the body and to emphasize other aspects of the self (Kaiser, 1990). This explains *deflection* and *compensation* in the disability study mentioned above. Kaiser discusses adornment as a tool that enhances personal appearance and thus builds self-esteem and psychological well-being. Simply put, the reasons people with physical disabilities use clothing as adornment are to enhance appearance and self-esteem. This self-esteem component was first explained by Anna Creekmore (1963) in her findings from a survey of 300 college women. Since Creekmore’s study, the focus of many studies (Caldwell, 1999; Kaiser, Freeman & Wingate, 1985; Liskey-Fitzwater, Moore & Gurel, 1993; Nisbett & Johnson, 1992) has been clothing as enhancing appearance and self-esteem.

Research in the social/psychological context has been approached in two ways: (a) individuals with physical disabilities’ perceptions of their clothing needs, and their attitudes to the role of clothing, and (b) external perceivers’ (e.g., able-bodied students, employers, and rehabilitation personnel) view of the clothing situation. Studies have used either physically

disabled individuals or non-disabled individuals as subjects, or have used both groups as two variables within one study. Researchers have also explored how demographic variables such as age, sex, occupational status, and ethnic background affects the outcome of these studies. The following section will summarize pertinent research according to approaches (a) and (b) above and in chronological order within both.

(A) Needs and attitudes of people with physical disabilities.

Feather (1976) evaluated relationships between self-concept and clothing attitudes of college men and women, with ($n=35$, nonrandom sample) and without physical disabilities ($n=76$, random sample). The findings showed a significant difference between clothing attitudes of men and women. Women in both groups displayed greater clothing interest than men in appearance, fashion, comfort, and durability. When individuals were grouped by physical ability this pattern continued. Feather concluded that women have more positive attitudes to clothing than men, no matter the extent of their physical ability. Feather also found that clothing appearance was important to all individuals regardless of their physical ability. She found that the able-bodied group had a more positive attitude towards clothing than the disabled group, but there was no significant difference in clothing satisfaction scores. Feather made recommendations that therapists needed to focus on clothing attitudes of the disabled, especially in the areas of clothing appearance, fashion, comfort and durability, and supported the belief that professionals in the rehabilitation field should use clothing interest as therapy for their patients. She warned that at the same time, these professionals should realize that an increased interest in clothing might not be paralleled by an increase in self-acceptance, which was one of her findings in the self-concept area of the study. Follow-up studies were suggested to focus on quality improvements in clothing products, acceptable levels of pricing for clothing modification as an alternative solution to ready-to-wear, and feasibility of vocational schools providing clothing modification services to rehabilitation patients. Feather's study was important because it broke ground in comparing physically handicapped and able-bodied people across demographic variables (i.e., gender and age) and in using two instruments, the Tennessee Self-Concept Scale (Fitts, 1965) and the Clothing Attitude Scale (Creekmore, 1966), to address clothing concerns across both populations.

College students with physical disabilities were also used as the subjects of a study almost a decade later by Kaiser, Freeman and Wingate (1985). They reported findings showing

reasons why clothing and personal appearance played an important role in the daily lives of 36 students of both sexes ranging in age from 19–73 years. Among the students, 64 percent agreed that, if they dressed attractively, other people would notice them instead of their disability. The researchers found four ways in which appearance management was used by these students: (a) concealment, (b) deflection (to another body attribute less discrediting than their disability), (c) compensation (“expressing mastery in an area usually closed to disabled persons” [Kaiser et al., p.216]) and (d) emphasis of the social uniqueness of their situation (see above for analysis and comparison with Kaiser’s later [1990] work). The study gave the researchers valuable qualitative information. One of the phrases used by the students, “innovations and improvisations”, was used as a part of the title for this study. The term *innovations* suggests future steps necessary to solve clothing problems; whereas, *improvisations* is what people have been making do with so far. Although a small sample was used, Kaiser, Freeman and Wingate demonstrated ways in which clothing can be used as a tool for appearance management by students with physical disabilities.

Freeman, Kaiser and Wingate (1986) also explored attitudes of these students towards ‘functional’ clothing (i.e., specially designed for individuals with physical disabilities), exploring its social costs and functional benefits. Students took part in group and telephone interviews, in which questions were asked relating to connotative meanings of special clothing features, feelings about ‘functional’ clothing in general, factors influencing the purchase and use of ‘functional’ clothing, and suggestions for effective design and marketing. Participants were shown color slides of various items of ‘functional’ clothing and they described the clothing features using bipolar adjective pairs. Quantitative and qualitative analyses showed that although ‘functional’ clothing was not a desirable option for these students, ‘normal’ clothing needed increased functionality. The group sessions provided a means of sharing ideas and were considered extremely beneficial to all participants. The clothing distribution system was found to be a consistent problem across groups, and participants strongly suggested stores employ specially trained personnel to assist customers. This study demonstrated the resistance to ‘functional’ clothing coupled with the desire for more functional features in ‘normal’ clothing, and highlighted shopping problems that existed for these students with physical disabilities.

In a subsequent study, Wingate, Kaiser, and Freeman (1986) looked at attitudes of people with physical disabilities towards ‘functional’ clothing by investigating the salience of disability

cues in such clothing. The impetus for this study was the need for a theory to explain a perceiver's personal selection of stimuli in clothing (i.e., drawing attention to a special feature) or the perceiver's personal evaluation of a clothing style. The subjects comprised 322 physically handicapped students at 72 universities across the United States. They were shown sketches of various types of adaptive clothing grouped in two ways. The clothing was shown by style-only view and by salient feature view, where illustrations included detailed views and written explanations. Functional features in clothing were considered more acceptable under four conditions: (a) the functional feature was not exclusive to clothing designed for someone with a disability, (b) the clothing item was less interesting before the inclusion of a feature, (c) the feature improved the overall design and/or style of a garment, and (d) the generic purpose of the garment was functional/protective (e.g., a rain poncho). The researchers concluded that condition (a) above might be the most practical solution for meeting the needs of this population in the marketplace. The researchers challenged designers to understand the importance of these psychological aspects of 'functional' clothing and incorporate the findings into future products, which would help to de-emphasize social differentiation. In addition, they encouraged increased consumer education about adaptations to help people explore self-image problems through clothing. This study was useful in exploring how people with disabilities assess their own and others' attitudes to functional clothing, and in creating solutions for acceptable clothing, which could be manufactured and marketed to this population. The solution proposed here, that a functional feature should not be exclusive to 'functional' clothing, echoes the principle of Universal Design, where a product is designed to serve the needs of all people.

Some studies have singled out specific body features for clothing research. Feather, Kaiser, and Rucker (1988-89) published a three-part series of articles in the Home Economics Research Journal describing research with post-mastectomy women. Using the same group of women for data collection, the researchers considered appearance satisfaction related to self-esteem, breast reconstruction and prosthesis use, and social concerns related to clothing. Data was gathered via survey questionnaire from 979 post-mastectomy women, of whom 57 percent of employable age worked outside the home. In addition, 27 personal interviews yielded supplemental qualitative data. The questionnaire covered topics such as social support, self-esteem, mastectomy attitude, educational needs, clothing concerns, prosthesis use and satisfaction, daily living concerns, and demographic and medical information. Results, in order

of publication, (Feather, Kaiser & Rucker, 1988; Feather, Kaiser & Rucker, 1989; Feather, Rucker & Kaiser, 1989) indicated that: (a) clothing/prostheses problems were considered more important than social and sexuality issues, but less important than medical, exercise/hygiene and nutrition/weight control issues, (b) women who opted for breast reconstruction over prosthesis were less embarrassed shopping for clothing, and (c) post-mastectomy women's perception of whether a garment projects the right appearance is significantly related to age and social context. Additionally, the women in the study indicated specifically which items and features of existing clothing were the most difficult to manipulate and wear (e.g., swimwear, nightwear, formalwear; low necklines, sleeveless garments). The findings show that, for this specific population, the importance of clothing issues was contingent on several variables (i.e., age, situation, post-mastectomy treatment). The study demonstrated that, even within a single disability type, clothing is a complex issue. Although not as important as medical and health issues, clothing was of concern to individuals; however, satisfying everyone's needs might have required a multiplicity of solutions just as with individuals who have full physical ability. One of the objectives of the current study is to discover whether a single solution, not a multiplicity of solutions, will solve a multiplicity of needs.

As pointed out by Kaiser (1990), clothing is considered one of the ways in which people with physical disabilities overcome their own physical differences from others. In another disability-specific study, Liskey-Fitzwater, Moore, and Gurel (1993) investigated the differences in clothing importance factors and self-perception domains between female adolescents with ($n=35$) and without ($n=35$) scoliosis (i.e., curvature of the spine). Clothing importance factors investigated included conformity in clothing, modesty in clothing, psychological awareness of clothing, clothing to enhance self-concept, and interest in clothing. Social-perception domains investigated included social acceptance, athletic competence, romantic appeal, physical appearance, and global self-worth. The authors argued that, because peer acceptance was vital for an adolescent's socialization, self-esteem and body image, followed by fashionable clothing, were especially important. They also hypothesized that dissatisfaction with the body often resulted in generalized dissatisfaction with the self. Results showed that females in the scoliosis sample placed a significantly higher importance on their physical appearance than did those in the comparison group, but their self-perception was lower. The results suggested a need to provide fashionable and attractive clothing for female adolescents with and without scoliosis.

The authors recommended the rehabilitative potential available through clothing therapy and concluded that clothing might help handicapped children overcome physical differences.

Clothing has been mentioned previously as a way of changing or enhancing outward personal appearance for people with physical disabilities and changing the impressions of others towards them. In an article in Quest magazine about personal appearance, a variety of people with muscular dystrophy discussed their feelings about their appearance (Caldwell, 1999). They all agreed that, if they took the extra time and effort to dress up and look good, they felt better about themselves. In addition, they acknowledged the impact that looking good had on the way other people perceived their disability. “‘To me, if I wear junk clothes, people would look at the wheelchair,’ says [Dan] Molloie” (Caldwell, 1999, p.18). Although not a scholarly research study, comments of the people with disabilities supported the findings of Kaiser, Freeman and Wingate (1985), that “junk” clothing leads to the perception that others will focus on the disability and not the person. Table 4 presents a brief summary of the studies and findings described in this section.

Table 4.

Summary of Social/Psychological (Affective Domain) Research on Clothing Needs and Preferences of People with Physical Disabilities

Conclusion/summary finding	Finding appears in:
<ul style="list-style-type: none"> • People with physical disabilities are interested in clothing as an appearance management, concealment or enhancement tool, especially when it helps take attention away from the disability. • They are not interested in specialized, 'functional' clothing. 	Caldwell (1999) Freeman, Kaiser & Wingate (1986) Kaiser, Freeman & Wingate (1985) Liskey-Fitzwater, Moore & Gurel (1993) Wingate, Kaiser & Freeman (1986)
<ul style="list-style-type: none"> • People with disabilities are interested in clothing from a durability, comfort and fashion standpoint, although opinions of what is appropriate clothing will differ according to the usage context and age of the wearer. • For a teenager, fashionable clothing is important for peer acceptance. 	Caldwell (1999) Feather (1976) Feather, Kaiser & Rucker (1988-89) Liskey-Fitzwater, Moore & Gurel (1993)
<ul style="list-style-type: none"> • People with disabilities have difficulties acquiring suitable clothing. • Shopping can be an embarrassing experience, and personnel are mostly ignorant of customers' needs. 	Feather, Kaiser & Rucker (1988-89) Freeman, Kaiser & Wingate (1986)
<ul style="list-style-type: none"> • Many different clothing solutions are required to satisfy even one disability grouping. • The most acceptable answer seems to be designing 'normal' clothing with concealed functional features built in to suit a number of people (i.e., Universal Design). 	Wingate, Kaiser & Freeman (1986)
<ul style="list-style-type: none"> • Clothing has rehabilitation potential. • Clothing therapy can be used in a vocational way as part of job training, and to improve self-esteem. 	Feather (1976) Liskey-Fitzwater, Moore & Gurel (1993)

Social/psychological attitudes to clothing for people with physical disabilities by people without physical disabilities.

Ray (1985-86) examined the job interview situation and questioned whether job applicants with physical disabilities should follow the same standards of dress for the job interview as prescribed for other segments of society. A lack of empirical evidence to support such an assumption acted as the impetus for the study. Ninety-four non-disabled subjects evaluated a job applicant in a wheelchair. The subjects were given a written job description, a color photograph of the applicant and a personal data sheet and asked to complete a questionnaire to evaluate the applicant's qualifications for the job. Levels of appropriateness of dress (i.e., high, medium, low) and applicant's credentials (i.e., high, low) were manipulated between the subjects. The results showed that clothing did affect the ratings in some areas, specifically the higher the level of appropriateness of clothing, the higher the rating of competence. Clothing had no influence on perceptions of experience or inexperience for a job, but it was found to be a significant factor on recommendation to hire and in salary assignment. Ray concluded from this study that clothing could be an important factor influencing perceptions made by interviewers and potential employers when a person with a physical disability seeks employment.

Researchers have also found that a perception of fashionable clothing equals social desirability (Johnson, Nagasawa & Peters, 1977; Pinaire-Reed, 1979) and higher intelligence (Lennon & Miller, 1984; Paek, 1986), for several populations of women. Nisbett and Johnson (1992) studied whether the same impressions of clothing would hold true for individuals with physical disabilities. The focus of their research was to investigate how clothing might be used in impression formation towards students with a disability. The sample consisted of 183 undergraduate students without disabilities, of whom 88 were male and 95 female. The results showed that unfashionable clothing worn by females with physical disabilities might have some negative influence on impressions of their mental competence. This could be interpreted as important support for Ray's (1985-86) study. A judgment of mental competence through clothing might be made in a job-seeking or maintaining situation, thus fashionable clothing becomes potentially important for women with disabilities in the workplace. The results of both the Ray (1985-86) and the Nisbett and Johnson (1992) studies indicated a strong relationship

between positive character evaluations and stylish, uncluttered clothing worn by individuals with physical disabilities. Table 5 presents these findings within the social/psychological context.

Table 5.

Summary of Social/Psychological (Affective Domain) Research on Perception of Disabled People's Clothing Needs and Preferences by People without Physical Disabilities

Conclusion/summary finding	Finding appears in:
<ul style="list-style-type: none"> • Clothing affects ratings of competence in a job interview situation. • The higher the level of appropriateness of clothing, the higher the rating. • Clothing is found to be a significant factor on recommendation to hire and in salary assignment. • Clothing could be an important factor influencing perceptions made by interviewers and potential employers when a person with a physical disability seeks employment 	Ray (1986)
<ul style="list-style-type: none"> • Unfashionable clothing worn by females with physical disabilities might have some negative influence on impressions of their mental competence 	Nisbett & Johnson (1992)

In summary, in a review of research studies on physical disability and appearance, Lamb (1993) explored aspects of the literature related to appearance management for people with physical disabilities and emphasized the potential of this literature to advance theory development and improve instruction about clothing for this population. She looked at a wide range of appearance-related research studies, primarily from the 1970s, 80s and early 90s, which covered topics in both categories (a) physically disabled people as self-perceivers and (b) others as perceivers. She noted that by varying the type of clothing used and changing the contextual environment, the type of perceiver has been manipulated as an independent variable in previous research. She also noted that stimulus persons (e.g., physically disabled subjects) have been varied by type of disability and the way in which they have been depicted. Lamb concluded that for designers and marketers, any venture into design for this population must give the consumers what they want, taking into consideration how the wearers of functional clothing feel about themselves and how others might react to their appearance. Efforts should be made to improve aesthetic and fashion appeal and situational appropriateness for these products. In particular, the

following issues are of extreme concern in the development of a new product: wear testing, social desirability, protection, comfort and consumer satisfaction. Along with Newton (1984-85), Lamb supports the need for a social/psychological component that incorporates appearance management for people with a physical disability as it relates to self-image. Lamb's work raises an interesting point in pushing for recognition of a social/psychological context by manufacturers and marketers of clothing for the physically disabled population.

Business Clothing – General Research

John Molloy in The Woman's Dress for Success Book (1996), outlined the 'rules' for women's dressing in the corporate workplace. Assuming promotion and career ambitions play a part in the way a woman perceives her work, Molloy offered strict guidelines on how to 'get ahead' and look professional using clothing as a non-verbal communication tool. His guidelines, based on men's business uniform of the three-piece suit, were (a) dark-colored skirtsuit and contrasting blouse, (b) jacket with blouse and contrasting skirt, (c) jacket over a dress, and (d) jacket with pants and blouse (less acceptable). He stressed the importance of impression management, encouraging women to convey images of authority and uniformity.

The term business clothing, as used in this study, requires conceptual clarification. Business clothing refers to clothing products required by their design, styling, and fabrication, to perform a particular function, not just for the wearer, but also for the beholder (Rabolt & Drake, 1984-85) in the white collar workplace. This clothing type differs from blue collar working clothing, which might be more casual, or a prescribed company uniform. The definition of business clothing is not universally defined except by individual company dress policy, within which a white collar worker is usually free to choose. Certain unwritten rules exist about appropriateness of appearance for most white-collar workers. Molloy was the first person to define these unwritten rules for women entering the white collar world and consequently by defining rules and providing guidelines for women, he established a new standard.

The appropriateness of this clothing is a concept that plays a major part in the determination of its success as a visual label, thus, clothing in this retail merchandise category embodies more complex issues than casual clothing. Professional women look for traditional, tailored and fitted, yet fashionable clothing (Dillon, 1980). Women face an additional dilemma

in the workplace because they have never had the 'uniform' of a suit and tie, which has long been associated with men's business clothing. For many years, women have tried to achieve an appropriate mix of formality and femininity in their business clothing. Many professionals see appropriate dress as capable of having an effect on a woman's success within a company (Solomon & Douglas, 1993). Kwon (1994) found that women put more emphasis on the appropriateness of clothing than do males and that, for them, traditional business clothing was still an important tool for women in the corporate world, especially if their current or desired position necessitated a high level of respect and authority.

Some studies in the corporate workplace have shown that women who achieved a high level of authority and solidified their power base tended to relax about dress codes, leaving new employees to dress the most formally for the office (Premeaux & Mondy, 1987). This suggested that traditional business clothing is important for women advancing in their careers, but once an upper-level position of authority has been reached, more freedom of interpretation is possible.

The definition of appropriateness of clothing is a topic of concern for clothing researchers. Many women in corporate America adhere, albeit through individual interpretations, to Molloy's doctrine (Bellinger, 1996). In a 1980 study of business dress for women corporate professionals, Dillon used a sample of male and female professionals ($n=15$) from industrial manufacturing companies in Ohio, to determine the criteria used by professionals for appropriateness of garment styles for female business dress. The results showed that professional subjects preferred formal, jacketed, tailored looks such as those presented by Molloy (in his original 1977 edition), but gave no preference as to whether the model was shown in a dress or coordinated outfit. Results about more detailed preferences showed that belted/unbelted styles and pants/skirts were evaluated as equally appropriate, and coverage of the bodice area was preferred. Park (1992) in a study of white-collar female workers ($n=313$) found that formulas for career clothing from earlier decades were still practiced, at least by managerial women. Significant differences were found in clothing choices made by managerial and non-managerial women, with predictors of clothing practices and expenditures being clothing attitude, price of clothing, career commitment, perceived clothing needs, and age of subject. Suits were found to convey a stronger professional image than dresses by Thurston, Lennon and Clayton, 1990). Subjects ($n=207$ business men and women) were shown black and white photographs of women, with age, body type and garment styles manipulated in each photograph.

Findings also showed that for business men, older women conveyed a stronger professional image than younger women when dresses were worn. Clothing with innovative fashion detailing was found to contribute to a weaker professional image than contemporary or classic fashion detail. In addition, the importance of the jacket in conveying a professional image has been well documented (Rucker, Taber & Harrison, 1981; Scherbaum & Shepherd, 1987). The results of these studies suggest that a classic-styled skirt or pants suit or coordinated outfit with a jacket were the most acceptable form of career dress for working women. Rabolt and Drake (1984-85) found that career women ($n=588$) looked to other women (e.g., friends and peers at work) for information on business clothing, but looked to male supervisors for approval (the researchers suggested that women were accustomed to the male-dominant role in upper management). Findings also indicated “career women accepted more influence when they felt clothing was important, were anxious in their careers, were less confident in dressing professionally, and were high self-monitors” (p.11). Possibly these results may be less valid in the 2000s due to changing upper management demographics in companies and institutions, but women are still concerned about selecting the ‘correct’ career clothing.

Since the early 1990s, the trend in business clothing has been towards ‘business casual’ style of dressing. About 53 percent of office workers now have the option to dress casually to work every day (Ten Kate, 1998), this percentage is up from seven percent in 1992. A retailer of women’s business clothing, Ann Taylor Stores Corp., has taken the initiative and expanded into business casual with non-traditional suits and sweater sets, among many other items of suitable merchandise, to target their 25 to 55-year-old target customers (Gallagher, 1999). ‘Corporate dressing-down’, as it is typically called, is becoming popular because employers feel that if an employee is dressed in a relaxed manner, greater communication and informality will open up, leading to greater job satisfaction and productivity (Bellinger, 1996). In a study of corporate individuals ($n=56$) at a company, which recently changed its dress code to optional full-time business casual, Bellinger found that one quarter of the 59 percent who wore casual clothing on a daily basis reported an increase in job satisfaction. One third of the sample reported more relaxed peer interactions and a more cohesive work unit due to the dress code change. However, half of the sample felt more professional in formal business clothing, while another half reported that clothing did not affect the way they felt about themselves as professionals. Faust, Cassill, Herr and Williamson (1999) found in a study of Fortune 500 companies ($n=189$) that the Casual

Workplace (i.e., wearing casual clothes in the office) had the following benefits: (a) increased morale, (b) incentive to attract employees, (c) less expense, and (d) improved productivity.

From a marketing/retail standpoint, women can be segmented according to their working status and within these segments there exist different attitudes towards clothing. Cassill and Drake (1987) found that women's employment orientation significantly affected evaluative criteria for apparel. In a survey of female consumers ($n=842$) using segments suggested by Bartos (1982) (i.e., Career-Oriented Working Women, Just-A-Job Working Women, Plan-To-Work Housewives, Stay-At-Home Housewives), Career-Oriented Working Women aged between 25 – 34 years placed importance on appropriateness (suitability and fit) when selecting clothing and were not likely to be price conscious when shopping. Another segment, Just-A-Job Working Women, placed most importance on economic criteria (good buy and price) when selecting apparel, sought information about apparel products from friends and were more price conscious than the career oriented group. Cassill (1990), through further analysis of the same market segments found that employed women (Career-Oriented and Just-A-Job) placed great importance on brand name when purchasing apparel and that Career-Oriented Working Women also placed importance on fiber content of apparel products. Forsythe, Butler & Pratt (1988) suggested another segmentation strategy for working women (i.e., professional and nonprofessional).

Research that focused only on the interview process demonstrated that appropriate clothing is an important factor. Clothing influenced hiring agents' impressions of the personality of a job applicant (Johnson & Roach-Higgins, 1987) to the extent that the hiring agents ($n=300$) had the impression that job applicants who dressed inappropriately were more creative and independent than those who dressed appropriately. This led to the opinion that job applicants who showed signs of recognizing and following prescribed standards of business clothing had potential to function better within the company than those who were considered creative and independent. For people with physical disabilities, appropriate clothing for interview situations is as important a non-verbal communication tool as for people without disabilities. Ray (1985-1986) found that style variations in a suit worn by male job applicants with physical disabilities affected ratings of personal characteristics, recommendations to hire and recommendations for entry-level salary by male and female managerial personnel ($n=84$). Christman and Branson

(1990) found that the influence of female job applicants' clothing rated by employers, rehabilitation personnel and disabled students is more powerful than physical condition.

Although research on career clothing for women with physical disabilities is sparse, additional research is necessary due to passage of the ADA, which was designed to facilitate more women seek positions of employment. More information about style, appropriateness, and acquisition is needed about this demographic segment, for potential employers and employees, and for rehabilitation personnel involved in skills-based job training.

Design to Distribution of Clothing Products: Product Life Cycle

This section of the literature describes the stages of evolution of a clothing product, from its inception as a design concept through its final sale to the consumer. The goal of this section is to give an overview of the aesthetic and structural development of a clothing product, not the development of its fiber and fabric materials component, so preliminary steps in the entire process such as fiber and fabric production will not be addressed in detail, nor will possible post-consumption processes such as care and disposal (i.e., secondhand sales and recycling).

A general overview initially describes the traditional and evolutionary steps of the process according to industry practice, beginning with design concept and moving through manufacture to distribution to the retail customer and ultimately the consumer. This overview is segmented to facilitate understanding of each step, beginning with a section on several approaches to product development. Specialized product development is then discussed, particularly in relation to research studies on disability. The next section outlines the next phase in the evolutionary process (manufacturing) and addresses some of the problems associated with the manufacture of specialized clothing products. Finally, distribution aspects (getting the product to the retail outlet and final consumer) are discussed in both general terms and with a sharper focus on concerns of individuals with physical disabilities.

Overview of Process: Product Development, Manufacturing and Distribution

According to Glock and Kunz (2000), the entire U.S. apparel industry can be organized into four levels: (Level One) textiles and findings manufacturers, (Level Two) apparel manufacturers, contractors and retailers, (Level Three) retailers, and (Level Four) consumers.

Stone (1999) also describes the fashion industry in terms of levels. Level One (fiber and fabric manufacturers) sell to Level Two (manufacturers and contractors) who sell to Level Three (retail) who in turn sell to the consumer. Glock and Kunz's (2000) and Stone's (1999) interpretations of the overall industry are broad to the extent that they include textile production, which will not be covered in this study, but they do address production and retail of a clothing product; the major concern of this section of the review of literature. These production and retail levels cover the many processes of the product life cycle. To focus on Levels Two and Three of Glock and Kunz's or Stone's description is to describe the phases of product development, manufacture and distribution of a clothing product. Glock and Kunz also include retailers as clothing manufacturers, a practice common in today's industry whereby manufacturers are in control of the product development and production of some or all of the merchandise sold at retail.

The evolution of a typical clothing product (e.g., skirt, blouse, jacket) within the three phases stated above can be divided into several processes. A simplified explanation of the evolutionary processes is described here. First, an initial idea about how the product should look is developed by a designer. This might be done by sketching on paper or computer or by draping fabric on a three-dimensional form. As the design is established, decisions are made about type and color of fabric and type of findings (e.g., trim, closures, thread). Then, a flat pattern of the sketch or three-dimensional form is made, laid on a piece of flat fabric and used as a template around which the fabric is cut in the shape of the pattern. Several different pattern pieces, or just two or three, may be required to make the product, depending on the product's complexity. After the fabric is cut, the pieces are sewn together according to a structured sequence. The product is known at this stage as a sample. Upon approval of the sample product, production planning takes place, and the process outlined above from the making of the flat pattern is repeated, this time with multiple layers of fabric cut and then sewn together by machine operators. Multiple versions of the same product are made in varying sizes and colors. After construction, the products are finished (e.g., threads trimmed, label attached), packaged and shipped to a customer. This sequence does not change much within industry except for products where the fabric is constructed in the shape of the final product (e.g., hose, socks, some T-shirts), but there can be many variables within each phase of the sequence of events.

The majority of clothing sold within the United States is made by mass production techniques. Industry standards vary between companies, but all companies follow a variation of the sequence outlined in the preceding paragraph. Over the past ten to fifteen years, researchers in the clothing and textiles field have tried to document and diagram the entire process as actually used by industry. Documentation should standardize the process and, therefore, the final product. Among the three major phases (i.e., product development, manufacturing and distribution), the first phase, product development, has been subject to many variations in interpretation by clothing researchers and industry professionals.

Product Development

Product development is a crucial phase in the overall product life cycle because it is here that many ideas and choices come together to form one product, which may or may not be successful in the mass-market. Product development in this study is the first of three phases that also include manufacture and distribution and is a term that covers all the processes performed in the evolution of a clothing product from design conceptualization to pre-production. These processes include many points of decision-making and activity. Some of these activities are: developing design ideas, researching the customer, deciding on colors, fabrics and findings, budgeting the product and setting specifications (specs) for manufacture. Just as with the diagramming of the total evolutionary product life cycle, there are many variations of the complete phase of product development. These variations have also been extensively researched by clothing professionals with the intent of more accurate standardization within industry. However, problems exist for researchers attempting to provide a clear picture of how product development is ‘done’ in industry, due to (a) the size (roughly 24,000 apparel companies in the U.S. alone (Dickerson, 1999), scope and skills of the companies, ranging from ‘giants’ like Sara Lee to small family-run businesses, (b) differences in terminology but not process (product development vs. design), and (c) orientation to retail (mass) production or individual (specialized) production.

According to Glock and Kunz (2000), product development can be specifically defined as the “design and engineering required to make products serviceable, producible, and profitable” (p.83). In their book, Apparel Manufacturing: Sewn Product Analysis, product development is described in terms of the merchandising functions within a company, where merchandising is

defined as the “planning, development and presentation of product line(s) for identified target market(s) with regard to prices, assortments, styling and timing” (p.61). The merchandiser within a manufacturing or retail firm is described as having the responsibility of developing and presenting product lines. Kunz (1998) developed a taxonomy of the apparel merchandising system in the United States in which product (line) development is embedded within the business plans of an apparel company and is dependent upon the flow of the entire merchandising process. Line development is a central portion of this taxonomy and consists of four phases: (a) line concept, (b) preadoption product development, (c) line adoption, and (d) postadoption product development. This phase stretches from establishing the direction of the line (collection of garments) to pattern grading, part of the preproduction process.

Another market-driven description is given by Stone (1999). This describes the sequence of events in the life-cycle of a clothing product as a six-stage process, consisting of: (a) planning the line (group of garments, usually linked by a common theme), (b) creating the design concept, (c) developing the designs, (d) planning production, (e) production, and (f) distributing the line. Stone’s (1999) description is applicable for a typical ready-to-wear consumer product and exists throughout the U.S. industry with variations dependent on company size, company type, personnel and type of product.

Consumer-driven product development.

In recent years, the clothing market has started to change from industry driven to consumer driven (Stone, 1999). This translates into an atmosphere where successful companies must listen to the needs of their customers and not dictate products to them. Product development must incorporate the consumer as a central focus from the start, because the consumer will either accept or reject a new product. Frings (1991) explains the general idea behind the importance of consumer-focused product development in the clothing industry. “It is very important that designers and manufacturers identify their customers as a group, develop a product that fits that identity and stay with it. This involves finding a market niche around a particular lifestyle” (Frings, 1991, p.146). Starting with the consumer in mind is part of the preliminary process of product development.

Clothing researchers work consistently to document and refine this first component of the product development process known as design. In the apparel industry, design is traditionally a creative process, involving the elements of color, fabric, line (visual direction), shape

(silhouette), and the principles of proportion, balance, repetition, emphasis and harmony (Diamond & Diamond, 1996; Frings, 1991). The principles can be seen as a set of rules, within which the elements can be manipulated for an original creation. Some key research studies in clothing design theory have guided efforts to create a User (consumer) model for product development. Lamb and Kallal's (1992) functional, expressive and aesthetic (FEA) User needs model is a circular model of apparel design beginning with the target customer at its core. Mediated by a cultural filter, the User's needs are considered within functional, expressive and aesthetic (FEA) contexts. The User needs model then guides a framework for the overall design process, a linear model that extends in a path from problem identification to implementation (actually a product development process). Beginning with the need for a solution, the designer works through various ideas, refinement of these ideas, development of a sample garment, evaluation with changes if necessary, and finally implementation into the production (manufacturing) process. Lamb and Kallal's conceptual framework was tested on three different design projects for specific target customers: (a) a figure skating costume design, (b) clean room garment design, and (c) design for a teenager with spina bifida. The FEA model is used to guide the first five stages of product development, problem identification through evaluation, and is an essential part of idea exploration and implementation as it provides a wide variety of User needs variables that must be thoroughly explored for the development of preliminary ideas (see Table 6).

Table 6.

Existing Product Development/Design Frameworks from Clothing Literature

Source	Generating Design Ideas	Sketching and constructing first garment	Evaluating feasibility and planning production	Implementing plans and re-evaluating where necessary
DeJonge (1984)	Request Made Design Situation Explored Problem Structure Perceived Specifications Described	Design Criteria Established Prototype Developed	Design Evaluation	
Gaskill (1992)	Trend analysis Concept evolution	Fabrication selection Palette selection Fabric design Silhouette and style direction Prototype construction and analysis	Line presentation	
Glock & Kunz (2000)	Line concept	Preadoption product development	Line adoption	Postadoption product development
LaBat & Sokolowski (1999)	Problem definition and research	Creative exploration		Implementation
Lamb & Kallal (1992)	Problem identification Problem exploration Preliminary ideas	Design refinement Prototype development	Evaluation	Implementation
Regan (1997)	Creating an apparel line	Develop colors and prints Implement fabric design and special operations Create the garment pattern and prototype	Set production specifications Produce samples	
Regan, Kincade & Sheldon (1998)	Problem recognition and definition Problem exploration	Searching for alternatives	Evaluating and making decision Specifying the solution	Communicating the solution
Stone (1999)	Planning the line Creating the design concept	Developing the designs	Planning production	Production Distributing the line
Wickett, Gaskill & Damhorst (1999)	Inspirational search of trends Trend analysis Concept evolution	Fabrication selection Palette selection Fabric design Silhouette and style direction Prototype construction and analysis	Line presentation Fit & style perfecting, materials/garment specifications writing	Production pattern making, retail firm/manufacturer development
Workman, Caldwell & Kallal (1999)	Design development	Sketching Precosting First patterns Samples	Testing Review of samples Determination of design specs Estimation of costs Standardization of fit	

In a second study, Kallal and Lamb (1993) extended the User needs model to incorporate industry practice. The name was changed to a product development framework. The researchers' objective was to consider needs of retailers as well as consumers. This would assist companies in manufacturing products that target customer would be happy to purchase. For the industry needs section of the FEA model, additional data were collected via multiple case studies for 10 apparel companies, both large and small manufacturers. By adding an industry component FEA model to the design framework, the model of consumer needs combining functional, expressive and aesthetic considerations was extended to incorporate industry (production and distribution) as a part of the design process. Consumer needs thus relate to individual consumers and industry customers. The steps of the overall design framework remain the same, but the entire process including the FEA model becomes known as a product development framework (see Table 6). As explained by the researchers, "we now have an enhanced perspective of who manufacturers are trying to please. Whereas our "design" framework focuses on designing for the ultimate consumer, in reality, the manufacturer caters to two customers, the ultimate consumer and the retailer" (p.5). The advantages of the FEA consumer needs model are obvious for design for special needs populations. The model encourages the designer to gather User needs information (e.g., protection, donning/doffing, self-esteem), which might otherwise be overlooked. The addition of the industry model provides useful information that can help guide a potential clothing product through the manufacture and marketing stages.

Regan's (1997) definition of product development also places emphasis on the customer (end-user). "The product development process is the set of activities, tools, methods, and procedures that translate customer needs into product designs" (p.34). This statement reflected Regan's study of the existing environment of three apparel manufacturing companies of traditional retail clothing products in the southeastern United States. In a survey of 72 apparel associates at these companies, Regan collected data about the current state of apparel manufacturing with a view to superimposing a concurrent engineering framework for greater efficiency and productivity. Regan determined from the 'as-is' part of the study that a typical timeline for translation of customer needs into a product was roughly 32 weeks. Regan's findings translate the product development sequence into the following tangible stages: (a) creating an apparel line (design, development of line plan and sales package at beginning of the

seasonal cycle), (b) develop colors and prints (selection of line color palettes), (c) implement fabric design and special operations (transform fabric design and dyes to a finished fabric product, develop any screen prints, embroideries or special fabric finishes), (d) create the garment pattern and prototype (approval of the sample garment), (e) set production specifications (instructions for the manufacturers, procurement of all raw materials), and (f) produce samples (these samples will be used to generate sales) (see Table 6). This system works best in a situation where clothing is not manufactured until orders are taken by the sales staff using sales samples of the clothing item in a line (group of garments selected by the clothing company as its representative products each season). This method shows the retail customer ‘pulling’ the product through the process. Manufacturers can use this system to produce clothing based on pre-line selling, past point-of-sale information and forecasting. They would manufacture to inventory in these situations. The product development process as described by Regan (1997) is part of the overall process known as sequential manufacturing, which shows how the entire process moves forward in separate and distinct stages (see Table 6). “The apparel industry uses a sequential manufacturing process in which designing, prototyping, producing, distributing and selling are separate sequential functions” (Regan, p.3). Regan’s model is based on an ‘as-is’ study of the current apparel manufacturing environment. The model represents apparel design as a separate stage from product development.

Regan, Kincade and Sheldon (1998) applied the engineering design process theory to the apparel design process. A six-stage model was used to adapt an apparel design process to an engineering design process in comparable stages. The model follows roughly similar stages to Lamb and Kallal’s: beginning with problem recognition and definition (problem identification), then exploring the problem, searching for alternatives (preliminary ideas), evaluating and making decisions (design refinement), specifying the solution (prototype development and evaluation), and finally communicating the solution (implementation) (see Table 6). This design process is actually the first part of Regan’s (1997) overall sequential model of product engineering. The Regan, Kincade and Sheldon model (1998) does not have a separate stage for gathering information on User needs. The Lamb and Kallal (1992) and Regan, Kincade and Sheldon (1998) studies have the objective of applying the design process to ‘real-world’ mass-market products. In this type of work, researchers are integrating industry practice with needs of the ultimate consumer, ultimately to develop a product that meets expectations for both parties.

LaBat and Sokolowski (1999) present a three-step User-oriented process defined as a textile product design process. The first step is product definition and research, which deals with gathering of information relevant to the end customer (see Table 6). The second step is creative exploration, which includes working through all possible ideas, examining User and production constraints, and finally producing and evaluating a prototype. The third stage is implementation, which involves refining production details for marketing, sales and use by the consumer. In this case, the implementation stage included a redesign stage where, after six months of wear, the User returns with ideas for further improvement. Here product development is extended past the usual phase of distribution and continues with the consumer playing an active part.

Retail involvement in product development.

Increasingly, distributors (traditionally the final stage of the overall process) are becoming more involved in product development, moving ‘backwards’ along the processes to design and develop their own consumer products. Companies with different specializations are contracted for production and, in some cases, for the design of the product, but the retail company is responsible for overall product development. Benefits to this approach for retailers (distributors) have been noted as increased control over the design and manufacture of the product, shorter lead time for product delivery, products tailored to merchandising goals and product differentiation which leads to competitive advantage (Stone, 1999). Gaskill (1992), in developing a model for the new area of retail product development, used a single case study of an international specialty retailer with in-house product development capabilities. Gaskill’s definition for product development is as follows. “Product development consists of a variety of activities ranging from an initial in-depth trend analysis, progressing to the evolution of the product, and ending with final line selection by the merchandising personnel” (p. 19). Gaskill’s model describes a fairly sequential range of activities which are performed chronologically, and have intervening internal and external factors. The activities are as follows: (a) trend analysis (looking at current global trends), (b) concept evolution (evaluation of trends and their applicability to chosen target market), (c) fabrication selection, palette selection, fabric design (all performed simultaneously, according to the sample of firms in this study), (d) silhouette and style directions (presentation of design sketches), (e) prototype construction and analysis (sample garments made), and (f) line presentation (presentation, editing, and final approval of clothing line by internal team) (see Table 6). This model provides a picture of processes from design

through to approval within one company. Subsequent steps, not included in this study, would comprise: initiating the production process, buying fabric and findings, negotiating assembly specs and size ranges, cutting, construction, trimming, shipping, delivery and negotiating retail prices. These would comprise part of the product development phase, but mainly the manufacturing and distribution phase of the product life cycle. These phases were not included in Gaskill's model because she found that these subsequent steps, in the companies under investigation, became the territory of the merchandising team, which, in her study was separate from product development. The activities in her model were carried out by the product development team, who handed everything to the next team at conclusion of their tasks (i.e., activity [f], line presentation) and moved on to the next product. However, there seemed to be some blurring of the functions of different teams within a company. Gaskill states, "An analysis of the functional activities taking place indicated both divisions [product development and merchandise divisions] actually perform merchandising functions, that is, both product development and merchandising were involved in the planning, development and presentation of the product" (p. 23). Wickett, Gaskill and Damhorst (1999) expanded the original model with a post (line) adoption phase, including fit and style perfecting, materials/garment specifications writing, production/pattern making and retail firm development/manufacture development. This latter model appears to provide a more complete product development picture, applicable to retail companies who intend to develop their own consumer products. This model could potentially be used by retail companies developing products for consumers with special needs.

Workman, Caldwell and Kallal (1999) describe product development as the design and engineering of a clothing product. Product development includes design development, sketching, precosting, first patterns, samples, testing, review of samples, determination of design specifications (specs), estimation of costs, and standardization of fit (see Table 6). The method and sequence in which all these processes are carried out depends on the size and type of the company. The researchers point out that the company in question may no longer be an independent manufacturer. Increasingly retail stores are developing and selling their own clothing products as 'private label' brands. Regardless of the type of company involved in clothing product development, the researchers place emphasis on having a product which is (a) appealing to the consumer, (b) fits costs budgeted by the company, (c) is developed in a set time

frame, and (d) sells for a profit. This study states that distributors (e.g., retailers) are becoming involved with product development and are no longer the final component of the process.

Table 6 represents a summary of the product development models discussed in this section of the literature. Four general categories seem to emerge that are consistent with every model: (a) generating design ideas, (b) sketching and constructing first garment, (c) evaluating feasibility and planning production, and (d) implementing plans and re-evaluating where necessary. Stages specific to the models can be placed within one of these broader categories.

Specialized product development

The previous models for clothing product development have focused on ready-to-wear mass-produced products where the needs and preferences of the individual User (consumer) are not known beyond a general market segment. Specialization of product development involves creating a product for a market of one end User with unique needs and preferences (customization). A more realistic conceptualization of specialized products is for the small group with specific needs not satisfied by mass-production.

On a broad level, there has been much discussion among design professionals in many fields about the inclusion of the needs of unique populations in the development of consumer products, especially in housing, appliances, and automobiles. Vanderheiden (1990) discussed whether development of mainstream consumer products should include considerations of people who have disabilities or are elderly. Vanderheiden pointed out some inherent problems that need to be addressed in order to answer this question and could be applicable to clothing as a consumer product. These problems are (a) definition of individuals who qualify as ‘disabled & elderly’ and the size of this population, (b) whether their needs should be handled separately as exceptions to the norm, (c) the economic and practical feasibility of including disabled and elderly persons in the design process for mass-produced products, and (d) the benefits of incorporating disability and aging considerations into mainstream human factors activities. Vanderheiden suggested that the best and most economical approach is to make mass-market goods more accessible through more empathetic design. This suggestion is in line with that of Wingate, Kaiser, and Freeman (1986), who suggested that successful mass-produced clothing for people with disabilities, should not have functional features as exclusive elements, but as features incorporated into ‘normal’ clothing to make it more accessible. Vanderheiden also points out that if product development is going to incorporate everyone, professionals have a

duty to master a wider range of information: new areas of knowledge, types, degrees, and implications of disabilities and the functional limits of ‘special’ populations. This places pressure on the design or product development professional to acquire new skills in potentially unfamiliar areas but lends more credibility to the process.

Annis, Clauser and Bradtmiller (1991) addressed the issue of redesigning workplaces for the older worker. Older workers surveyed were males and females aged 40-70. The researchers used sample means from selected cross-sectional and longitudinal studies. Items of investigation included changes in weight and selected body dimensions between the third and eighth decade of life. The findings showed significant challenges for common design because measurements showed differences in the way men’s and women’s bodies age, especially in terms of weight and stature. These challenges could extend more acutely into the clothing area, for two reasons: (a) a great number of people with physical disabilities are also elderly and (b) standardization of sizing has been an essential feature of ready-to-wear clothing products but will not serve the needs of variances in weight and stature experienced by both the disabled and the elderly.

The Annis, Clauser and Bradtmiller (1991) study is similar in concept to a recent transition in housing design known as ‘aging in place’, which has changed the way professionals are seeing the design of new houses. Aging in place focuses on independent living as residents become older and personal abilities change in their interaction with the environment (Brandt, 1993). New ways of looking at product design is a common activity in the human factors and housing areas. Clothing, as a consumer product used by all people, poses similar challenges for professionals involved in this type of product development. Clothing too could benefit from a holistic and innovative approach to specialized product development and discussion over the ‘design for all’ or ‘design for one’ alternatives. It is important to note, however, that while a place of residence is designed to last many years, clothing is not and need not be subject to the same ‘in-place’ needs.

The specialization of product development in the clothing industry has been under investigation for some time, as a way of producing clothing with increased consumer satisfaction. Rosenblad-Wallin (1985) first proposed *user-oriented product development* as a method of designing clothing products. In assessing the state of specialized clothing product development, Thoren (1997) observed that people with physical impairments are not accommodated into the current clothing product development system because they are in need of

individual clothing adaptations and there are sizing difficulties with the standardized system. Thoren's paper addressed the viewpoint of both manufacturers and final users and suggested a systems approach. In other words, in order to bring about some change in the current ready-to-wear clothing situation, the entire system, or product lifecycle, needed to be changed, especially as Thoren observed that neither manufacturers nor users are happy with the current system. The three main groups of disabled individuals ($n=65$) surveyed in the study were discovered to be differing in their clothing needs because of varying levels of intensity of mobility problems. An important dimension of clothing, the symbolic value, was not being taken into account by the manufacturers in the design process; therefore, the final user's needs were not all being met. Thoren concluded that a single solution to satisfy user, manufacturer and distributor is unlikely, but increased satisfaction is attainable by concentrating on the manufacturing, marketing and end-use of a product while in the development stage and the use of information technology to provide support is recommended. At the time of Thoren's study, some of the technologies that are now being used in the clothing industry were not available. In addition, potential innovations (e.g., service centers at stores to meet individual needs of the disabled user) are considered necessary components to be added to the distribution segment of the system.

Watkins (1974) explored functional design theory as part of curriculum changes in a university apparel course. Watkins saw limited differences between the clothing design processes for ready-to-wear and specialized 'functional' clothing. She believed that all clothing is functional because clothing must cover the body and ornament it. Certain specialized clothing, she explains, may include perhaps more thermal qualities, for example, or allow greater freedom of movement in certain situations, protection, and safety. Watkins encouraged designers to take an interdisciplinary approach to design and explore the relationships between apparel design and other disciplines. Her view is in line with Vanderheiden's (1990) views on generic product design from a human factors' point of view. Regan (1997) has made a strong case for this rationale from a theoretical viewpoint with the incorporation of a concurrent engineering approach to apparel design. Hers is an interdisciplinary approach exploring relationships between clothing and other industries. According to Watkins, designers who specialize in functional design must have a thorough background in mechanics, body structures, properties of materials, basic psychology, and visual appeal. In this way, the task is different than design for ready-to-wear goods, where most consumers buy a product for looks rather than for a special

function, because specialized knowledge is not considered to be essential for successful ready-to-wear design.

In the foreword of Watkins' 1984 book, Clothing the Portable Environment, DeJonge describes a 'new' approach to clothing design, which is often referred to as 'functional design'. "Functional design involves a process that takes the designer step-by-step from the initial idea through an evaluation of the final design" (Watkins, 1984, p.vii). DeJonge's functional design process closely resembles the apparel design processes outlined in the previous section of the literature. In fact, DeJonge's work is generally accepted by clothing and textile researchers to be a landmark by which many clothing designers develop their own processes. However, differences between merchandising and functional design processes become apparent when the details of each system are explained. Regan, Kincade and Sheldon (1998), Gaskill (1992), and Glock and Kunz (1990) make constant references to line planning and line assortment. These parameters are the domain of the retail product development strategy and deal with many products for multiple Users; whereas, functional design processes (e.g., DeJonge) use the terms of an individual customer because the product is more specialized or custom designed.

The formulation of a design theory for clothing, necessary so that designers set down their processes in a logical manner, to avoid designing in a 'black box', has been applied most often with items that have a function to perform. Examples of empirical tests of the design process are a jacket for kayakers (Mullet, 1984), an upper body practice garment for violinists (Vass, 1989), a figure skating costume, clean room garments, clothing for a young adult with spina bifida (Lamb & Kallal, 1992), clothing for a child with sensory deprivation (Haar, 1999), and clothing for premature infants (Bergen, Capjack, McConnan & Richards, 1996). All of these studies have used the full, or adaptations of, the basic design process to create clothing for special populations with the emphasis and knowledge of the User's specific needs. Design theory researchers have borrowed from engineering, ergonomics and architecture literature in attempts to define a formal design-within-product development process that can be applied to "real-world" activities. In the clothing field, much research has focused on the design of specialized products as a way of applying a linear process; however, several problems exist with this body of literature. Unfortunately, some research fails to specify which steps are being used in the design process. There has also been a concentration of needs assessment studies that explore the early stages of product development without follow through to design or

implementation processes. In addition, a large number of case studies on specific products with small sample sizes have been performed thereby reducing generality. In addition, since 1995 recent work in this area is scarce (Clevenger, 1999). Analysis of the research supports the view that successful product development frameworks should begin with the customer regardless of the direction in which a company proceeds towards realization of a tangible product. Whatever the stages, product development is an essential part of the ready-to-wear apparel industry and is growing more specialized, as firms struggle to give customers a satisfactory product that not only meets but exceeds expectations.

Clothing for individuals with disabilities has long been considered under the umbrella term of ‘functional design’. The following section will explain in more detail specific studies relating to functional design for people with disabilities.

Applications of functional design for people with physical disabilities.

Much applied research has been performed to design and produce clothing for individuals or small homogeneous groups with physical disabilities; the bulk of it written before 1980. The results of these studies shed some interesting light on the commonalities of clothing problems and needs for people with various types of physical disabilities. The limitations of these studies are that most of them are User specific and result in one garment being designed and/or produced for one person or a small group of Users. These studies do not follow a version of the design process theory and none of the research was carried out with a view towards a retail distribution environment. One reason for this could be the time frame in which they were completed. The product development theories outlined in previous sections were mostly completed after the mid 1980s; whereas, the following studies were carried out in previous years, without the benefit of theoretical frameworks developed in the 1980s and 90s, and without the technology available in the 1990s and 2000s.

Hallenbeck (1966) compiled an exhaustive list of research completed in this area. The following are general conclusions drawn from the existing research by home economics and rehabilitation professionals:

1. The basic assumption underlying design of special clothing is that the clothing must solve the problems of the disabled person (product development is now becoming User focused in an effort to solve multiple needs).

2. From the point of view of design and production of clothing, the physical impairment, and not the cause, is the essential factor (this is a similar view taken by researchers working decades later).
3. Garments may be designed to include several special features that make them useful for many kinds of physical disabilities (first practiced by Dorothy Behrens in 1962-63).
4. Individual differences in size and body proportions, individual preferences in fabric, style, and color and special problems of need resulting from the disability and environmental circumstances would appear to rule out 'mass production' of any garments other than underwear or exercise shorts and skirts at the this time (the challenge of this research study).
5. Basic adaptive clothing best serves the disabled person if it is further modified for individual needs (e.g., a pouch pocket put on the side of the 'good' hand).
6. Many ideas and general design features are available but few patterns or specific detailed instructions exist for making or modifying garments (hence the need for a more accessible clothing product).
7. A disabled person, particularly an adult, should be able to obtain special clothing without having to make or adapt it themselves.

Hallenbeck's conclusions are still relevant to guide research. Strategic points of relevance for the development of clothing in the current study include (a) problem solving nature of clothing solution (point #1), (b) use for a variety of disabilities, with further modifications for individuals (points #3 and #5), and (c) procurement of such clothing in a ready-to-wear environment (points #4 and #7). Both Thoren (1997) and Vanderheiden (1990) have suggested similar strategies.

Later studies between the mid-60s and late 70s were very user-specific in their problem-solving. Kernaleguen (1978) and Hoffman (1979) published books with specific adaptations detailed with illustrations and descriptions and research studies approached the problems from a much narrower angle. Friend, Zaccagnini and Sullivan (1973) were interested in solving some of the children's clothing problems that had long been left to parents to solve. They performed two case studies to determine the best design solutions for clothing for two children. The first case was a nine-year-old girl with cerebral palsy and the second case was a teenage girl with spina

bifida. To develop the clothing, the researchers looked for commercial patterns that could be adapted for a pants outfit for the teenager and they developed innovations for each of the clothing patterns. The garments were constructed and the researchers, mothers, and other caregivers evaluated each of the clothing innovations. Limitations for this study were that it was a very small sample, different disabilities, and the girls were different ages. The study suggested that commercial patterns could be adapted for people with varying levels of ability, if a person has the skills needed to create the adaptation.

Schwab and Sindelar (1973) looked at designs for homemakers with physical limitations. For a sample of 46 women, they discovered four common problems with existing clothing: (a) difficult styles to don and doff, (b) hard to manage fastenings, (c) lack of freedom of movement for such activities as crutch-walking or sitting in a wheelchair and (d) lack of extra-strength fabric to handle wear and tear of garments from wheelchair, crutches or braces. Their recommendations were that clothing for this population needs to be accessible, roomy, and strongly constructed with easy fasteners, similarly to some earlier studies (Frescura, 1963). They also discovered that these women were not familiar with any developments that had taken place with functional clothing. None of the participants was familiar with specially adapted home sewing patterns, and only a small percent were familiar with manufacturers of specialized garments. This study demonstrates the lack of information circulating about functional garments to the people who are most in need.

Warden and Dedmon (1975) began their study by stating that mass production of clothing for seriously handicapped persons is not financially feasible, that commercial patterns adapted for their use are not available in the retail market, and that little research has been directed specifically to brace-related problems and clothing construction. In this study, four people confined to Milwaukee braces and two people who formerly used braces were interviewed. The six young women were aged between six and seventeen years old. The results showed that they preferred to wear shirts, tops and pants; also, maxi dresses because these all completely covered the brace. This finding supported one of Kaiser's (1985) claims that clothing is worn for concealment. Needs existed for clothing that is more durable, more absorbent, larger size, additional fabric and these findings are in line with the Schwab and Sindelar (1973) study of homemakers. The Evaluators in the Warden and Dedmon study could not find ready-to-wear garments that completely covered the brace. As most young women, they had a desire for

fashionable, attractive (to resemble their peers), and durable clothing. As a result of the research, garments were made using alterations to existing patterns, and the 'new' clothing was considered successful. Characteristics of the new clothing included shirts, tops, pants, and maxi dresses, all of which were durable, absorbent and came in larger sizes with additional fabric to cover the braces and helped the girls resemble their peers.

Moran (1976) investigated the clothing needs of elderly incontinent women in six nursing care establishments in upstate New York by interviewing personnel ($n=21$). The criteria for their clothing was as follows: it should resemble regular clothing, it should be easily manipulated, have attractive color and design features, and be functional for standing, walking, sitting, and toileting, a list similar to Frescura (1963), Schwab and Sindelar (1973) and Warden and Dedmon (1975). An item of clothing was designed and evaluated by patients, nursing staff, caseworkers, and occupational and physical therapists. Characteristics of the item were a blouse and skirt in a satisfactory color for all the Evaluators, with an adjustable waistband that allowed ease of dressing and extra waist size for the sitting position. The garments were considered successful by all the evaluators and the conclusion was made that this type of product could help restore incontinent women to a normal social life and that manufacture should be encouraged.

Studying a sample of five elderly women between 74 and 84 years of age, Phipps (1977) identified style features in outerwear preferred by elderly women with a variety of physical disabilities. The research problem stated was that the individual presents problems for manufacturers due to hard to fit figures, covering a wide range of sizes, and different personal tastes and preferences. The result was a garment designed for ease of use and constructed from easy-care polyester. The garment was rated successfully against the subjects' 'normal' clothing. Phipps concluded that a successful product is possible, but further research is necessary in manufacturing and promotions and suggests that manufacturers and commercial pattern companies could offer styles that could also be worn by non-disabled persons. Phipps also discussed the theoretical possibilities for the manufacture of special clothing for people with physical disabilities.

White and Dallas in a 1977 study, decided to focus on helping an individual with clothing problems. The subject was a unilateral upper extremity amputee child, aged seven years. The aim of the researchers was to create garments that facilitate self and assisted dressing and, thereby, enhance the personal and social development of the child. They used an occupational

therapist to identify dressing problems of the child, while a clothing designer used the information to develop solutions for clothing patterns and fabrication of new garments. This study demonstrates the success of a collaborative approach between patient, caregiver, therapist and clothing designer, to develop a successful custom clothing product.

Reich and Otten (1991) conducted a needs assessment study of arthritis patients looking at how specific physical aspects of an individual's condition affect clothing and related issues. This study did not intend to develop a product but rather to identify general clothing needs of a wide variety of subjects with a similar condition. This marks a departure from previous studies and begins a new stage of investigation to satisfy a larger population. They chose arthritis as the physical condition, based on the current figures received by the Arthritis Foundation that stated 37 million people (one in seven of the total U.S. population) have some form of arthritis, and the authors determination of the significance of this handicapping condition (Reich & Otten). The authors used a sample of 787 arthritis patients, of whom 77 percent were women. The principal movement problems were with fingers, hands, knees, shoulders, and wrists. Lack of comfort, unsuitability of designs, proper fit, and fastener manipulation as well as body fatigue, pain, and weakness while handling difficult and unyielding clothing were cited as problems, findings similar to Schwab and Sindelar (1973) and Moran (1976). Features in ready-to-wear clothing that proved most difficult were identified and suggestions for improvement were made by the participant, which included fabric preferences, additional ease placement in various garment areas, larger openings (for example at the neckline and armseye), and better fastener and pocket design and placement. The findings were recommended to be useful for clothing designers, manufacturers and marketers. Reich & Otten mention that clothing manufacturers and marketers should pay attention to the requirements of individuals, so that features designed into clothing for this target market actually benefit the customer in some way.

An overview of design suggestions.

Although developed from User-specific studies with small samples, many suggestions on suitable clothing features for the development of clothing products for people with physical disabilities have been tested and put forward. From the review of the literature about specific design solutions for individual problems, a number of features that are considered desirable in the clothing appeared repeatedly and are shown in Table 7.

Table 7. Design Solutions and Features from Clothing Literature

Problem	Solution	Feature	Study	
Difficulty donning and doffing clothing	Use styles that are easy to don and doff	Over head donning and doffing Side front openings Side zippers neckline Two front openings Sleeve openings	Side or inseam openings on pants Wrap around styles Shoulder opening Large neck and sleeve openings Center back opening Snap crotch Envelope	Frescura (1963) Schwab & Sindelar (1973) White & Dallas (1977) Kernaleguen (1978) Reich & Otten (1991)
Difficulty managing fastenings (e.g., hooks and eyes, zippers, buttons) due to restricted use of hands and lack of mobility	Easy-to-manage fastenings	Large buttons Flat rimmed shank buttons CF zipper/large pull tabs Velcro dots	Large hooks and eyes Vertical buttonholes Facing sewn down under zipper No fastenings Lightweight	Behrens (1963) Frescura (1963) Schwab & Sindelar (1973) Reich & Otten (1991)
Lack of freedom of movement for a variety of activities (e.g., crutch walking, sitting in a wheelchair)	Add features that allow for movement	Action pleats Box pleats Yokes Elasticated waistlines Raglan or kimono sleeves Bigger armseyes	Underarm gusset Putting more fabric in the garment Back hem of jackets raised Scooped-out seat Cut fabric on bias	Schwab & Sindelar (1973) Moran (1976) Kernaleguen (1978) Reich & Otten (1991)
Inappropriate and uncomfortable fabric	Use fabrics with situational appropriateness	Stretch Comfort Absorbency Air circulation Low static Odor release Non-irritant Aesthetically pleasing	Smoothness Ease of care Dimensional stability Durability Thermal insulation Hypoallergenic Lightweight Non-flammable	Schwab & Sindelar (1973) Warden & Dedmon (1975) Reich & Otten (1991)
Inadequate amount of fabric, e.g., body coverage in w/chair	Provide extra length	Adjustable hems Overlap skirt panels	Extra fabric	Behrens (1963) Warden & Dedmon (1975)
Not all clothing is aesthetically pleasing	Design clothing with more visual appeal	Attractive styling Color	Fashionability	Moran (1976)
Styles of clothing can be constricting and uncomfortable especially during temporary changes	Provide clothing styles that are comfortable and sized appropriately	Big shirts Oversized tops and pants Maxi dresses	Double waistband Adjustable waistband Coat-style dress	Behrens (1963) Frescura (1963) Reich & Otten (1991)
Construction quality inadequate for stress exerted by User	Ensure quality durable construction of all clothing	Reinforcement stitching in stress areas Double stitched seams		Kernaleguen (1978)
Inadequate coverage of the body (e.g., for poor circulation)	Ensure coverage in needed areas	High neckline Long sleeves		Behrens (1963)
Some features are irritating and get in the way	Adapt features	Sew down collar so it does not ride up on neck Put a pouch pocket on belt		Behrens (1963)

Manufacturing

Manufacturing involves turning the idea of a product into a tangible entity, which will be distributed to consumers as output. In order for a product to be transformed from an idea into a sellable object, it must be manufactured. This involves transforming raw materials into a finished consumer product. In the automobile industry, steel and other components become cars and trucks. In the textile industry, manufacturing is generally a two-part process. Raw materials such as cotton fiber become fabric in the textile manufacturing process. In the second stage, manufactured fabric becomes clothing in the apparel production process, where fabric and findings (e.g., buttons, trims and thread) are combined by workers using machinery into finished mass-produced clothing products. Traditionally, clothing has been manufactured in the same way for a number of years, regardless of size and type of the company. A master pattern is made and graded (i.e., making the same pattern in various sizes). A marker is created to accommodate all pattern pieces, sizes of the patterns, and quantity of items. Fabric is spread on a machine, usually several layers deep to save time in cutting multiple pieces. The marker is laid on the fabric and the fabric is cut around it. The cut pieces are then assembled, using a sewing machine and support technology. The assembled clothing item is pressed, finished, inspected, packaged and shipped to the customer. Many versions of this system exist, depending on the size and type of clothing manufacturer and the ratio of human labor to computerized equipment.

Mass production definitions.

The traditional manufacturing method for clothing since the late 1800s has been mass production. Before mass production existed, products were made on a customized basis. Each item was made individually and was a unique product. A few products are still made this way today, but these items tend to be very expensive for consumers. Mass production developed in the 19th century from a need to produce a large amount of standardized consumer goods for a new middle class mass market with money. Endo (2000) describes the characteristics of mass production as follows: (a) large factory necessary for manufacturing, (b) economies of scale (low margins, mass selling, reduction of unit cost), (c) narrow skill set required of professionals in product design, (d) production by unskilled or semiskilled workers with expensive single purpose machinery, (e) repetition, (f) standardized parts, and (g) high volume of standardized products. Endo lists the advantages of mass production as inexpensive prices, workers rewarded for individual productivity and a wide selection of available products; however, disadvantages

include high inventory, low product variety, much repetition of products and labor conditions. Mass production thrives on being able to produce a large number of undifferentiated goods at a low cost, with the manufacturer dictating to the customer what is sold at retail. In this respect, the production of clothing has been no different from the production of cars, appliances and packaged foods during the course of the 20th Century.

The traditional method of clothing manufacture (i.e., mass production), as it now exists, cannot work for individuals with physical disabilities because most mass produced clothing does not have the special features mentioned in Table 7 and these individuals have problems with access to suitable clothing (MacDonald, Majumder & Bua-Iam, 1994). Lamb (1993) found some problems with the design and manufacture of clothing for the physically disabled. Specifically, she found that some specially designed clothing lacks aesthetic appeal, lacks current fashion appeal, and lacks situational appropriateness. She recommended that designers and manufacturers give attention to how the wearers feel about themselves and how others might react to them because wearers are using their clothing as visual cues. She also suggested the use of market segmentation by manufacturers and designers for people with special needs.

Clothing choice for the consumer is extremely personal, and depends on several objective and subjective interacting factors, such as personality, income level, social status, and body type. Paradoxically, manufacturers of mass-produced clothing products traditionally standardize their products to fit large groups of consumers, in order to profit from economies of scale. For this reason mass production has been traditionally the optimal method of distributing a product to the public at a profit.

Economies of scale, the benefits of mass production, are only obtained with repetition of standardized products and parts. The body structure and physical abilities of someone with a disability are not standardized. Every disability is unique and comes with its own set of sizing, fit, and mobility anomalies. Mass produced clothing, without adaptation for special needs, cannot serve this population efficiently or effectively. Finding ready-to-wear fitted and stylish clothing for women with physical disabilities is problematic. To approach the problem on an individual case-by-case basis which is a solution proposed by previous researchers (Frescura, 1963; Friend et al., 1973; Warden & Dedmon, 1975; White & Dallas, 1977), may be too costly and time consuming for the clothing industry. Manufacturers would have to be willing to produce a fitted garment for each body not in the 'normal' range of movement, posture or

standard dimensions for the clothing industry. Limited evidence exists suggesting that manufacturers who are successful with mass production would be willing to make these adjustments.

Sizing.

Another problem with finding an acceptable method of designing specially produced clothing items lies within the current apparel sizing system. The sizing system for ready-to-wear clothing in the United States is based on outdated standards that are pulled from anthropometrical data taken by the U.S. Department of Agriculture (USDA) in 1941 from the mean measurements of 14,689 women (O'Brien & Shelton). For this reason, fit of ready-to-wear clothing is a problem for many women (Huckabay, 1992). The research by the USDA was funded through a Federal Grant under the umbrella of the Works Projects Administration and functioned within the industry for a number of years; however, even the 'average' body size and silhouette has changed since 1941 due to changes in our daily lives, culture and health. In addition to outdated anthropometrics, few efforts have been made to collect large amounts of data from the 'non-typical' consumer population. The U.S. military maintains, by far, the largest current database of body measurements, but the physique of men and women in the military does not necessarily reflect that of the general population in size, shape or proportion, due to the age and lifestyle of those in the military, nor does it necessarily reflect the body size and shape of people with physical disabilities.

Standardization attempts have been made at the U.S. Federal level, including Commercial Standard CS 215-58 (U.S. Dept of Commerce, 1958) and Voluntary Product Standard PS 42-70 (U.S. Dept. of Commerce, 1971). However, major discrepancies still exist in ready-to-wear sizing and even more so in women's clothing than in men's clothing. To exacerbate matters, many designers do not size according to this U.S. system and have developed their own methods of sizing and labeling apparel products (Stone, 1999). This situation seems to be more diverse in the US than in many other countries, where trade alliances are forcing manufacturers to adopt generic standards for a very broad consumer base, for example, in the newly formed European Union.

Some researchers have tried to address this sizing problem by studying various demographic cohorts. Very few studies have concerned themselves with the fit of ready to wear, mass-produced clothing for individuals who do not have 'normal' body proportions and 'normal'

mobility. A few studies have looked at problems of fit of clothing for the elderly population. Reich and Shannon's (1980) survey of 297 equally distributed elderly males and females with physical disabilities confirmed that fit is a significant problem with existing ready to wear clothing. Reich and Otten (1991) surveyed 787 individuals with arthritis using a questionnaire, to try and gain an understanding of the specific clothing needs of this group. The results indicated significant problems with fit in clothing for women with arthritis. In another study of elderly individuals, Phipps (1977) studied the clothing needs of a small (five) purposive sample of elderly women between 74 and 84 years old with arm or leg disabilities who were residents of nursing and convalescent facilities in Montana. Fit was considered a problem in ready to wear clothing for these women, and Phipps extended her discussion to include the manufacturing and theoretical possibilities for further research in ready-to-wear clothing and commercial pattern companies for people with special needs. Phipps contends that manufacturers could offer styles that could also be worn by non-handicapped persons as well as clothing specially designed and produced for older, handicapped women.

Relatively little anthropometric information is available for the elderly and research shows that mass produced clothing seems to serve the needs of the elderly less effectively (Woodson & Horridge, 1990). They took measurements of 104 ambulatory women aged 65 and older using a Body Graph Measuring Device, to determine how older women's bodies deviated from standard sizing systems such as PS72. They found some significant differences, mostly in body shape, for example, prominent abdominal extensions, lowered bustline, and rounded back, which would affect the fit of standard apparel. Differences in width, length measurement and additional curvature to the body further heightened the differences. They stated that fit also becomes more complex for women over 65 due to variations in posture. They recommended that further research could focus on methods of measuring taking into consideration bodies that deviate from the standard size and postures, and that technology (e.g., computers for assessing means of body dimensions) should be employed to save time. The conclusion that can be drawn from this study is that mass production of clothing serves the needs of the elderly, many of whom suffer from some type of physical disability, less well than other demographic segments.

Although no data supports the acceptance of individually sized ready-to-wear clothing for people with disabilities, Caldwell and Workman (1993) explored the potential market for customized clothing patterns that can be purchased in fabric retail stores. They determined that a

need exists for these patterns by women with irregular anatomical structures. This finding could be extended to women with physical disabilities.

Distribution

Traditionally, distribution of clothing products covers the movement of a finished product from the manufacturer's loading dock to the retail sales floor where it will be purchased by a consumer. Many steps may be taken within this process, depending on the product, the retail environment and the company type. Generally, after a product is assembled, pressed, finished and packaged, it is shipped to the customer (Stone, 1999). The customer (i.e., the retailer) might be within the company, if the whole process is vertically integrated, or might be a distribution warehouse for a variety of retail stores. In many cases, products going directly to retail customers are 'floor-ready', which means they are labeled with hang tags, steamed and hung on racks ready to move right onto the sales floor of a store. In all cases, the object of this process is to sell the product to the retail customer as quickly as possible.

The traditional retail environment is no longer the only way to purchase a mass-produced clothing product. Consumers can now purchase via catalogue, television or Internet. As an alternative to purchasing mass-produced clothing, consumers can have a product custom-made. Access to custom-made clothing ranges from the highest quality haute couture and tailoring establishments, to home-based sewing businesses. Customization is logically the most successful in terms of getting the exact product that is needed but can be expensive and time consuming. In a 1991 study of consumers of customized sewing services, Johnson, Littrell and Reilly found that these consumers frequently used other customized services and that 65.5% of them expected that a clothing item made by custom sewing service would be priced more highly than a ready-to-wear product. The researchers found that the typical User had a higher income and education level than the general population, leading them to recommend that anyone starting in this business should contact professional women's organizations. Watson (1998) also found that women who purchased sewing services had a higher income and education level than the general population of women in the United States. Watson's study was done using a sample ($n=657$) taken from a pool of women at the same university as that of the current research study; therefore, some similarities may be found between Watson's sample and the current's study's sample in terms of preferred methods of purchasing clothing products.

Clothing researchers have studied the distribution aspects of clothing for retail consumers with physical disabilities. O'Bannon, Feather, Vann and Dillard (1988) looked at the type of information sought and the information sources used by wheelchair-bound consumers when purchasing clothing. They found that people with disabilities use a variety of information sources to make their clothing purchase decisions, with family members and mail-order catalogs ranking highest as the sources most often used. Retail sales personnel are viewed as personal sources for making clothing purchase decision. The most important types of information sought by these consumers are price, care information, garment coordination, fiber content, budget, and stylistic appropriateness. Fashion trends are deemed the least important. The highest perceived risk in making clothing purchases decisions is physical risk, operationalized thus; "a combination of the subjective uncertainty of selecting physically uncomfortable clothing and the importance of avoiding physically uncomfortable clothing" (p. 15). O'Bannon et al. suggest implications for marketers and educators for improving product performance and training knowledgeable sales personnel.

Wuest (1999) found that an elderly population and retailers placed different levels of importance on various customer services in a retail situation. Elderly consumers placed reliability and provision of service as promised highest on the list of five given factors in the survey, while retailers placed responsiveness highest.

Barriers to shopping for the consumer with physical disabilities can be physical and non-physical. MacDonald, Majumder and Bua-Iam (1994) studied purchasing practices and barriers to shopping for people with physical disabilities and found that these consumers are willing to pay more for clothing that fits and serves their needs, but, due to the barriers to shopping that exist, both physical and non-physical, acquiring this clothing is not easy and in many cases, physically exhausting. The majority of subjects in the study made independent shopping decisions (i.e. without the aid of another person at the point of purchase). The authors made recommendations that a National Information Center is developed to serve as a clearing house on apparel information and that stores try to determine the optimal store attributes preferred by customers with disabilities. The authors also address the impact of retailing depersonalization, the apparent lack of knowledge of store personnel and attitudinal barriers to selling. The results suggested an information gap regarding special clothing made for this population and the knowledge needed to acquire it. The study showed that consumers are willing to pay more to

obtain acceptable clothing. Researchers have found that the availability of clothing information is limited and that some information is repetitive, involving time-consuming searches.

Clothing advertisers should not leave people with disabilities out of the marketing and distribution chain. Research has shown that they could potentially play an important part in this phase of the clothing system. When viewing a fashion advertisement featuring models reclining in a lawn chair or seated in a wheelchair, a group of working women without disabilities ($n=101$) rated themselves more likely to enquire about, consider purchasing and actually purchase clothing items modeled by the female in the wheelchair (Workman & Freeburg, 1996). The model in the wheelchair was deemed more credible in creating a customer commitment to a fashion product. Although only 1.5 percent of people with one or more physical disabilities appear in advertising media (Gerbner, 1998), the Freeburg study shows that consumers might be likely to commit to products advertised by models with some type of physical disability.

Finally, communication methods for information about available products need to be thoroughly investigated. In a questionnaire survey of orthopedically disabled adult men and women ($n=91$), information sources about selection, adaptation and construction of clothing were prioritized in order of preference: (a) county extension bulletins, (b) videotaped programs, (c) catalogs, and (d) pamphlets (Koester & Leber, 1984). The authors recommended that more information should be distributed to disabled clothing customers using these methods.

Future Paths

In the following section, new strategies are presented. The first, *Universal Design*, is a concept borrowed from housing and product design literature and refers to a design method, which encompasses all people. The second, *Mass Customization*, refers to a concept gaining acceptance in many industries as a way of serving a niche market of one person, according to personal needs and preferences.

Universal Design

Universal Design, design for all people, good design, and lifespan design, are a few of the names that have been given to a concept that has become a strategic research area for the designers of our built environment. The concept of Universal Design refers to creating environments and products that are usable by people regardless of their age or physical ability.

The term was first used by Ronald Mace of the University of North Carolina in 1989, with a view to eliminating the term ‘special needs’ in reference to spatial and product design:

Universal Design is the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. The intent of Universal Design is to simplify life for everyone by making products, communications, and the built environment more usable by as many people as possible at little or no extra cost. Universal Design benefits people of all ages and abilities (Center for Universal Design, 1997, p1).

Both Universal Design methods and the ADA attempt to make life more equal and satisfying for all people regardless their abilities and at the same time attempt to facilitate independence through adaptive environments and products. This parallels much of the research done in the clothing field. Clothing researchers have attempted to find ways of producing clothing that makes life equal and satisfying through its ease of use. Much of the early clothing research was begun by rehabilitation workers promoting independence through adaptive clothing. In this study, clothing is being considered as a product and clothing for people with physical disabilities as a specialized product. Therefore, it is logical that the concept of Universal Design can be used when thinking about clothing for an independent lifestyle.

The Center for Universal Design outlines seven principles to be used in guiding and assessing an environment or product that is universally designed. These are outlined as follows:

Principle One: Equitable Use – The design is useful and marketable to any group of Users.

Principle Two: Flexibility in Use – The design accommodates a wide range of individual preferences and abilities.

Principle Three: Simple and Intuitive Use – Use of the design is easy to understand, regardless of the User’s experience, knowledge, language skills, or current concentration level.

Principle Four: Perceptible Information – The design communicates necessary information effectively to the User, regardless of ambient conditions or the User’s sensory abilities.

Principle Five: Tolerance for Error – The design minimizes hazards and the adverse consequences of accidental or unintended actions.

Principle Six: Low Physical Effort – The design can be used efficiently and comfortably and with a minimum of fatigue.

Principle Seven: Size and Space for Approach and Use – Appropriate size and space is provided for approach, reach, manipulation, and use regardless of User's body size, posture, or mobility.

(All the above from the Center for Universal Design website; Center for Universal Design, 1997)

Although these principles were formulated primarily for use by architects and other researchers and designers of the built environment, other types of product designers, including those working with clothing, could find them, perhaps with the exception of Principle Four, to applicable to design problems. In addition, according to Null and Cherry (1996), there are four cornerstones of Universal Design, guiding principles that can also be useful for product development in the area under investigation. These cornerstones are essential in developing a product that is (a) supportive (aids in function placing no stress on the user), (b) adaptable (serves a majority of Users who have varying abilities), (c) accessible (removes attitudinal and physical barriers), and (d) safety oriented (promotes health and psychological well-being through increased competence). Other proven benefits of a product designed using this approach are economical, aesthetically pleasing and marketable. Null and Cherry use different terminology to cover the same concerns outlined in the seven principles explained earlier, that a universally designed product should be accessible, adaptable, safe, attractive and marketable to all users, no matter the extent of their physical or mental abilities.

Universal Design has its own design process. According to Null and Cherry (1996), the designer should begin a project with empathy for the user. The design process should be participatory, involving a sequence of activities: (a) establishing goals, (b) conducting research, (c) uncovering concepts, (d) determining needs, and (e) stating problems. These steps are similar to the stages of user-oriented product development found in clothing literature (see Table 6). Implementation of the design ideas for the built environment includes modeling, role playing and post-occupancy evaluation. Fitch, Inc., a business and design consultancy firm, uses the following three-step criteria in product development to guarantee the users' needs are being met (a) Is the product useful? (b) Is the product usable? (c) Is the product desirable? (Null & Cherry). These three criteria could apply equally effectively to clothing product development.

Null and Cherry (1996) also address the issue of marketing Universal Design, acknowledging that the term needs to become well accepted and recognized so that it is not automatically recognized as ‘design for special needs.’ They and many other professionals envision a day when a separate term will be unnecessary because all environments and products will be designed and marketed universally. Harden (1996) recognizes that in the past, the labeling of a product as fulfilling special needs has not been one that attracts consumers. Marketers need to present an environment or product not as something targeting a special population but as satisfactory for the general population. Harden identifies specific marketing channels that hold potential success as catalog and TV shopping.

The conceptualization of universally-designed products and environments for the general population differs from mass production in that accessibility, adaptability, visual appeal and affordability are central advantages to Universal Design, but not always the focus of mass production. A universally-designed product should have mass appeal because of the empathy for the User embedded in the product:

The principles of Universal Design are powerful in their simplicity; they are held within a simple formula that uses thinking and understanding of the varying abilities of people as its base. The four A’s—accessibility, adaptability, visual appeal and affordability, are its dictums; independence, freedom of choice, normalization, value, flexibility, and improved self-esteem are its excellent results” (Null & Cherry, 1996, p.280).

The present study uses these guiding principles in developing a clothing product that has mass appeal and serves the needs of the sample population with physical disabilities.

Mass Customization

The option of Mass Customization is one of the most technologically advanced total services for the end consumer and it has become an essential business strategy throughout many manufacturing industries (Cox & Alm, 1991). By using the technology required for Mass Customization, which is being applied in the clothing industry to improve clothing fit for consumers of basic and fashion goods by progressive companies such as Levi Strauss & Co.; this strategy should be just as effective for people with physical disabilities. Use of the technology for Mass Customization establishes a win-win situation for both users and producers. Users

benefit from getting exactly what they want and need, and producers benefit from adopting the agile manufacturing approach necessary to succeed, where variety and speed must be prime components in order to effectively serve many different market segments as efficiently and productively as possible (Cox & Alm, 1991). In this case, the market segment is users with a physical disability.

The concept of Mass Customization could become one of the most important principles guiding businesses in 21st Century. Mass Customization is beneficial because it offers flexibility, lowers inventory cost and enables niche marketing to a market of one. Customized production transforms raw materials into individually differentiated products, giving consumers a wide variety of product choices. Mass production has already started to give the appearance of providing 'personal', differentiated products, such as soft drinks (several types of Coca-cola), footwear (types of athletic shoes), fast food (Burger King's 'Have it your way' slogan), but certain parameters still exist with these products, so that the final choice is still not completely personalized. Mass Customization involves the production and delivery of high quality custom-made products to the masses at low prices similar to those expected from mass production. (Cox & Alm, 1991).

There are many examples of traditionally mass-produced goods, which can now be designed in large part by the consumer, with some standardized components and various options of how to 'put it all together'. Clothing, computers, and cars are being custom designed for high quality combined with the low cost of mass production, made possible through technology such as the Internet. The Internet not only allows consumers to access manufacturers and participate in the product design process but it also speeds up the management and production of manufactured products by allowing industry to communicate faster and more accurately (DeLong, Ashdown, Butterfield & Turnbladh, 1993). Other technology in the clothing industry is helping to enable mass-customization as a strategic business practice. The '3D' body scanner, which picks up thousands of data points on the human body as a method of measurement, is the most technologically advanced method of collecting anthropometric data to produce custom patterns, but these scanners are not widely available. At this time, five scanners are in use for apparel by the following organizations: the Textile and Clothing Technology Corporation (TC2) in Cary, NC; Levi's in California; Clarity Fit Technologies in Minnesota; University of North Carolina; and the U.S. Navy. The scanner operates using white light with proprietary

measurement extraction software. It captures over 300,000 data points of an image and automatically extracts measurements. It can be used to determine the best fit for ready-to-wear garments, or to be the basis for made-to-measure customized clothing. In a potential retail situation, the data gathered from body scanners, translated to measurements, can be transmitted via the Internet to a production facility, where the pattern is made, the fabric cut and the garment sewn. Consumers can keep a 'smart card' containing the data, for future use. However, the system is in its infancy, and it remains to be seen how well consumers and manufacturers will accept this strategy.

Clothing researchers are realizing the need for research that shows consumers' acceptance of the idea of mass customized clothing. One of the earliest studies in the clothing area to look at the idea of customization for consumers was Caldwell and Workman's (1993) exploration of the potential market for customized clothing patterns that can be purchased in fabric retail shops. They determined a need for these patterns by women with irregular anatomical structures. Using a marketing framework, the researchers identified the patterns as an improvement on an existing product; the researchers surveyed various fabric retailers to assess their customers' reactions to idea. Their findings showed the customization idea was acceptable to customers of smaller independent fabric retailers, with the main advantage for the customer being less frustration fitting patterns to body, while the main disadvantage to the customer being dissatisfaction with the fit of pattern. The customers were also surveyed on their preferred method of measurement data collection. The most acceptable method of measurement was when a customer was measured by another individual (non-store personnel). This was preferred over self-measurement, or measuring an existing garment. The independent fabric retailers cited greater customer satisfaction as the main advantage to selling customized patterns. The researchers believed that the success of this concept depends on measurement accuracy and a reliable source of measurement. In addition, they recommended further concept testing with a specific target market. At the time this research was completed, technology was not at the point it is today in applications related to measurement and fit for clothing products.

Research that is more recent focuses specifically on the mass-customization approach and consumer acceptance. In an investigation into a simulated co-design of a job interview outfit with a design manager, 64.8 percent of women surveyed would place an order in a real-life situation, while 88.3 percent found it easy to make design decisions using the technology (Wu,

Anderson & Ulrich, 1999). A basic profile of women interested in Mass Customization was established by Biedron (1999) using a national sample ($n=1011$) of women between the ages of 20-64 with household income greater than \$25,000. Biedron defined the profile of a mass-customization user as a woman in her 20s who scores high on a general innovativeness scale, likes to shop frequently at large specialty store chains, department stores, off-price stores, warehouse clubs and catalogs and has enough Internet experience to browse and purchase apparel online.

Current advantages of Mass Customization for design and production include consistent specifications between styles, increased organization in cutting and tracking individual pieces, appropriate fit models and more choices in fabric, style and fit (Ashdown, 1999). Other technologies can potentially take this concept even further. Much research is being done with virtual fashion technology at Nottingham Trent University (Gray, 1996). In addition to the 3D body scanning capability, from which the data points are translated into measurements by software programs to construct an individual pattern, the data can be used to create a 3D virtual body of the customer on a computer monitor, from which a 2D pattern can be “unwrapped”. The advantages of this technology for producing more tailored clothing are obvious. Retailers can make use of this technology to present an electronic catalog to the public, for selection, ordering, and paying. The body profiling data can be kept on a card, like a credit card, to be carried with the individual. It can be used to select clothes appropriate to measurements, shape & posture, (a “best-fit” strategy) or to make a single garment. Other advantages include the ability to see the customer’s body wearing the clothing, so choices can be made more easily. Many companies are embracing this customer choice-driven method of marketing. Gerber, a company that specializes in technology for the sewn products industry, is a pioneer in Mass Customization technology. Gerber produces single and low ply cutting machines and digital printers to print small runs and samples (Hye, 1999).

The clothing industry in the United States can benefit from the advantages that Mass Customization offers. In 1992, a report from the Department of Commerce, authored by Howard T. Moncarz, outlined problems with the current U.S. Fiber, Textile and Apparel Industry and suggested a new vision using Information Technology as the key to improving the situation. Moncarz stated several problems with the existing apparel sector, which is, as he sees it, the weakest link in the overall textile complex. These problems included (a) the traditional method

of mass production is no longer enough to ensure productivity and profitability, (b) the entire industry needs fine styling and high quality products through flexible automation in order to compete in the global fashion market, (c) labor no longer has the necessary skills to compete, (d) communication barriers exist, (e) consumers' needs are not being addressed, (e) style changes cannot be tracked, (f) fit of clothing is poor and inconsistent in apparel sizing designations, (g) the apparel sector is not taking steps to compete globally (e.g., by still using imperial instead of metric measurements), and (h) there is inadequate funding for research and development.

Moncarz recommends using information technology to transform the industry. This transformation will make for a demand-activated system of manufacture where goods are pulled directly through the textile product system facilitated by computers. Some of Moncarz's recommendations are already in place in the apparel industry. Technology is being used by some businesses and consumers to obtain quicker access to high quality, customized products and inputs for products. To compete globally, the U.S. apparel complex must become more customer-focused and explore niche markets. In some cases, the niche market is one person and may be served effectively by Mass Customization.

In a study of small apparel manufacturers, Jones (1999) examined strategies for small apparel companies (SAMs) to gain competitive advantage within the market. Using Bordogna's (1996) four manufacturing infrastructure strategies, Jones comments that "The SAM who does not intend to become a mass producer of apparel appears to fit into the next generation paradigm, but due to the diversity of products within the apparel industry and the small employee size of most manufacturers, one manufacturing strategy may not fit the needs of the entire population" (p.18). The study showed that manufacturers who were flexible, or found a niche and developed their resources to address a specific need in the market were successful. Written comments, echoing Moncarz's earlier suggestions, were gathered from the survey form used to collect data from manufacturers. For example, manufacturers said, "Customers want specialty items. If you make a basic item they can get it any place. Specialty garments create a repeat customer" (Jones, p. 163).

Summary of Future Paths

Both Universal Design and Mass Customization offer potential benefits to the clothing User with physical disabilities. Both methods of clothing design and production entail a change

in the clothing system proposed by Thoren (1997). Universal Design addresses the initial conception of a clothing product, beginning with a search for user needs, determination of specifications and realization of a product that suits multiple needs. Conversely, Mass Customization addresses the needs and preferences of a market of one. Both concepts are currently not in use for clothing for consumers with physical disabilities.

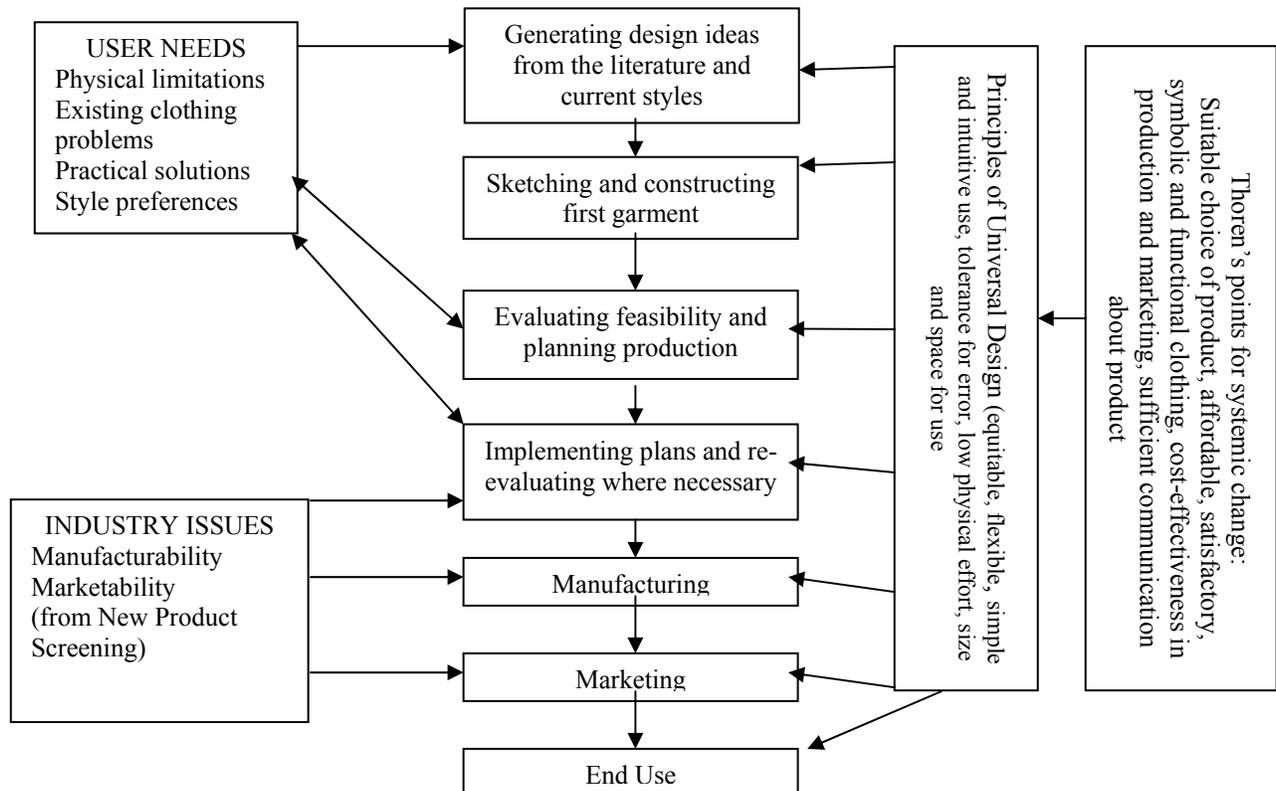
In this study, the principles (i.e., support, adaptability, accessibility, safety, visual appeal, affordability) of Universal Design provide guidelines most applicable for the development of a specialized clothing product. Universal Design should be applicable to clothing just as easily as to other types of products and environments. Mass Customization could be a logical approach for the future of clothing product development for the disabled population when industry and consumer acceptance are more closely involved with the process. The use of Universal Design, a concept typically used in the built environment, allows designers and manufacturers to create a product that will accommodate the needs of all people. Sensitivity and empathy for all Users is the key to Universal Design for the built environment and similar sensitivity should apply to clothing products. Use of the Enabler model to collect data on Evaluators' particular needs provides a legitimate background for designers to explore the physical limitations of consumers with physical disabilities, and to adapt features of potential clothing accordingly. The principles of Universal Design will be used to guide the development of the product through the overall system and to evaluate its success as a product that can serve a variety of needs.

CHAPTER THREE

Conceptual Framework

Two existing frameworks were synthesized with a product development model to guide the overall plan of the research (see Figure 3). The first framework was based on a new approach to clothing availability for users with a physical disability (Thoren, 1997), which called for a system change within current clothing manufacture and distribution. The four points for change within the system that Thoren proposed were (a) availability of suitable choice of clothing products, (b) development of a system that will produce affordable and satisfactory clothing for the physically disabled consumer at both a symbolic and functional level, (c) maintenance of cost-effectiveness in production and marketing, which can be passed down to the consumer (user), and (d) communication about available clothing products. These suggestions for change guided the current research through the process of developing a suitable product. Thoren's suggestions for system change echoed those of Moncarz (1992), who suggested that a new method of manufacturing is necessary in order for apparel companies to remain in business, and that consumer needs should be more effectively addressed. The second framework was built on Universal Design principles, as identified by the Center for Universal Design (1997), and was used as a check throughout the process. These principles ensured that the product would be equitable in use, flexible in use, simple and intuitive, tolerant of error, low in physical effort and would possess size and space for use. These frameworks used within the specialized product development model assisted in ensuring that the product could potentially assist a variety of users and presented a new conceptual framework to be used and tested in the current study.

Figure 3. Proposed model for specialized clothing product development for working women with physical disabilities



Specialized Product Development Model – Description

Figure 3 shows the proposed model for specialized product development to be used and tested in this study. It is designed to work within the existing textiles and clothing system, which involves transforming raw materials into a finished product for consumer end use. According to Thoren (1997), this system is composed of three stages: (a) apparel manufacture, (b) marketing and (c) end use. Additionally, before apparel manufacture begins, textiles must be made from raw fiber (Glock & Kunz, 2000). Thoren does not address this first stage of the system, nor was it addressed in the current study. Stage (a) of Thoren's approach, apparel manufacture, is composed of product development and clothing manufacture. Stage (b), marketing, is composed of promotion and distribution, and Stage (c), end use is comprised of the interaction of the consumer with the final product. From a review of the relevant literature (see Table 6), the product development substage (a) can be further divided into four specific processes: (a) generating design ideas, (b) sketching and constructing first garment, (c) evaluating feasibility and planning production, and (d) implementing plans and re-evaluating where necessary. This approach, combined with Thoren's Stages (b) and (c), lead to the following sequence of processes: (a) generating design ideas, (b) sketching and constructing first garment, (c) evaluating feasibility and planning production, (d) implementing plans and re-evaluating where necessary, (e) manufacturing, (f) marketing, and (g) end use.

Generating Design Ideas

The generation of design ideas involves many activities. For this study, Lamb and Kallal's (1992) FEA User needs model was used to guide development of questions for the User interviews and thus generate ideas for the new product. Gathering user needs information is also an essential part of the design process (DeJonge, 1984; LaBat & Sokolowski, 1999; Lamb & Kallal, 1992). In the Lamb and Kallal model, the user is at the center of a sphere, with culture as a filter between user and FEA factors. FEA factors comprise: *Functional*, *Expressive* and *Aesthetic*. *Functional* needs are important for clothing for people with physical disabilities, and might include such variables as fit, mobility and ease of donning and doffing. To aid in understanding more completely the mobility limitations of each User, the Enabler figure (See Figure 2) was used at this stage of the research to gather information about disabilities.

Expressive needs address such variables as role or status in society. Career can be equated with role or status; therefore, the gathering of data related to working clothing needs and preferences determined expressive needs of the Users. *Aesthetic* appearance of clothing has been found to be a significant factor for clothing selection because people with disabilities are interested in clothing from a durability, comfort and fashion standpoint, although opinions of what is appropriate clothing differs according to the usage context and age of the wearer (Caldwell, 1999; Feather, 1976; Kaiser, Freeman and Wingate, 1985; Wingate, Kaiser, and Freeman, 1986).

The FEA model helped to generate design ideas (process [a] of model) and when information was collected, the second process, sketching and constructing first garment, was performed.

Sketching and Constructing First Garment

This process involved translating user needs and preferences into a visual representation of a clothing product. This sketch and the spec sheet contained information essential to the manufacturing process and were the only information that industry professionals received about the product. This precedent was in accordance with industry methods (Solinger, 1988). Details (e.g., dimensions, color, fabric type, closure type) were recorded on the spec sheet next to the sketch. Further information about construction of the first garment (prototype) is described in detail in Chapter Four.

Evaluating Feasibility and Planning Production

This process involved reviewing the first garment (sample) and determining whether it should go forward into manufacture. From the literature, a variety of activities are completed at this time, including evaluation of the design (DeJonge, 1984; Lamb & Kallal, 1992; Regan, Kincade & Sheldon, 1998; Workman, Caldwell & Kallal, 1999), line presentation and adoption (for retail products) (Gaskill, 1992; Wickett, Gaskill & Damhorst, 1999), materials and fit specifications and testing (Regan, 1997; Wickett, Gaskill & Damhorst, 1999; Workman, Caldwell & Kallal, 1999) and estimation of costs (Workman, Caldwell & Kallal, 1999). In the current study, this evaluation took place in the designing of the product by users and the making of the prototype by the researcher, in wear-testing for user evaluations and in performing industry interviews, to determine manufacturability.

A model was needed to guide data collection about manufacturability of the product, which is defined by Shankar and Jansson (1993) as “the ability to manufacture a product to obtain the desired quality and rate of production while optimizing cost” (p.248). A screening model for new product development (Cohen, 1991) was used to guide data collection in this stage. This model encompassed company operations, potential market, concept marketability, engineering and production, and financial matters. Questions were divided into groups according to these industry areas. This evaluation was designed to yield information giving insight into whether this product, based on the views of companies in the sample, could be manufactured as presented, or if modifications need to be made.

Implementing Plans and Re-Evaluating where Necessary

Glock and Kunz (2000), Stone (1999) and Thoren (1997) considered plan implementation and re-evaluation activities as pre-production. At this stage, the final product should be ready for manufacturing. Implementation as an activity is not expanded upon in some of the product development literature (e.g., LaBat & Sokolowski, 1999; Lamb & Kallal, 1992); however, in some studies specific activities are very clearly defined (e.g., production pattern making) (Wickett, Gaskill & Damhorst, 1999). Re-evaluation of the product could take place during this time, as changes might have to be made during production, which is considered post adoption product development by Glock and Kunz (1990). Changes could take place after re-assessing initial User needs and preferences, after sketching the product, after the User evaluations of the prototype and/or after industry review of the product.

Manufacturing

Manufacturing of a clothing product involves the cutting, sewing and finishing activities needed to transform flat fabric pieces into a product ready for retail sales (Glock & Kunz, 1990; Solinger, 1988). Manufacturing was addressed as part of the industry feasibility review, and data reflected the opinions of companies involved in the study. However, even with a small sample of varied companies, industry information was essential in the product development process and recommended by Thoren (1997) and Lamb and Kallal (1993).

Marketing

Marketing in this study refers to the promotion and distribution to the consumer. Promotion, or advertising, to this population, was not separately addressed in this study, unless specific issues arose in the data collection stage. Distribution, or methods of putting the final product into the hands of the consumer, was addressed in wear-testing and industry interviews. The ability to retail a product was considered an important issue in product development that needed to be addressed as an evaluation activity. In this study, retail criteria were based on business constraints found by Kallal and Lamb (1993) and were linked to the Cohen new product feasibility model. In the Kallal and Lamb study, factors representative of industry constraints had the potential to impact merchandising and retail. They listed the following factors: ability to retail, brand image, calendar, company success, competition's past performance, costing and availability of resources and skills, line plan "formula", past product performance, product quality, product sell-through and the response to market changes. To obtain these retail constraints, Kallal and Lamb gathered information from three companies with in-place product lines and found, that typically, companies "used past performance of their own and their competitors' products as a gauge for projecting new product development" (p.4). The product in this study was a new product with no past performance; therefore, some of the factors in Kallal and Lamb's model did not apply (i.e., calendar, competition's past performance, line plan 'formula', past product performance) and were not used. The remaining retail constraints were included within Cohen's (1991) screening questions for new product development, addressed in the evaluation section above.

End-use

This research was designed to address initial needs and preferences of a group of consumers prior to assessing industry's viewpoint of whether a specialized product can be made and marketed. Appropriateness for end use was inferred from the User's initial needs input and from their evaluations. Wear-testing also contributed to knowledge of end use but represented limited input because of the time frame and situation of the wear-test. Extended end-use including storage and care was beyond the scope of this study.

Moderators

Moderating forces acting on the central stage of product development in the model included, on the left side, user needs and industry issues, and on the right side, Thoren's points for systemic change and the principles of Universal Design. User needs were determined by collecting information about physical limitations, existing clothing problems and needs, practical solutions, and styling preferences. Industry issues were addressed by assessing companies' opinions of manufacturing and marketing feasibility for the prototype. Throughout the process, two guiding frameworks directed product development. Thoren's four points maintained the search for an affordable, satisfactory, cost-effective product, and helped to ensure that sufficient communication was made to bring users and manufacturers together. The six principles of Universal Design were used to verify that the clothing product adhered to the same criteria as any other universally-designed product (e.g., an interior space).

CHAPTER FOUR

Methods

The purpose of this study was to explore the possibilities of making suitable clothing more readily available to people with physical disabilities, and to explore the process of specialized clothing product development, using a sample of working women with physical disabilities, a prototype of an upper body clothing product, and manufacturing/marketing personnel from large apparel companies. The study was exploratory in nature; therefore, qualitative methods were used to achieve the objectives of the research. Qualitative research is defined as “any kind of research that produces findings not arrived at by means of statistical procedures or other means of quantification...some of the data may be quantified as with census data but the analysis itself is a qualitative one” (Strauss & Corbin, 1990, p.17).

Research Questions

The following five questions formed the basis of this research study and guided the development of sample, instrumentation, data collection and data analysis:

1. What are the specific physical limitations of a sample of working women and how do these limitations impact their ability to find, purchase and wear currently available ready-to-wear clothing for the work situation?
2. What are the desirable clothing features that reflect current styling availability, yet allow adaptability for specific physical limitations and maintain a suitable appearance for this sample of women?
3. Can all these selected features be incorporated into an upper body clothing product and still maintain universal appeal and functionality?
4. What issues exist in the production and marketing areas of the clothing industry that might impact or limit further development of this specialized type of product?

Multiple methods of instrumentation and analysis worked best to answer the research questions for this study because of the multiple steps to be taken in searching for results, the variety of respondents, and the types of information to be obtained in each stage of the study. To fully answer the questions outlined above, specific objectives were developed:

1. Gather detailed information about specific physical limitations, professional clothing needs, preferences and current acquisition options from a sample of employed women (Users) who are affected by a variety of physical disabilities.
2. Design an upper body clothing product using Universal Design principles from data gathered in interviews with women and produce a prototype product from this design.
3. Assess the success of the product with the sample of women using wear-testing and interview evaluation.
4. Explore the issues embedded in production and distribution potential of the clothing product with appropriate personnel (Manufacturers) at a variety of clothing companies.

Research Design

The research design for this study comprised two distinct phases and used different methods for each phase. The two phases were (A) User product development and evaluation (Objectives One, Two, and Three), and (B) industry feasibility evaluation (Objective Four). In Phase A, the unit of analysis was the woman with physical disabilities who provided information about her disability and clothing, data that were used to develop a design for a prototype of an upper body clothing product. The method used for Phase A was a multi-faceted, semi-structured interview, carried out by the researcher and containing questions relating to the User's specific physical limitations, general clothing needs and specific clothing choices (Objective One). Data collected from all Users ($n=9$) in this initial stage were used to generate design specifications (specs) for one upper body clothing product universally designed to satisfy the needs and preferences of each User (Objective Two). The researcher made a prototype of the upper body clothing product (Objective Two). While wearing the prototype, the Users were asked to give responses to questions that evaluated various dimensions of the product through wear-testing and by visual and tactile assessment (Objective Three). Their responses were used to determine how well the prototype met their needs and to ascertain their preferred method of acquisition for potential mass-market distribution of the prototype. A group of working women without physical disabilities ($n=6$) (Evaluators) also wear-tested and evaluated the prototype during this stage of the study.

In Phase B of the study, the unit of analysis was the clothing company (Manufacturer). A convenience sample of large vertical clothing companies ($n=6$) was selected. In addition, for verification of the data collected from the companies, an industry simulation/consulting organization was also used. In-depth interviews were used to gather data from personnel at these companies about the issues facing the production and marketing of a specialized clothing product (Objective Four). Obtaining industry feedback in response to User product specifications follows Kallal and Lamb's (1993) framework for product development, in which industry needs are meshed with consumer needs. Cohen's (1988) business model for new product development feasibility was used to develop questions for this stage.

Validity and Reliability of Research Design

Using an exploratory research design for this study was the best approach, due to the lack of existing research on the topic. From a review of past and current literature, no information appeared to be available about resolving the problem of appropriate clothing for women with physical disabilities who work, nor was there inquiry into the use of Universal Design to address clothing needs. In addition, evidence from findings in individual studies was inconclusive about the production and marketing possibilities for clothing for the disabled within the mass market.

According to Babbie (1992), exploratory research is done for three key reasons: (a) to satisfy the researcher's understanding, (b) to pave the way for a more careful study, and (c) to test methods for that subsequent study. Babbie's tri-step justification for exploratory research can be applied to this research study in the following ways: (a) the research idea has developed from personal interest and experiences of the researcher in specialized product development and future paths for the clothing industry, (b) future, more detailed, research studies to further augment the literature should be possible with many different aspects of the current study, and (c) proposed methods can be refined and adapted for use in subsequent studies. Due to the exploratory nature of the study, qualitative, rather than quantitative research methods were most appropriate in this study. Large amounts of accurate in depth information were uncovered from a small purposive sample of clothing Users and Manufacturers. Qualitative research is also useful for finding information where little is already known and for uncovering minute details that might be overlooked in statistical analysis (Strauss & Corbin, 1990).

This study was a cross-sectional approach within a qualitative design. Cross-sectional studies involve taking a cross-section of a particular phenomenon at one time and analyzing it very carefully (Babbie, 1992). The cross sections here were of women with physical disabilities who were working, and current ready-to-wear clothing industry practices. By analyzing these cross-sections in detail, inferences were made about how the two units of analysis at this particular point in time impacted the feasibility of this product. Qualitative interviews have been used in the clothing field to gather data from companies (Jones, 1999; Kallal & Lamb, 1993; Kang, 1999; Regan, Kincade & Sheldon, 1998). Qualitative interviews are a valid way of gathering in-depth information about the nature of the problem and the factual evidence relating to that problem (Rubin & Rubin, 1995).

In addition to qualitative interviews for needs assessment, Phase A of the study included generation of a sketch and production specifications as well as a prototype and evaluation of the prototype by the women with disabilities. Inclusion of these processes follows the framework for product development and has been employed by Kallal and Lamb (1993) where sketches are generated (design refinement), a prototype is constructed (prototype development), and Users evaluate the prototype (evaluation).

Peer checkers and expert valuers were used throughout the research process to maintain reliability of the research design by reducing researcher bias, as recommended by Babbie (1992). Peer checkers were used in the analysis of the data from User evaluations of the prototype, while expert valuers in the fields of clothing, Universal Design and disability checked interview data analysis, sample sketch and clothing prototype, and interview data analysis from company interviews.

Sample

In Phase A of the study, the sample population consisted of employed women with a variety of upper body physical limitations. Upper body, not whole body limitations were required, because the development of the prototype would consist of the upper part (bodice and sleeves) of a garment. The sample of women was purposively drawn. Various techniques were used to select Users for the study. The initial selection of Users was done using a snowball method. This method is appropriate for populations when names and addresses cannot be distributed. “Snowballing is an appropriate method of obtaining participants whereby a set of participants is recommended to the researcher by word of mouth” (Babbie, 1991, p. 309). An

additional method of obtaining participants in the study involved inviting other qualified individuals to participate. Invitations were made via paper and electronic sources, such as local newsletters and email lists aimed at selected groups of individuals. Local professional women's groups were contacted to solicit participation from members who might be eligible. Local hospital support groups were contacted, as well as local community organizations and recreation centers that might have programs aimed at the type of clothing User required in the study. Women who chose to participate in the study received a packet of information with useful advice on how to deal with clothing issues for the physically disabled (see Appendix E). The initial sample size was small ($n=10$) but disabilities were varied (see Table 8). This size represented a nonprobability sample, useful, according to Babbie (1992), when "you may wish to study a small subset of a larger population in which many members of the subset are easily identified, but the enumeration of all of them would be nearly impossible" (Babbie, p.230). Data or listings of people with disabilities is notoriously difficult to obtain and in many cases unreliable due to the variations in types of disabilities. Privacy laws prevent any listings from being published where they would be accessible to the researcher. The only way to procure possible participants was to describe the study and let the women self-identify themselves as having one or more upper body physical limitations and as working. In this case, a nonprobability, small sample was the most effective means of obtaining the depth of information required. After the study had begun, one User dropped out of the study for personal reasons, leaving a sample size of nine for the User group. In addition to women with upper body limitations, a sample ($n=6$) of working women without physical limitations (Evaluators) were included in the wear-test evaluation. This type of sample was necessary to determine the extent of the universal applicability of the clothing product. Evaluators were selected by the researcher from a group of professional women in both administrative and faculty positions in the College of Human Resources and Education at Virginia Tech and were only involved in the prototype evaluation stage of the study.

Table 8

Users Participating in the Study and their Physical Disabilities

User	Disability
01	Fibromyalgia
02	Post-polio syndrome
03	Carpal tunnel syndrome both wrists Osteoarthritis Both hips replaced
04	Spina bifida
05	Fibromyalgia Chronic fatigue
07	Severe trauma from auto accident
08	Peripheral neuropathy Auto-immune disease Vasculitis
09	Rheumatoid arthritis Frozen shoulder
10	Rheumatoid arthritis

Initial contact with a potential participant was made by telephone call or email, during which the researcher determined the person's eligibility for inclusion in the sample. There were two criteria for participant selection. First, they had to be women with an upper body physical limitation. This delimitation to the upper body was due to time and financial constraints of the study and to develop a convenient size of prototype. The second criterion for participant selection was that each woman had to be employed in a position where clothing was important to the function of that position. Importance here was self-defined and categorized by the prospective participants. Questions that were asked informally in the telephone conversations included: Do you consider that the clothing you wear to work is an important part of your job? Does the clothing that you wear to work impact promotion and evaluation in your position? Do you have visibility to the public in your job and is clothing of importance in this respect? If the responses to one or more of these questions were positive, a meeting was set during which the researcher distributed an interview guide containing the instruments to be used in the User interview, and a university Institutional Review Board (IRB) form (see Appendix A). A date for the interview was then scheduled for one week later. To ensure that the User understood and

was willing to participate in the study, the IRB had to be signed and returned to the researcher at the time of this meeting. Participants taking part in this first section of Phase A of the study were referred to as the Users. Users received a package of information relating to clothing for people with disabilities as a token of thanks for their participation in the study. This package consisted of helpful information in the form of text and pictures gathered from fifty years of research, consisting of proven methods to facilitate dressing and altering clothing to suit their needs.

Two consultants from the Textile/Clothing Technology Corporation [TC]² were interviewed to provide additional product development and distribution information as support for Phase B. [TC]² is a research and development organization for the soft goods industry that provides business and professional services to companies within the textile complex (<http://www.TC2.com>, 2001). Data gathered from this organization were used to gain another perspective on industry issues as this organization typically has access to more cutting-edge technology and clothing production and distribution methods than some of the companies used in the study. The consultants were interviewed after initial User interviews, but before the prototype and spec sheet were made. Suggestions made by the [TC]² consultants necessitated changes in the design of the prototype, which the researcher incorporated in advance of making the prototype. The second sample population, used for Phase B of the study, was initially intended to consist of product development and marketing personnel (Manufacturers) employed by a group of successful national and multinational clothing companies. These companies were the 40 largest clothing companies in the United States in terms of gross sales per annum by millions of dollars (Bobbin, 2000). Further descriptions and contact information for these companies were obtained from the American Apparel Manufacturers Association Directory (1999). Within the group of companies, there was variation in product type (e.g., ladies' sportswear, uniforms) and type of company (e.g., manufacturer vs. manufacturer and retailer). From the listing of the 40 companies, the researcher and a professor/expert valuator in the manufacturing/marketing area of Clothing and Textiles at Virginia Tech selected the companies ($n=37$) who were most closely involved in producing the type of product under investigation in this study (i.e., a women's dress bodice). Initial contact with companies was made via email or telephone to introduce the project and ask for identification of a contact person with knowledge of company procedures in product development and marketing who could be interviewed for the study. This procedure helped to ensure that someone with valid knowledge of company

operations and constraints provided information during the interview. As a result of this initial contact with 37 of the 40 companies selected, five representatives responded that they might be interested in participating in the study. Information (Instrument II and Instrument IV, Appendix B) was forwarded to these five individuals. Two responses were received indicating non-interest in participation and no information was received from the three other individuals.

The researcher then contacted alumni of the Clothing and Textiles Department ($n=14$), Clothing and Textiles Advisory Board members ($n=7$), and local manufacturers ($n=3$) in a second attempt to collect data. Of these companies contacted ($n=24$), 10 responses were received indicating an interest in the study. Packets of information were sent via email and six individuals representing six different companies (Manufacturers) reported their answers to the researcher. These six Manufacturers represented the convenience sample for the study. No financial information was collected from these six Manufacturers to determine how they differed from the original goals of Phase B sampling selection. Individuals (Manufacturers) participating in this stage of the study received a Virginia Tech coffee mug in return for their time.

Instrumentation

Description of the Instruments

A variety of instruments were used to gather data from Users, Evaluators and Manufacturers. During Phase A, instruments were needed to (a) gather information, (b) interpret information, and (c) evaluate information from the Users and Evaluators. For Phase B, an instrument was needed to gather exploratory information from Manufacturers. Table 9 shows a complete listing of instruments and their functions.

Table 9

Stages of the Study and Instruments to be Used in Each Stage

Objective	Concept	Instrument	Description	Support materials
One	Upper body limitations	Instrument I Section A	Partial Enabler figure, physical limitations, ranking matrix	
One	Potential clothing problems, body measurements	Instrument I Section B	List of potential clothing problems, solutions and features with sketches	A style book, consisting of flat sketches and pages from catalogs, commercial pattern envelopes, fashion magazines and store research, tape measure
One & Two	Sketch development	Instrument I Section C	Flat sketch (line drawing) of a basic dress bodice and sleeves, front and back, measurement chart	Copies of flat sketches, colored pencils, style book, fabric swatch
Two	Communication of ideas as design sketch	Instrument II	Specifications (spec) sheet of the basic dress bodice	
Three	Evaluation of product prototype, acquisition methods	Instrument III Section A	Evaluation questionnaire, acquisition questions	Prototype
Three	Universal Design	Instrument III Section B	Universal Design evaluation check sheet	
Four	Industry issues	Instrument IV	Open-ended interview questions	Interview guide, Instrument II, cover letter

Note. All instruments can be found in Appendix B.

Instrument I was used to gather information from Users. Section A of Instrument I was adapted from the Enabler figure (Null & Cherry, 1996) to gather information about upper body limitations that might impact clothing issues. Nine areas of potential limitations were identified from the literature, the Enabler figure and a Virginia Tech professor with research experience in specific areas of disability. These areas were (a) incoordination, (b) limitations in upper body

strength, (c) limitations of head movement, (d) limitations of stamina, (e) limitations of sensation, (f) difficulty in lifting, reaching or carrying, (g) difficulty in handling and fingering, (h) inability to use upper extremities, and (i) difficulty with range of motion of upper body. Each of these areas was listed next to an outline sketch of the upper body, with definitions provided on a second page. On the right side of the sketch from the listings was a matrix, which plotted the identifying letter of each limitation area against a Likert-scale ranking of zero to four. The rankings are designed to measure the degree of difficulty with a specific physical limitation. Rankings were anchored at zero (not difficult) to four (impossible) and centered at two (difficult at times). The Users were asked to rank each area of physical limitation that applied to them and were also asked to give extra qualitative information in a space provided on the instrument. These data gave the researcher expanded information into the particular nature of each User's problem, which supported Objective One.

Section B of Instrument I was designed to identify the nature of clothing problems for each User and to link these problems to potential solutions identified from previous literature (see Table 7). Nine potential clothing problems were identified and listed in a table. These problems were: (a) difficulty putting on and taking off (donning and doffing) clothing, (b) difficulty managing fastenings (e.g., hooks and eyes, zippers, buttons) due to restricted use of hands and lack of mobility, (c) lack of freedom of movement for a variety of activities (e.g., crutch walking, sitting in a wheelchair), (d) inappropriate and uncomfortable fabric, (e) inadequate coverage of the body (e.g., body coverage in wheelchair), (f) some features are irritating and get in the way, (g) styles of clothing can be constricting and uncomfortable especially during temporary changes in size (periods of weight gain and loss), (h) construction quality inadequate for stress exerted by User, and (i) not all clothing that is available in typical retail outlets is aesthetically pleasing. Likert-type rankings were provided that quantified the degree of difficulty of each potential problem. Rankings were anchored at zero (not a problem) to four (impossibility) and centered at two (problem).

Section B of Instrument I also contained solutions to each of the nine problem areas together with features found in previous literature to be helpful in solving those problems (see Table 7). Flat sketches (line drawings) of each of these features (similar to those found on commercial patterns) were provided with the instrument to clarify features for Users so that they could select the features they felt most adequately provided solutions to their clothing problems.

In addition, flat sketches and pages from catalogs, commercial pattern envelopes, fashion magazines and store research comprised a style book (Addendum to Section B) from which Users selected favorite styles of dress bodices to which these functional features might be applied. This served the purpose of combining a functional solution with a personal style choice based on up-to-date fashions for business clothing, both traditional and casual.

Section C of Instrument I consisted of several copies of a flat sketch (line drawing) of a basic dress bodice and sleeves taken from a fashion design textbook (Kopp, Rolfo, Zelin & Gross, 1991). This was used to consolidate the information obtained in Section B. The researcher and the User applied the features and styles selected from the Addendum of Section B by using colored pencils to change style lines and add features. In addition, a swatch of an appropriate fabric and color was shown to the User. A measurement chart was included in this section, which was used to record measurements of the Users according to directions on commercial pattern bodice envelopes and industry textbooks (Glock & Kunz, 2000; Solinger, 1988). The measurements recorded were bust, waist, hips and back (neck to waist). The researcher recorded the measurements using a tape measure in both centimeters and inches.

Information gathered in Instrument I was interpreted for use in Instrument II, a spec (specifications) sheet of the basic dress bodice. The spec sheet had a twofold purpose: (a) to interpret and consolidate information gathered in Instrument I so that a prototype could be built, and (b) act as the communication link for the prototype when the researcher gathered data from clothing companies. A spec sheet is also known as a production analysis or quality specifications. According to Giddings (1999) and Solinger (1988) specifications are a typical part of industry practice and are made before the prototype is constructed. "It is usually possible to save a great deal in sample-making time and money by properly analyzing a sketch before the sample or even the fitting is made" (Solinger, p.431-432). Solinger's steps for the production analysis of a clothing product are to (a) determine style line specifications, (b) sketch garment in detail, with sketches of pattern pieces and all grainlines shown, (c) determine fabrication, (d) analyze trims and findings, and (e) determine and state production processes and tolerances for each operation. Instrument II (see Appendix B) provides an example of the spec sheet. Items from each of Solinger's steps are embedded in the spec sheet. Sketches produced in each User interview were consolidated into one sketch of a universal product (dress bodice). From the spec sheet, a prototype was made in a fabric of similar weight to the selected fabric, using

construction techniques similar to those used in industry. A basic bodice and sleeve pattern were developed from standard industry pattern blocks and manipulated by the researcher to achieve the correct style and shape of the finished prototype. User measurements were condensed into two sizes; one of which corresponded to Women's size 16, the other to a Women's size 22, using ASTM standard D5586-95 (Standard Tables of Body Measurements for Women aged 55 and Older, 1995). Interpretation of the information ended with the construction of the prototype in the two sizes.

Evaluation of information was the final component of Phase A of the study. Instrument III (see Appendix B) consisted of two sections: wear-test and Universal Design evaluation. Section A comprised an evaluation questionnaire, used to gather information from the Users in a wear-test session, which took place after the prototype had been constructed in two sizes. During Section A of Instrument III, choice of size of prototype depended on the User's measurements, recorded in Instrument I. Each User's measurements were matched against the measurements of the medium or large sizes to determine which prototype would be the closest fit to wear-test. At the time that the User was wearing the product, the researcher asked the User to rate features of the prototype using a three-point Likert-type scale anchored at one (worse than I envisioned) to three (better than I envisioned), and centered at two (just as I envisioned). Users rated each of the nine clothing problems from Instrument I used in the initial interviews. The format of the scales was derived or adapted from the literature (Huckabay, 1992; Prevatt, 1991; Rainer-Jeanes, 1994). Section A concluded with questions relating to preferred acquisition processes and price for a product that they would be willing to buy ready-to-wear.

Section B of Instrument III comprised a list of principles of Universal Design established by the Center for Universal Design (1997) and used to guide the development of successful universally-designed products. This section was addressed after all User evaluations were completed and was used to evaluate the success of the prototype clothing product in terms of the principles of Universal Design. These seven principles are: equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, and size and space for approach and use (see Chapter Three for explanation of each). The following principles were selected as applicable to this clothing study and were used to assess the universal appeal of the product: (a) equitable use (people of varying abilities can use it), (b) flexibility in use (the product can adapt to fit a variety of different body types), (c) simple and intuitive use

(no mistakes can be made as to how the product will be worn), (d) tolerance for error (e.g., fasteners still functional if not properly closed), (e) low physical effort (easy donning, doffing and wearing), and (f) size and space for use (room enough for comfort and mobility). These assessments were made by the researcher and a professor in the Universal Design specialty of the Housing area at Virginia Tech.

For Phase B of the study, an instrument was needed to gather exploratory information from clothing companies about the issues surrounding the development and marketing of a specialized clothing product. Instrument IV consisted of open-ended questions derived from four areas defined by Cohen's (1991) screening questions for new product development opportunities. The four areas were: (a) Company Operations, (b) Engineering and Production, (c) Financial, and (d) Concept Marketability, as described in Chapter Three. These questions addressed areas impacted by the development of new products, a category into which the prototype developed in this study would fall. These questions raised issues relevant to future assessment of feasibility of specialized clothing products relating to company's current products, compatibility of current company activities, technologies involved in production and their cost, and financial aspects of producing and selling the product. Instrument IV and Instrument II (the spec sheet) were sent to selected companies prior to telephone interviews so that the respondent had a chance to review materials before answering interview questions, a technique used by Regan (1997) and Woodard, Kincade and Owens (2001). The researcher also traveled to [TC²] for a personal consultation with personnel to collect field notes and observe pertinent equipment use.

Validity of the Instruments

Validity must address the question of whether the measures used during the study will accurately "...reflect the *real meaning* of the concept under consideration" (Babbie, 1991, p. 132). The instruments to be used in User interviews (Instrument I, Sections A, B & C) were developed from various aspects of the literature. By incorporating an adapted version of the Enabler model (Section A) to describe type of physical limitations, the instrument for this interview format "closely reflect(s) the world being described" (Rubin & Rubin, 1995, p.85), a necessary criterion for validity in qualitative research. The Enabler model is an accurate and useful way of translating medical problems into design solutions in the building arts field (Null

& Cherry, 1996). Section B of Instrument I was developed from the literature on clothing for people with disabilities (see Table 7) and recorded information about proven problem areas taken from fifty years of research. Section B also included a style book addendum, which provided Users with examples of current styling in brick and mortar retail stores, general apparel catalogs and online shopping with brand name retailers. This provided validity because women were shown a wide variety of current ready-to-wear women's styles for working clothing. In Section C, allowing the User to co-design the clothing product with the researcher provided validity in that the sketch represents the true wishes and needs of the User.

The spec sheet (Instrument II) developed from the sketch of the product after User interviews was a valid method within the industry of communicating various dimensions of a product (Solinger, 1988) and was common industry practice if high quality and cost-efficiency were to be maintained throughout. It provided communication about the engineering of a product through the product development and manufacturing stages. Components of the spec sheet were selected from industry texts (Glock & Kunz, 1990; Solinger, 1988; Tate, 1989) and from class notes (Giddings, 1999).

Wear testing (Instrument III, Section A) involved having the Users try on the clothing product to assess how it corresponds with the nine clothing problems from the initial interview. This related the prototype directly back to User needs and preferences, and helped to determine whether each of the women's specifications was satisfied by the prototype. This ensured that the prototype followed User needs criteria determined during User interviews, a process deemed important by several researchers (e.g., DeJonge, 1984; Giddings, 1982; Lamb & Kallal, 1992; Thoren, 1997) and an important part of the Universal Design process (Null & Cherry, 1996; Warble-Nienow & Null, 1996). Lamb and Kallal (1992) in their original framework for the design process established that during the evaluation stage of the process the User needs should be reassessed to evaluate if the product satisfied User needs. Every aspect of the original User interview questions was interpreted and evaluated. By developing assessment questions from the literature, validity was maintained through this stage of the process. Section B of Instrument III verified that the principles of Universal Design were incorporated in the prototype, satisfying the criteria assigned to successful Universal Design (Center for Universal Design, 1995).

The questions developed for the interview with industry personnel (Instrument IV) came from manufacturing and marketing screening factors for new product feasibility (Cohen, 1991).

In addition, the concept of bringing industry constraints into the framework for development of new clothing products was envisioned by Kallal and Lamb (1993) and perceived by them to be an essential part of the product development process. Other researchers also consider this an important part of the process (Moncarz, 1992; Null & Cherry, 1996; Thoren, 1997). Additional company constraints, which might be particular to the company and/or the industry and which do not fit into the categories outlined in the protocol arose during the data collection process and were noted in the transcripts. Personnel for this stage of the study (Manufacturers) had a degree of knowledge of both manufacturing and distribution phases and provided accurate information about both processes as they related to their company.

Reliability of the Instruments

Reliability must be present in a qualitative study to ensure that the study is replicable (Creswell, 1994). Instruments I, III and IV contained a detailed protocol, which described the steps to successfully complete the instrument. In addition, pilot testing was performed on each of these instruments to ensure clarity and ease of use. Instruments I and III were pilot tested by two women with disabilities to check for clarity of questions and to determine length of time required to complete the instruments. Their suggestions were recorded and incorporated into the final instruments. A basic garment bodice was used for the wear-test pilot study, to enable the researcher to check for clarity and ease of use of the questionnaire. Instrument II (spec sheet) and Instrument IV, the industry interview protocol, were pilot tested with an expert in clothing industry product development and with an alumna of the department working in industry for communication clarity. Suggestions were recorded and incorporated.

To aid reliability in the design stage, the final sketch and spec sheet which incorporated all User design choices were drafted and verified by a faculty expert in apparel design. The researcher made the prototype, which was a result of data collection in early stages of the study, but became an instrument for User evaluation. The researcher has 12 years' experience designing and constructing functional clothing products to specifications for individual clients. A professor in clothing design evaluated the original sketch to ensure it addressed User needs and preferences, and evaluated the prototype so that it followed the original design and specs.

Data Collection

Data for this study were collected in two phases. In Phase A, data were collected first about the Users' physical limitations, clothing choices and body measurements, and second about their evaluations of the prototype product and their preferred methods of acquisition and price range for the product. In Phase B, data were collected about potential issues in industry clothing production and marketing for specialized products. Data gathered during these two stages helped to satisfy the four objectives explained at the beginning of this methods section. The data collected in both stages generated possible strategies for future production and marketing for the product.

Phase A began with an interview (Instrument I, Sections A, B & C) in which data were collected from Users about their physical limitations (Section A), the nature of their current clothing problems and their choice of solutions (Section B), which were then consolidated into the co-designed sketch (Section C). Also in Section C, body measurements were taken. The researcher recorded responses to all sections with a pencil in the charts provided in the instruments. Data collection during this interview was also audio taped to aid in later transcription of interview notes. Phase A continued with these data being the input for the universally-designed sketch and spec sheet (Instrument II), which was used to produce the prototype and to communicate product information to the clothing companies (Manufacturers) in the sample. Data collection to evaluate the final product was performed by asking Users and Evaluators to wear-test the universally-designed prototype (Instrument III, Section A). They answered a group of questions about the clothing product, which related directly to the information given by them in the personal interviews. They also answered questions relating to preferred acquisition preferences, alterations, and price of product. Data were recorded by the researcher and was written directly onto the question sheet. Data collection was also audio taped to aid in the data transcription process. The Evaluators followed the same process as the Users.

For Phase B, the industry interviews, initial contact was made with clothing companies via generic company email or telephone where email was unavailable. This email message explained the study briefly and asked for a contact person within the company with knowledge of product development and marketing operations. A letter of introduction, spec sheet and interview guide were then sent to this contact person, requesting his/her help in this stage of the study and giving some available dates and times for telephone interviews. This packet of

information was sent to the contact person one week before the scheduled interview, as recommended by Regan (1997) and Woodard, Kincade and Owens (2001). The researcher called the contact person after four days in order to establish his/her willingness to participate and to decide on an interview time. Telephone interviews and email were used to gather information from Manufacturers. The researcher was the only collector of data at this point, interview responses were written on notepaper with pencil or printed from original email replies.

The notes, transcripts and audiotapes of every stage of data collection were the property of the institution at which the research was taking place and were kept in a secure location in the office of the researcher's advisor. Confidentiality was assured to all participants. A code number was assigned to each participant, and only the researcher and advisor had access to this code number.

Validity of Data Collection

Due to the multiple methods used in this study, care was taken to ensure that the methods of obtaining results were valid. In Phase A of the study, interviews were used to collect data from Users. According to Miller (1991), interviews are advantageous for gathering data in many ways, including that (a) interview responses are likely to be correct, (b) interviews yield a high rate of return, (c) supplementary information about the respondent's environment can be assessed, (d) visual materials can be presented, and (e) the interviewer can usually control which person answers the questions (within a multi-subject interview). Qualitative interviewing is a way of gathering in-depth information about a phenomenon, "a way of finding out what others feel and think about their worlds...you can understand experiences and reconstruct events in which you did not participate" (Rubin & Rubin, 1995, p.1). During the qualitative interview process, keywords were taken in note form. This note-taking actually starts the data analysis process simultaneously with data collection (Creswell, 1984). Interviewing is expected to be an effective method of identifying personal limitations and clothing problems within the context of this study. Other methods might not obtain the depth of information necessary to ascertain real User needs and preferences. Information from interviews was used to design a prototype that is User-oriented, as recommended by many researchers of design theory and practice (e.g., DeJonge, 1984; Lamb & Kallal, 1992).

Data were collected during User evaluations of the prototype using wear testing and written evaluation to determine whether the prototype reflected choices made in User interviews. Wear-testing has been recommended by previous research and has been put into practice with many small groups similar to the one proposed in this study (e.g., Friend et al., 1973; Moran, 1976; Phipps, 1977; Warden & Dedmon, 1975; White & Dallas, 1977). Wear testing has been used in many clothing studies as a final component of new product development (Koberg & Bagnall, 1981; Lamb & Kallal, 1992; Watkins, 1984). Wear-testing of a product is done in industry by testing a garment on a fit model for consistency of fit (Frings, 1991; Diamond & Diamond, 1997). In this study, more factors were involved than fit therefore more criteria needed to be assessed. Wear-testing can be problematic in terms of measuring the reality of the situation when testing for garment performance. Validity of wear-testing can be increased as more variables are controlled and explicit instructions are given. There is evidence of low correlation between simulated 'lab' tests and long-term studies (Collier & Epps, 1999); however, due to time and financial constraints, the wear-testing in this study was conducted in a short time frame, not over a longer period of time. The researcher recognized the 'unreal' situation of the wear-tests. The focus of this study at this stage was more on the success of the product development methods rather than long-term clothing product performance; therefore, a short one-time wear-test was considered sufficient to evaluate User satisfaction. Precedent exists for both wear-testing and an evaluation questionnaire in assessment of functional clothing (Bergen, Capjack, McConnan & Richards, 1996). For accuracy of assessment, the evaluation questions related directly to the clothing dimensions outlined in User interviews.

For Phase B, the industry segment of the study, telephone interviews and email were used to gather data. As discussed by Rubin and Rubin (1995), telephone interviews lack relationship building and visible cues of face-to-face interviewing but are sometimes necessary and useful to collect similar types of data. Semi-structured interviews are useful for probing for in-depth information about phenomena (Rubin & Rubin, 1995). They are useful for gathering specific information, where the researcher is guiding the topic by asking questions directly related to that topic. For this study, the sample of Manufacturers was purposively drawn because of their business orientation, but they did not possess geographical proximity. For this reason, telephone interviews, as used by Woodard, Kincade and Owens (2001) were necessary in order to collect necessary data within the time and financial constraints of the study. Gathering data by

telephone and email was the only way that this information could be acquired at this time from a stratified sample.

Reliability of Data Collection

In qualitative research, reliability (i.e., whether two researchers using the same methods will come up with similar results) is generally assessed by transparency, consistency-coherence and communicability of the study (Rubin & Rubin, 1995). Research has transparency if the processes of data collection are clearly laid out and steps are taken to ensure that measurements of specific concepts are the most accurate available according to the constraints of the researcher. The model developed for this study (see Figure 3) shows the flow of the processes used in data collection. To maintain transparency, transcripts were made of all data collection processes and audiotapes made of User interviews, and User and Evaluator wear-test evaluations. Patton (1990) recommends tape recording and taking short notes during the interview process to prevent important information from being neglected, to keep up the pace of the interview and to avoid recall problems. Audiotapes were also useful to ensure accuracy in data analysis. Audiotapes are recommended for reliability by Endo (2000). An expert in the clothing design field checked the sketch and spec sheets to maintain transparency in the evolution of the product. This person was an expert in the clothing design field with experience in industry practices.

Wear-testing with the Users and Evaluators took place using audiotapes as back-up to researcher notes. These audiotapes were replayed to check User comments against the researcher's notes during transcription of the evaluation sessions. During data collection in wear tests, the researcher asked for comments by Users and Evaluators in reaction to the clothing according to specific categories on the instrument. Other comments or suggestions were noted separately. This wear test with both Users and Evaluators was essential to the process because the intention was to have one outfit that will serve the needs of a variety of consumers.

Protocols for User interviews and wear testing evaluation were clearly explained within the instruments. The researcher read only from the protocols given with the instruments – no other explanations or means of data collection were used unless there was confusion understanding the instructions, in which case the revision was noted in the researcher's field notes. The protocols and instruments for interviews and wear-test evaluations were pilot-tested by graduate students in the researcher's department who were not participating in the study.

Suggestions for improvements to the clarity and content of the protocol were noted and checked with an expert in this field before administration of the instruments to the User and Evaluators. To render the time frame reliable for the study, all research was conducted in as short a time as possible, to avoid change through maturation in the situation of the Evaluators and in technology.

A professor in the clothing industry research area reviewed the data collected from Manufacturers. The Manufacturers had been sent a packet of information including the cover letter (see Appendix C), Instrument IV (the questionnaire) and Instrument II (the spec sheet) one week in advance of having to give information to the researcher. According to Regan, there are four benefits to sending the contact personnel an interview guide: (a) to serve as a guide and checklist for relevant topics, (b) as an avenue for replication, (c) to give flexibility in working and sequence of questions, and (d) to inform associates prior to the appointment.

The researcher has performed qualitative work before this study. The researcher's Bachelor's thesis was conducted using a variety of qualitative methods. A series of personal on-site semi-structured interviews were carried out with leaders in a technology-based industry. The results of these interviews were transcribed by the researcher. For the same research study, a content analysis was performed on industry literature from a 50-year period. The researcher's Master's research project used qualitative methods. A content analysis was performed on written and visual clothing media from a ten-year period during the late nineteenth century. In addition, classes have been taken in the researcher's Master's and Doctoral course of study in qualitative research methods. In the Doctoral program, individual and team class research projects were completed by the researcher using qualitative research methods. The researcher is also skilled in apparel design techniques, completing classes in the Master's and Doctoral program in clothing design and construction and product development and analysis. In addition, User-based clothing development has been performed by the researcher in a variety of areas, including theatre costuming, active sports, physical disability, living history museums, weddings and special occasions.

Data Analysis

In qualitative research interviews, the taking of notes during data collection actually begins the simultaneous processes of data collection and analysis (Creswell, 1994) because the researcher is immersed in the process as it takes place (Merriam, 1988). Typically, in qualitative

studies, data analysis takes the form of coding. “Coding represents the operations by which data are broken down, conceptualized, and put back together in new ways” (Strauss & Corbin, 1990, p.57). For this study, coding categories, which sometimes emerge during thorough analysis of the data by an open coding method, were pre-determined according to the framework used to guide the interview and evaluation processes and to construct the instruments; therefore, the researcher’s role was to place participant responses into predetermined categories. By becoming part of the process in this way, the researcher was beginning to analyze data while collecting information from participants.

In both Phases A and B of the study, data were collected from Users, Evaluators and Manufacturers using semi-structured interviews. Endo (2000) analyzed interview data by using a mix of Marshall and Rossman’s (1999) sequential process and Tesch’s (1990) interpretative analysis, both of which have been used separately by Kang (1999), Regan, Kincade and Sheldon (1998), and Vass and Kincade (1999). Endo’s data analysis process is described in the following sentences. After the interviews, field notes and audiotapes are transcribed into written documents. Transcriptions are read carefully by the researcher in order to become familiar with the data and to ‘clean’ the data. The data are then coded, which entails segmenting data into separate units of analysis. This process is also known as decontextualizing the data, or taking it out of its context. Various methods can be used for this, including abbreviations of keywords, colored dots or numbers (Marshall & Rossman, 1999). Data are then recontextualized, which entails linking the units of analysis with common meanings into categories or themes. This process of evaluation and decision-making during data analysis, as constructed by Endo, was used in this study to place data into the relevant product development categories (see Figure 3).

In Section A of Instrument I, data collected on User physical limitations were analyzed using descriptive statistics (frequency and means) for both the individual Users and the total sample. In addition to the textual interview data, some quantifiable data for rating scales were analyzed. This provided demographic charts on the nature of the disabilities involved in the study. Data collected using Section B of Instrument I were analyzed using descriptive statistics, for both individual Users and the total sample. This provided information on the types of clothing problems experienced by the Users in the sample. Analysis of the features developed in the literature and the current professional clothing styles resulted in a co-designed sketch of a bodice for each User (Section C). These sketches were then analyzed by the researcher by

consolidating the information provided in the interviews and sketches to arrive at one final sketch of a universally designed clothing product. Features favored by the women in the sample were incorporated into one sketch, along with design preferences for current styling. In the event that incorporation of features and styles was impossible, preference was given to incorporation of functional features over stylistic features due to the objectives of the study. Analysis of the final design sketch generated a spec sheet (Instrument II). The spec sheet was used as a guide for constructing the prototype, which was wear-tested by the Users and Evaluators. Data collected during the wear-testing component (Instrument III, Section A) were analyzed using descriptive statistics (frequencies and means) to describe how positively or negatively the product met the expectations of Users (e.g., donning and doffing, fabrication). Due to the small sample size, no other statistical tests could be run on this group of data. Acquisition information collected during this stage was also analyzed using descriptive statistics. Section B of Instrument III involved evaluating the prototype and wear-test results to determine the success of the product as a Universal Design. The researcher and an expert valuator analyzed the prototype and wear-test evaluations and determined how successfully each one of the six selected principles of Universal Design was met by the prototype.

During Phase B, data from telephone interviews were transcribed by the researcher. Following this process, information gathered from Manufacturers was placed into categories defined by the instrument (i.e., engineering and production, company operations, financials, concept marketability) using the process suggested by Endo (2000), Marshall and Rossman (1999), and Tesch (1990). Information was put into the four categories using colored highlighters to differentiate the responses. New categories for coding appeared that were added to existing categories. This allowed new data to emerge into their own categories, as practiced by Beach (1999), Kang (1999), Regan (1997), and explained by Creswell (1994). New categories were added as variables to the proposed model for specialized product development.

CHAPTER FIVE

Results

Multiple methods of instrumentation and analysis were used for this study. Multiple steps were taken in searching for results from a variety of respondents, and multiple types of information were obtained in each phase of the study. The following four questions guided the development of sample, instrumentation, data collection and data analysis:

1. What are the specific physical limitations of a sample of employed women and how do these limitations impact their ability to find, purchase and wear currently available ready-to-wear clothing for the work situation?
2. What are the desirable clothing features that allow adaptability for specific physical limitations and maintain a suitable appearance for this sample of women?
3. Can all these selected clothing features be incorporated into an upper body clothing product and still maintain universal appeal and functionality?
4. What issues exist in the production and marketing areas of the clothing industry that might impact or limit further development of this specialized type of product?

To answer the four research questions, the following specific objectives were used to organize the research findings in this chapter:

1. Gather detailed information about specific physical limitations, professional clothing needs, preferences and current acquisition options from a sample of employed women (Users) who are affected by a variety of physical disabilities.
2. Design an upper body clothing product using Universal Design principles from data gathered in interviews with women and produce a prototype product from this design.
3. Assess the success of the product with the sample of women using wear-testing and interview evaluation.
4. Explore the issues embedded in production and distribution potential of the clothing product with appropriate personnel (Manufacturers) at a variety of clothing companies.

The study was divided into two principal phases. Phase A (Objectives One, Two and Three) focused on gathering data from a group of Users to provide the necessary information for successful product development and then focused on performing a wear-test on the resulting product with the original group and with another group of women who had no known physical

limitations. This process was in accordance with the User-oriented product development and evaluation strategy suggested by Thoren (1997) and also maintained credibility in the assessment of Universal Design (Null & Cherry, 1996). Phase B involved gathering data from a sample of clothing companies and consultants to obtain feedback that helped construct a picture of the feasibility of producing a specialized clothing product within a ready-to-wear business model. The Phase B process was an industry feasibility evaluation as recommended by Kallal and Lamb (1993) to add an industry component model to the design framework. In addition, Thoren proposed a systems approach, which addressed not only concerns of individual Users but also the viewpoint of clothing manufacturers. Thus a model of consumer needs combining functional, expressive and aesthetic considerations (Thoren's proposed systems change) was extended to incorporate industry capabilities (production and distribution) as a part of the design process.

Phase A Results – User-Oriented Product Development Process

Phase A followed a linear progression of data collection and analysis. Information was gathered from Users concerning (a) types of physical limitations, (b) professional clothing needs and preferences, (c) body measurements, and (d) current acquisition options. Using this information, a prototype was developed along with a detailed specifications sheet. Wear-testing of the prototype took place with two groups of women: (a) Users ($n=9$) and (b) a sample ($n=6$) of working women without physical disabilities (Evaluators). Clothing acquisition choices were also determined during wear-test evaluations. Detailed results for Phase A are provided in this section. Both individual and aggregate data are presented.

Types of Physical Limitations – Overview

Phase A began with a search for a sample of employed women affected by a variety of upper body physical disabilities (Research Question One, Objective One). Many sampling methods, as outlined in Chapter Four, were employed to search for participants. These methods included word of mouth, advertisements in campus newspapers, flyers distributed around the campus of the university, local recreation centers, doctors' offices and shopping centers, visits by the researcher to support group meetings, and references given by friends and acquaintances. From this search, ten participants came forward to volunteer for Phase A. All Users had a type of disability that limited upper body movements. All Users were currently employed or

volunteering in a job where visibility to the public was important and clothing and appearance were significant considerations. After the interviews began, one User decided not to participate for personal reasons, which left a final sample of nine. During data collection and analysis, Users were identified only by numbers from 01 to 10 (06 was the User who left the study).

Users presented a variety of physical limitations which affected their upper body (see Table 8). These limitations included fibromyalgia, post-polio syndrome, osteoarthritis, rheumatoid arthritis, frozen shoulder, spina bifida, chronic fatigue syndrome, trauma injury from auto accident, peripheral neuropathy, autoimmune disease, vasculitis, and carpal tunnel syndrome. The researcher conducted semi-structured in-person interviews with Users at locations most convenient for the Users. Instrument I Section A (see Appendix B), an adaptation of the Enabler figure (see Figure 2), was used to determine their degree of physical limitation in various functional areas. Users were asked to assign a rating to each area using a five point Likert-type scale, ranging from 'no problem' (0) to 'impossibility' (4). Results are given in Table 10. Users were asked to give a full description of problem areas rated (1) or higher. The researcher made written and audio recordings of responses.

Table 10

Degree of Physical Limitation Areas with Number of Respondents per Level

Area of physical limitation	0 No problem	1 Potential problem	2 Occasional problem	3 Problem	4 Impossibility
1. Incoordination	2	3	1	3	0
2. Limitations in upper body strength	0	2	4	3	0
3. Limitations of head movement	5	2	2	0	0
4. Limitations of stamina	1	3	3	2	0
5. Limitations of sensation	5	2	0	1	1
6. Difficulty lifting, reaching or carrying	1	0	3	4	1
7. Difficulty handling & fingering	1	1	3	4	0
8. Inability to use upper extremities	6	1	0	2	0
9. Difficulty with range of motion of upper body	4	2	0	3	0
10. Other	8		0	0	1

Note. Greatest problem areas shown in bold type

According to the disability classifications discussed in Chapter Two, one participant could be categorized as having a congenital disability, seven as having developmental disabilities and one as having an acquired disability. This study was concerned only with the functional limitations of disability (Stage Three of Nagi, 1965; NCMRR, 1992; Pope & Tarlov, 1991); therefore, further discussion relating to clinical aspects of disability was considered unnecessary for data analysis.

Table 10 shows the frequency results of Instrument I Section A for Users for 10 areas of physical limitations. Each of the 10 areas was either identified from the Enabler figure (see Figure 2) or by a disability professional as common upper body physical limitations. In a pilot test of this section of the instrument, an occupational therapist confirmed the applicability of each area to the study. The greatest problem areas were assessed by determining the number of

Users who rated them as an occasional problem or greater. These areas were (a) limitations in upper body strength, (b) limitations of stamina, (c) difficulty lifting, reaching or carrying, and (d) difficulty handling and fingering.

Types of Physical Limitations – Details

The qualitative descriptions that follow describe each physical limitation and its rating as reported to the researcher during interviews. The ratings represent the Users' perceptions of what constitutes a potential problem, occasional problem, problem or impossibility. Areas of physical limitation were defined clearly in the instrument (see Instrument I Section A, Appendix B) according to descriptions provided with the Enabler figure (see Figure 2).

Incoordination (Area 1).

Seven Users gave incoordination (lack of body coordination) a score higher than zero on the rating scale. Incoordination has been described in the literature as lack of large muscle coordination (Yep, 1976). Of these seven Users, three (01, 07, 09) considered that incoordination will be a potential problem. User 07 is beginning to have difficulty standing on one foot, which affects putting clothing on her lower body. Her legs and feet have undergone multiple surgeries for trauma sustained in an automobile accident, in which she also sustained head and neck injuries, affecting upper body coordination. These problems were manifested through some sudden movements of the head and neck that affected her balance, occasional difficulties with motion sensation resulting in a loss of standing ability, and an inability to look at strobe lights without almost passing out. User 01 experienced a similar problem. She discussed occasional bouts of dizziness and sensations of movement, especially around fluorescent lights and/or large crowds. She overcame this by focusing on the floor and her final destination. User 09 assumed that incoordination will become a problem as her rheumatoid arthritis becomes progressively worse, but currently she has no problems.

User 02 rated incoordination as an occasional problem. She had difficulty coordinating some detailed work with her fingers, but this depended on the level of fine motor skill needed for the activity, which also related to difficulties handling and fingering.

Three Users (04, 08, 10) rated incoordination as a problem. User 04 had constant difficulty with fine motor skills and carrying out detailed work with her fingers. For this User, the problem was worse in the right hand than in the left because her right side was more affected

by her disability. She explained how she perseveres with her fingers until she either accomplishes the task or gives up. For User 08, incoordination was a lower and upper body problem focused in her ankles and hands. She had peripheral neuropathy, a neurological disorder that causes weakness, numbness, paresthesia, and pain in her hands, ankles and feet. Due to weakness in her ankles and feet, she sometimes has problems coordinating movements in the rest of her body (e.g., she has to use a handrail at all times to climb or descend stairs). User 10 cannot coordinate movements behind her or to her side, only in front of her, due to problems related to rheumatoid arthritis.

In summary, incoordination, as interpreted by seven Users in this study, seemed to affect the Users' control over their body extremities in performing fine and gross motor skills, which might affect handling clothing and fastenings. Incoordination could also be interpreted as affecting overall balance and equilibrium, which in turn might affect some movements related to donning and doffing and also to the wearing of clothing. Incoordination was also close to handling and fingering skills. The inclusion of fine motor skills and balance and equilibrium extended the clothing literature definition of incoordination, which up to this point had only addressed large muscle coordination as an element of coordination (Yep, 1976).

Limitations in upper body strength (Area 2).

All nine Users gave the category of upper body strength a score greater than zero. Two Users (03, 09) indicated that upper body strength was a potential problem. User 03 was given weight restrictions for lifting by her doctor (currently 15, 20 or 40 lbs. depending on how she is lifting the object) because of carpal tunnel syndrome in both hands and replacement surgery on both hips. If she does not remain in compliance with the doctor's orders, her conditions may worsen. Another respondent, User 09, predicted her upper body strength would deteriorate as her age progressed and condition worsened.

Four Users (01, 04, 08, 10) rated strength as an occasional problem. User 01 experienced occasional burning sensations in the trapezius muscle across the back of her neck, which was referred pain from overuse of arm muscles. She reported that these sensations have been getting less frequent over the past few months as she performs exercises promoted by her physical therapist. Another User, (04), had arthritis in both wrists, from years of using crutches, which limited her ability to perform tasks requiring wrist strength. If she "overdoes" it with her wrists, the left one would occasionally swell. User 08 lacked strength in her neck and upper arm

muscles. She could not work with her hands above her head and avoided carrying any kind of weight. She was trying to strengthen that area with moderate exercise but had to exercise very slowly because she could experience long periods of chronic pain if she made any mistakes. Her strength problems were mainly in the upper back rather than the extremities, but the upper back problems affected the performance of the extremities. User 10 had occasional but not constant problems with upper body strength.

Three Users (02, 03, 07) rated strength as a problem. User 02 had no strength in the upper arm (triceps) muscles in both arms and consequently could not get her arm up above her head without using the other arm for support. Another User, (07), experienced severe traumatic back injury on the right side and right shoulder in an accident and consequently had little strength on her right side. She had also had a fractured right wrist and arm and could not lift anything on that side of her body. User 03 had very little strength in her hands and arms due to rheumatoid arthritis so that she had trouble lifting anything over 10 pounds of weight.

Upper body strength for these nine Users involved the full length of the arms (including wrists and hands), shoulder, neck and upper back. The Users' limitations in these areas have implications for donning, doffing and wearing clothing. Endurance and strength have been identified as being necessary for dressing (Yep, 1976), but have not been used as variables which impact aspects of clothing in other literature.

Limitations of head movement (Area 3).

Four Users gave limitation of head movement a score greater than zero, while five Users had no problems with head movement. Two Users (05, 09) considered head movement to be a potential problem. User 05 was beginning to have problems moving her head to the right and turning it quickly to either side, so that she had to guard against moving her head to the side and could no longer touch her chin to her shoulder. User 09 had the beginning of limitations in movement to the left or right side and could only turn her head about halfway towards her shoulder on either side. Up and down movements were currently not problems for her.

Two Users (03, 07) considered head movement limitations to be an occasional problem. User 03 mentioned that occasionally, when she turns her head, it locks in a muscle spasm at the base of the neck. User 07 mentioned that when she drives a car she almost always has problems turning her head to the left side when yielding in traffic.

Head movement for these four Users was a problem when sideways movement was involved to the right or left, towards the shoulder. This could have implications for donning and doffing clothing and for the styling features of a garment around the neckline area. Usage of head movement as limitation was not found as a separate issue in other clothing literature.

Limitations of stamina (Area 4).

Eight Users gave limitations in stamina a score greater than zero (see Table 10). One User had no problems in this area. Three Users listed stamina as a potential problem (03, 05, 10). User 03 stated that stamina limitations are dependent largely upon the type of activity at this stage of her disability. User 05 stated that stamina is a by-product of fibromyalgia, which among other things, prevents her from getting into phase four sleep and that if her routine is disturbed she becomes run down and cannot sustain activity. User 10 in this group has problems reaching behind her back and pulling things up such as bathing suits. She has to rest while she performs work behind her back.

Three Users rated stamina as an occasional problem (02, 04, 08). User 02 described how she does not have the endurance to perform sustained work due to fatigue. An example would be using the computer and then going to get a glass of water and not being able to lift it. She has recently started using an electric chair rather than walking with her crutches in order to prolong her overall rate of endurance. User 04 explained how stamina is dependent on whether she is feeling well on a particular day. If she is not feeling well she knows she will not have the stamina “to get herself together” and will not go anywhere that day because of the effort needed to get ready. User 08 considers stamina to be an occasional problem because she has autoimmune disease, one of the symptoms of which is fatigue. She also gets fatigued because of having to spend the day in some amount of pain.

Two Users considered stamina to be a problem (07, 09). User 07 feels that her stamina problems have recently worsened. She has been experiencing tiredness, headaches, dizzy spells, and a tremendous amount of pain. She has also been excessively thirsty and has had high blood pressure, blood sugar and cholesterol levels. Her stamina is limited in many tasks. For example, she takes about an hour to get dressed. User 09 accepts that limited stamina is one of the characteristics of her disease. She has given up many tasks and hobbies since being diagnosed with rheumatoid arthritis because she gets fatigued so easily. She also finds the air very humid where she currently lives, which aggravates her condition.

For all these Users, stamina was reported to the researcher as a problem dependent upon several factors: activity (dependent on type of activity), disease (fibromyalgia, auto-immune disease, rheumatoid arthritis), environment (climate), and occasion (good days and bad days). Common symptoms of lack of stamina included loss of sleep, getting run down and running out of energy, not being able to complete a task without resting at intervals, and not being able to perform tasks at all. Limitations in stamina was an area taken from the Enabler model (Null & Cherry, 1996), previously used for ergonomic design, but not as yet applied to clothing research. According to the Users, lack of stamina impacts donning and doffing and the type of clothing that is worn during the day (e.g., lightweight and comfortable fabric, styling that allows for easy movements).

Limitations of sensation (Area 5).

Four Users gave this area of limitation a score greater than zero. Two Users (03, 09) had a potential problem associated with sensation. User 03 is experiencing increasing numbness in her fingertips due to carpal tunnel syndrome. She viewed this numbness as a potential problem because currently she has “good days and bad days.” User 09 has recently moved to the area and is starting to be affected by the humidity. The humidity takes away her strength, and in the winter in very cold weather, she becomes stiff and cannot move without considerable difficulty. Both of these are potential problems because she has moved here from a more temperate climate and she feels this new climate will worsen her condition.

User 08 considered sensation to be a problem. She is limited in sensation in her upper body due to peripheral neuropathy. She also has auto-immune disease. Three years ago she had a “bout” of vasculitis, which means that she had a swelling in a blood vessel in her spinal cord causing paralysis in her right leg. Also she has a band of pain that goes around her chest from her spinal cord to the breast bone. This band of pain lies roughly under her bra. The amount of sensation she has and degree of pain she can withstand varies daily.

User 07 rated sensation as an impossibility. She has numbness in her ring finger and little finger on her left hand that creates problems with handling and fingering. She notices it most when she works on her hobbies.

Limitation in sensation for these Users encompasses numbness in the fingers, sensitivity to humidity and cold, and hyper-sensitivity of the skin in some parts of the body. These limitations have implications for the manipulation of clothing and fastenings, the type of fabric

used in a garment (e.g., warmth factor and texture against the skin) and the construction of the garment (e.g., the amount of layers built into a garment). Numbness in the fingers affects the User's ability to apply pressure to fastenings and to handle a garment during the donning and doffing processes, and hyper-sensitivity of the skin would mean that a product would have to be made with a fabric that does not irritate, and provides necessary heating and cooling effects.

Difficulty in lifting, reaching or carrying (Area 6).

All nine Users had difficulty considering these three activities as one problem, as they might have difficulties lifting and carrying objects, due to lack of strength but have no problems reaching with the arms. Users, therefore, gave an average overall score to the best of their judgment. Eight Users considered this area of limitation to be at least an occasional problem.

Three Users (01, 04, 08) considered lifting, reaching and carrying to be occasional problems. One of these three Users (01) mentioned that she would have liked to see these separated in the instrument because she has no problems reaching but cannot lift or carry due to limited strength. User 04 rated this area as an occasional problem because of trouble carrying things due to difficulty in walking. She has trouble reaching for things because of rotator cuff limitations. Her rotator cuff becomes easily strained causing her to seek physical therapy. For User 08, this area relates to an ankle problem. For instance, she has difficulty carrying groceries upstairs because she always has to have one hand on the railing. She can reach up because of continuous physical therapy, but she cannot reach to her back.

Four Users rated this category as a problem (02, 05, 09, 10). User 02 mentioned having difficulty unloading the dishwasher, putting things up over her head, and pulling things towards her. She uses extensions (aids) to help her with this activity and supports her arms because of a lack of triceps muscle. User 05 cannot lift or reach above her head because of strain on the neck and upper back, and she tries to avoid carrying weight of any kind. User 09 in this group keeps everything at eye level so she does not have to reach up and she cannot carry or lift anything, especially with the right hand. User 10 has a frozen right shoulder and rheumatoid arthritis and limits herself in terms of what she can lift, reach or carry. The pain is in the upper part of her right arm, but the source of the problem is in the shoulder. She does not do much lifting or reaching, especially around to the back. Although she feels the pain much more in the right arm, she also experiences some similar pains in the left arm. She is treating the frozen shoulder as a temporary disability, but it may take 16-18 months to recover fully.

User 07 found all the activities in this area impossible to perform. She cannot lift anything because she has no strength in her arms or wrists, cannot reach behind her, and cannot carry any weight. In addition, she tries not to put any stress on her wrists.

For all the Users who considered this area to be at least an occasional problem, the problems in lifting and carrying are related to strength. Most Users tended to treat the three facets of this area as one activity when answering the question but noted that they may have problems in one facet and not in another. These problems encompassed walking difficulties, trouble in lifting things overhead, and strain on the neck and upper back, hands, wrists and arms. Reaching tends to be a separate problem from lifting and carrying, whether it is around to the back, up over the head, out to the sides or to the front. The area of limitations of lifting, reaching and carrying limitations have implications for dressing and for the type of fastening that might be applied to a garment, together with the location of the fastening. These limitations were taken from the Enabler model (Null & Cherry, 1996), previously used for ergonomic design, but not as yet applied to clothing research. In this study the three separate areas were found to be important issues, but in future studies should be treated as separate categories instead of being treated as one.

Difficulty in handling and fingering (Area 7).

Eight Users gave this area scores greater than zero, with one User having no problems in this area. User 09 rated it as a potential problem because she is starting to have problems with fine motor movements such as manipulating small fasteners, jewelry and hair ornaments.

Three Users specified it as an occasional problem (04, 05, 08). User 04 has problems handling small items due to limited ability in grasping and picking things up. She mentioned that she knows what she wants her fingers to do but cannot always make them work. User 05 finds some activities (e.g., clicking a computer mouse with the index finger, playing the piano) will send a shooting pain into her trapezius muscle, giving her a pain in her neck for a prolonged period of time, and User 08 has to get help to do certain tasks, such as tying her headscarf because her fingers do not have the sensitivity to be able to manipulate small objects.

Four Users rated handling and fingering as a problem (01, 02, 04, 07). User 01 has pain and numbness in the base of her thumbs and cannot grip tightly for any length of time. She uses other fingers to compensate. User 02 regards this limitation as a problem that is worsening with age. She finds some movements very difficult, such as manipulating small objects and placing

them into something, such as pegs in holes or buttons into buttonholes. User 04 also has difficulty manipulating small objects but perseveres and eventually succeeds in most cases. The last User (07) in this group referred to numbness in the fingers and thumb of her left hand, preventing her from manipulating many objects. She is frustrated because she has strength in the left arm but none in the right.

Handling and fingering is a problem for eight out of the nine Users due to insensitivity, numbness, and/or pain in the hands and fingers. These hand movements lead to limitations with fine motor skills and referred pain elsewhere in the body, which might have implications for clothing fastenings, and manipulating fabric while donning and doffing. Handling and fingering in relation to clothing was previously found to be of concern in handling fastenings as well as certain types of fabric (Moran, 1976; Reich & Otten, 1991; Schwab & Sindelar, 1973). Moran and Schwab and Sindelar's samples were small (21 and 46, respectively), and covered a variety of physical disabilities, while Reich and Otten's sample was large (787) with a single disability (arthritis).

Inability to use upper extremities (Area 8).

Three Users gave upper extremity problems scores greater than zero, and six Users had no problems with this area of limitation. User 07 was concerned with this area being a potential problem. She previously experienced confinement in a wheelchair and the inability to use any extremities, but "worked her way back" to being almost fully functional in all limbs. However, she feels that, as she ages, she may lose the ability to use some of her extremities and keeps all the equipment she used (e.g., wheelchairs, walkers) in anticipation of needing it again.

Two Users rated upper extremity use as a problem (02, 09). User 02 said this was a problem because she has no movement between her shoulders and elbow in either arm. She has no strength in the triceps muscles, which leads to difficulty lifting, reaching and carrying. The other User, (09), knows that, if she could not walk anymore, she could not use crutches because she has no strength in her arms and would have to go directly into a wheelchair.

For these three Users, upper extremity limitations are focused in the arms and shoulders. The inability to properly use the arms and shoulders is an important factor for the design of garments. A limitation in this area would affect donning and doffing, because the arms and shoulders are typically used during these movements. It would also affect the styling of clothing

because of necessary accommodations for the lack of arm and shoulder movements (Kernaleguen, 1978; Reich & Otten, 1991; Schwab & Sindelar, 1973)

Difficulty with range of motion of upper body (Area 9).

Five Users gave this limitation a rating greater than zero. Two Users (07, 09) considered range of motion to be a potential problem because they thought that their symptoms will worsen with age. In this category, User 09 is starting to have trouble moving her arms over her head and behind her back, and User 07 has similar problems turning her head to the left side.

Three Users (02, 04, 05) considered range of motion to be a problem. User 02 has range of motion in her arms only from her elbows to her hands, but she can move her head and torso without any problems. User 05 can move her arms but cannot sustain a position with them either behind or above her head for any length of time. User 04 lacks the ability to reach to her side or behind her back using her arms.

Problems with range of motion for these five Users are focused on limited movements of both arms from the shoulder to the fingers and limited movements of the head and neck in some cases. As in previous areas of limitations, these problems affect donning and doffing, and the shape and styling of garments to accommodate for lack of range of motion in the upper extremities. Limitations might also affect fastening systems and their locations. A certain range of body movement has been suggested conceptually as necessary to don and doff clothing, manipulate fasteners, adjust clothing once it is on the body, and move around comfortably (Watkins, 1984).

Other (Area 10)

User 07 mentioned that her body was asymmetrical due to trauma sustained in a car accident. She regarded this limitation as an important aspect of upper body limitation not covered in the instrument. Her right side was crushed in the accident and slopes down, creating problems keeping straps of any kind on that shoulder. Because of her perception of how this asymmetry affects the way clothes lay on her body, she regards asymmetry as an impossibility in terms of trying to find suitable clothing to fit her body. No other Users reported additional limitations to the researcher.

Types of Physical Limitations – Discussion

The researcher interpreted a rating of two (occasional problem) or more as a current problem area; therefore, any area where five or more Users (i.e. more than one-half of the sample) rated the area a two or more was considered of significance importance to the remainder of the study. The interviews revealed these significant areas of limitation as interpreted by the researcher to be (a) limitations in upper body strength, (b) limitations of stamina, (c) difficulty lifting, reaching and carrying, and (d) difficulty handling and fingering. Limitations in endurance and strength (parallels a, b and c) and skilled movements involving complex motor manipulation (parallels d) had been identified by Yep (1977) as part of a classification system suitable for clothing issues.

Professional Clothing Needs and Preferences - Overview

During initial interviews, all Users ($n=9$) responded to Instrument I Section B (see Appendix B) which assessed the severity of specific problems with clothing for the workplace. Nine dimensions of clothing problems (see Table 11) had been determined from previous research (e.g., Behrens, 1963; Frescura, 1973; Kernaleguen, 1978) to be the most commonly occurring clothing problems for people with physical disabilities. Ten original dimensions had existed (see Table 7) but the researcher combined coverage for modesty and coverage for warmth into one category. When Users identified the severity of a specific clothing problem, they also described their ideal features in a clothing product suitable for work. Research has shown that women with disabilities should place as much importance on clothing and appearance for work as other, non-disabled populations (Christman & Branson, 1990; Johnson & Roach-Higgins, 1987; Ray, 1986). Table 11 shows the distribution of scores for each problem. Qualitative responses added by Users are presented after the table for each dimension, but are not User specific, except for User quotes deemed by the researcher to be of particular interest to the problem. For each clothing dimension, all Users ($n=9$) responded to every item.

Table 11

Professional Clothing Needs and Preferences Scores with Number of Responses per Level

Clothing dimension	0 No difficulty	1 Potential difficulty	2 Occasional difficulty	3 Difficulty	4 Impossibility
1. Difficulty donning and doffing clothing	4	3	2	0	0
2. Difficulty managing fastenings	0	4	5	0	0
3. Lack of freedom of movement	6	2	1	0	0
4. Inappropriate and uncomfortable fabric	3	3	3	0	0
5. Inadequate coverage of the body	7	2	0	0	0
6. Styles of clothing can be constricting and uncomfortable	3	1	2	2	1
7. Construction quality inadequate for stress exerted by User	3	2	3	1	0
8. Some features are irritating and get in the way	2	4	2	0	1
9. Not all clothing is aesthetically (visually) pleasing	3	3	3	0	0

Note. Dimensions presenting greatest difficulty to Users (Five Users scored as 2 or more) shown in bold type

Using the same analysis as for Table 10, any problem rated a two or more in degree of difficulty was considered significant. Two problems, ‘difficulty managing fastenings’ and ‘styles of clothing can be constricting and uncomfortable’ were reported by more than half the sample as significant. For each clothing problem discussed below, qualitative results are presented and followed by solutions for previous literature and examples of styles of modern working clothing.

Clothing Problems and Professional Clothing Needs and Preferences - Details

Difficulty donning and doffing (Dimension 1).

Four Users had no problems with donning and doffing, and five Users gave this dimension a score greater than zero. Out of these five, three Users had potential problems, and two had occasional problems. While some of these problems stemmed from having clothing that they considered “difficult”, some problems were caused by pain and fatigue when performing the acts of donning and doffing clothing. “Difficult” clothing appeared to be that which is confining, does not open down the front, and is tight when put on or taken off over the head (constricting in donning and doffing). Fatigue and lack of stamina appear to manifest the problem because on days when the Users are fatigued, donning and doffing becomes a greater problem. One User (07) mentioned taking an hour to get dressed every morning because she has to alternate dressing with rest periods. Another User (05) mentioned that she gets a shot of pain across her shoulders and down her arms when crossing her arms and pulling something up over head, making some aspects of dressing a painful task. Two Users (07, 10) reported needing assistance from a member of their family on a daily basis to don and doff clothes.

The Users who had occasional problems with donning and doffing had experienced problems with all of the physical limitation categories (e.g., range of motion [1], motor planning [2], strength [3], stamina [4], sensory [5] and other [6]). When translated into User needs and preferences for potential professional clothing, these problems necessitate some type of opening to facilitate donning and doffing, preferably located at the front of the garment. An alternative design solution would be to use a stretch fabric with a large opening for the head that can be put on and taken off with ease and without assistance; however, this solution represents problems for Users with limitations in strength and other problems (e.g., inability to use upper extremities).

Difficulty managing fastenings (Dimension 2).

All Users ($n=9$) had some type of problem with fastenings. Four Users had potential problems and five had occasional problems. Due to the varieties of commercial fastenings available on ready-to-wear clothing, this section will be organized and reported according to type of fastening to increase clarity in analysis and validity with industry usage.

Zippers were mentioned as a problem most often by all Users for various reasons, primarily due to restricted use of hands (e.g., motor planning, strength). Also, zippers located in the back of the garment were a problem because most Users were either unable to reach around

their body or they could reach around for a limited period of time but not long enough to manipulate the zipper. Other than eliminating the need for a zipper completely, solutions from the literature (e.g., Kernaleguen, 1978) had suggested using large metal zippers only, placing a large pull tab with a hole on the zipper so one finger can be used to operate it, attaching a facing to prevent fabric and threads getting caught in the zipper teeth, and applying the zipper on the left side of the garment for easier access (at least for right-handed Users). Users, in general, were in favor of these solutions.

Another frequently mentioned problem area for the Users was the use of buttons as fastenings. Buttons and buttonholes present problems because buttons become undone when a User turns around in her wheelchair if the button is too small for the buttonhole, the button is too small and difficult to manipulate, the button comes off because it is not securely attached to the garment fabric, the buttonhole gaps because it has been sewn on vertically down the center front of a garment, buttons are placed at the collar and are too difficult to manipulate, and too many buttons are placed in one area. Acceptable solutions for Users included making sure the buttons are larger than average buttons and are spread along the garment so the work load is easier, securing buttons so they stay put during manipulation, attaching buttons with a long shank so they can be manipulated more easily, undoing only a few buttons down the front or back of a garment so a minimum amount of buttons need to be re-fastened, and making keyhole buttonholes even though Users are aware of the extra time and cost they take to apply to a garment.

Velcro®, a hook-and-loop fastening mechanism, was also considered a problem by the Users. Common complaints included the materials used in Velcro® are too stiff and inflexible and not durable enough for daily needs, Velcro® commonly comes undone when used as a front closure, the materials are uncomfortable because the sharp corners dig in to the skin adding additional discomfort to the pain of the disability, and a Velcro® on clothing displays a lack of professionalism for a woman in a position of power (Users' perceptions). Acceptable solutions included finding a new type of hook and loop fastener that is flexible, soft around the edges, stretchy and longer lasting, which in turn builds consumer confidence in its ability to stay fastened at the front opening; using the circle type of Velcro® instead of the rectangular strips; and placing it with a sensitivity to the varying needs of different areas of the body.

Hooks and eyes were mentioned as potential problems by some of the Users (N=4). Problems included small size of hook and eye, position of hook and eye in the rear of the garment, and hooks and eyes becoming mutilated in the laundry process. Acceptable solutions included eliminating hooks and eyes completely for this population, making them larger, and placing them in front as a closure so that they are visible while being fastened.

Another problem fastener type for this population was the snap. Users perceived that snaps require more pressure by the fingers than they currently possess or might have in the future. For these Users to accept the use of snaps in ready-to-wear garments, the fastening would need to be redesigned so that less pressure is required to manipulate them and/or they are made of a more flexible material. One User (02) firmly believed that a completely new type of fastening is needed for this population because all others were outdated and had not improved over the years in the ready-to-wear market.

Finally, elastic loops used with buttons were considered a problem. Users mentioned that although this type of fastening was aesthetically pleasing in ready-to-wear garments, Evaluators were unable to coordinate finger movement to put the button inside the loop. No solutions were forthcoming except for making the loop and button larger, which Users felt would detract from the appearance of a garment. The researcher presented a solution of applying 'fake' loops and buttons which had no function while concealing another type of fastening, and this seemed to be popular with some of the Users but still not a universal solution.

General comments were made during the interviews regarding fastenings that did not relate specifically to any one type, which might impact the design of future clothing products. General problems with fasteners were attributed to lacking hand-to-eye coordination, not being able to see the fastening, not having enough time to manipulate fastenings, locating fastening on the garment with worst areas for all Users in center back and at side, not having enough stamina to work in a particular spot for any length of time, and having a combination of any of these problems. The Users who had problems with fastenings had experienced problems with all six physical limitation categories (i.e., range of motion, motor planning, strength, stamina, sensory and inability to use upper extremities). General solutions proposed by at least one User included using a fake seam with a fastener underneath and putting fastenings where the Users can see and feel them – at the front, not the back. Most Users already were making adaptations on their own (e.g., fastening a bra at the front and then sliding the opening around to the back). For this study,

the objective was not to create an entirely new type of fastening system but one that would work within the ready-to-wear system; therefore, the design solution at this point would have to utilize currently available fastenings. The optimal Universal Design solution is to use a fastening that is usable by all Users, by making it big enough to manipulate without assistance and placing it on the garment where it can be most easily handled. This would help Users with limitations in the categories of motor planning, strength, and stamina (see Table 10).

Lack of freedom of movement (Dimension 3).

Lack of freedom of movement was not a problem for six of the Users but was a potential problem for two and an occasional problem for one. The User (02) who considered this an occasional problem is confined to a wheelchair and uses oversized dresses because they “hide a lot.” She also mentioned that a blouse/skirt combination is impossible for her whether she is in wheelchair or using crutches because the skirt and blouse becomes twisted around her body. Darts and shaping of any kind were mentioned as problems by the Users. Evaluators also described heavy garments such as winter coats and garments that lie close to the neck as constraining movement.

Solutions for improving freedom of movement in a garment to satisfy all Users included creating plenty of ease for various physical abilities (e.g., by putting a gusset under the arm, making a raglan instead of a traditional set-in sleeve, eliminating darts), allowing freedom of movement through fabric technology (e.g., developing “cold weather” clothes in lightweight fabrics, utilizing flexible fabrics like knits in products where they are not traditionally used) and eliminating style lines that interfere with movement (e.g., cutting fabric away from the neck area, replacing traditional waistbands with elastic). Users who identified lack of freedom of movement as a problem had all six categories of physical limitations as at least potential physical problems.

Inappropriate and uncomfortable fabric (Dimension 4).

User responses were evenly split between no problem (three), potential problem (three), and occasional problem (three) for this area of clothing difficulty. All Users who rated fabric as a problem stipulated that the use of man-made fibers in the garment be kept to a minimum. They stated that fabric made from fibers such as polyester is not comfortable and that natural fibers “breathe” and look nicer. User 02 was strongly against the use of any man-made fiber in a garment. She said “...if you are in a wheelchair in a polyester dress, by the end of the day you

have a rash because the polyester doesn't breathe." Every User who considered fabric to be a potential (01, 03, 04) or occasional problem (07, 09, 10) said they might consider a very small percentage of man-made fiber with a maximum of ten percent. Polarfleece® was mentioned as an option to keep warm, but this statement suggests some inconsistencies in Users' knowledge of fibers and fabrics because Polarfleece® is made of polyester fibers. This finding suggests to the researcher that, if a man-made fiber, which acted in similar ways to a natural fiber, was used for the fabric in the product, the Users might be convinced to compare its performance favorably against 100% natural fiber fabric. There was also an inconsistency in the way that wool was omitted from the natural fiber discussion. Some Users stated they could not tolerate wool because of their perception that it is scratchy and uncomfortable against the skin and one User (07) stated that she is allergic to wool. Another User (09) mentioned that her skin is affected by rheumatoid arthritis and is becoming very sensitive to rough fabric or fabric that is tight and clings too close to her skin. Natural fibers appear to be synonymous with cotton, silk and linen fibers for these Users.

Fabric construction was also an issue mentioned by most Users in terms of preferences for future products but not necessarily considered a problem. Knits were identified as comfortable by some of the Users because knits had some stretch and flexibility. The disadvantage of knits was that they became "shiny" if the User was sitting in a wheelchair most of the day. "Slippery" fabric was also a problem. One User actually slid out of a bus door because the fabric of her dress had no traction on the slick bus seat. Fabrics that were considered "off-limits" for potential professional clothing included heavy fabrics of any kind, double knit polyester, denim, and lightweight canvas that has no flexibility. In general, washable fabric was mentioned by all Users to be most useful because it is much easier for this group to wash their clothing at home than to take it to the dry cleaners. One User (08) was annoyed that she could buy wash and wear and permanent press shirts for her husband but not for herself. She said "...yes, if I could get short sleeved oxford shirts that were permanent press I would buy them, but I can't find them." Ironing is also problematic for this group of Users so that wash and wear fabric would be preferable, in most cases.

In conclusion, fabrics are needed that are washable at home and do not have to be sent to the dry cleaners, that are soft to the touch but not necessarily slippery, that do not need to be ironed, and that maintain their appearance throughout a typical work day without bringing

discomfort to the wearer. Either a woven or a knit construction would be acceptable for the flexibility and softness required by the User. A fabric made from natural fibers (i.e., cotton, silk), natural fibers blended with a small amount of man-made fibers, or man-made fibers that performed and felt like natural fibers should be acceptable for the future product. Users who had problems with fabrics also listed the categories of physical limitation range of motion, strength, stamina and sensory as at least occasional problems.

Inadequate coverage of the body (Dimension 5).

The researcher assumed at the start of data collection, that coverage of the body would only relate to modesty issues, based on previous literature (Behrens, 1964; Warden & Dedmon, 1975). After interviewing the Users, coverage for warmth was found to be another important concern. This section will be reported in terms of modesty first, and warmth second, with separate possible solutions for each.

Seven Users had no problems with body coverage and two Users considered this a potential problem, but almost all Users had comments that they wished to make on this Evaluator. This high level of input is similar to interviews on the fabric issue. Problems that related to modesty issues included sizing and measurements. User's upper body measurements are not the same as commercial standards; therefore, ready-to-wear garments are too short in the body and not broad enough across the shoulders. Another problem is the use of specific types of mobility aids (i.e., crutches), which raise hems about two inches on the sides, exposing areas of the body. Solutions for the modesty issue suggested by both researcher and User included lowering the back hem to make the back of the garment longer than the front, putting extra fabric in strategic places that allows for coverage of different body types, lowering dress hems for crutch walkers, and placing a band inside the skirt and pant waistband that adheres to blouses and keeps them from coming untucked.

Both Users who considered coverage to be a problem also stated that warmth in addition to modesty was a problem. Inadequate blood circulation was to blame for not maintaining adequate body temperature, and clothing does not usually keep them warm enough. For User 02, clothing that keeps the body warm, especially when confined to a wheelchair, is important. Solutions suggested included arranging clothing in layers to keep heat trapped next to the body and wearing extra items of clothing for extra warmth. Two popular items for achieving this effect were stockings and undershirts. User 05 mentioned that she has problems finding clothing

to hide her undershirts, which she needs to wear year-round, even on hot summer days, to maintain a comfortable body temperature. She also compensates for her internal lack of heat by adjusting the individual thermostat in her office and when she goes to meetings takes jackets.

The two Users who considered coverage of the body to be a potential problem with their clothing also had listed the categories of physical limitation range of motion, strength, sensory and other as problem areas.

Styles of clothing can be constricting and uncomfortable (Dimension 6).

Six Users had problems with constricting styles of clothing, which they explained in terms of their body parts. The results of this section will, therefore, be reported according to areas of the body. Beginning with the top of the body, clothing problems for Users began at the neck. Two Users mentioned not being able to have anything tight at the base of the neck, preventing a potential garment from having a tight collar up around the neck. One User (05) had problems with her trapezius muscles on either side of the neck and could not stand to have any pressure across the back of the neck, especially from a garment neckline with a rib or tight edge to it. Two Users (07, 08) had a problem with the bustline in that they could not have anything constricting around the bust; therefore, they do not wear bras and do not want constricting clothing in this area. For these Users, great importance is also attached to sleeves and sleeve openings that are neither tight nor constricting. At the waistline, plenty of room is needed, but neither elastic nor a waistband is a popular method of providing for extra ease. Any design has to be loose around the waistline or able to expand at least one size due to temporary changes in size. Many of the Users cannot exercise in order to maintain control of their weight. An empire waist is also out of the question because it rides up when a User is sitting in a wheelchair. One User (08) thought that clothing companies make many assumptions about the shape of women's bodies and felt that, if one does not fit standard sized ready-to-wear clothing, choices are extremely limited. These problems are compounded when trying to find suitable clothing for work because many items for work are tailored and fitted.

Solutions to the problem varied, according to User and body area of the problem. V-neck and low round necklines were stated as being a possible solution to the neckline problem. Soft, lightweight and slightly elastic fabrics were mentioned as being popular because they do not constrict around the body. Also suggested as a solution to the neckline were front collars that begin level with the shoulder seam and do not extend around the back of the neck. To

accommodate the ease needed for the rest of the body, loose fitting duster style dresses or housecoats were mentioned as being acceptable for casual clothing. This style may be translated into working clothing. Some Users also stated that elastic waistlines on skirts and pants that do not require buttons and zippers are acceptable for their needs; however, elastic waists and separates were not acceptable for other Users. Users who reported a difficulty with constricting styles of clothing in general had reported all categories of physical limitations to be problems.

Construction quality inadequate for stress exerted by User (Dimension 7).

Two Users rated construction quality as a potential problem, three as an occasional problem, and one as a problem. Three Users did not have any problems with the construction quality of their ready-to-wear garments. The six Users who rated construction greater than zero agreed that the quality of ready-to-wear was not as they desired. They thought that construction quality needed to be excellent for their specific needs but felt they could not find or afford top quality in ready-to-wear clothing. User (02) who considered this dimension to be a problem was specific in indicating that she needed quality, durable, construction features such as double-stitched and French seams. Most Users were not as knowledgeable about clothing quality as User 02 and just said that ready-to-wear clothes were not as their mothers or grandmothers used to make for them and this difference made them upset. Specific problems included wearing out the elbows of sleeves if sitting in a wheelchair, wearing out underarm seams when using crutches, getting skirt hems dirty because they drag on the ground, popping seams, losing buttons, disintegrating waistbands, falling out hems, and failure of clothing in washing and drying.

According to the Users' responses, quality of construction of any garment that they will purchase and wear is a high priority. Construction of clothing needs to be durable, mainly due to the extra "wear and tear" that these Users place on garments in stress areas (e.g., seams, fastenings). The challenge for this project is to maintain the highest quality of construction while keeping costs affordable in the final product. The Users who had problems with constricting styles of clothing had experienced problems with all physical limitation categories.

Some features are irritating and get in the way (Dimension 8).

Seven Users consistently had problems with irritating features in ready-to-wear clothing. As in the section on constricting styles, this section will be reported according to garment areas corresponding to areas of the body because this is how the Users chose to report their problems.

Seven Users reported a score higher than zero for this section – four Users rated the section as being a potential problem, two rated it an occasional problem and one rated it a problem.

Beginning at the neck, User (05) enjoyed the way that shoulder pads looked in a garment but was irritated because they do not lay flat and the inside of the pad is annoying against her shoulder muscles, which are very sensitive. Virtually anything around her neck, even a silk scarf, is irritating because she cannot stand any heaviness on the trapezius muscles across the back of her neck. The same User needed to wear undershirts for warmth but had problems concealing the undershirt at the back of the neck when wearing a silk or polyester shell blouse with a button and keyhole opening as the closure. This particular fastening is also difficult for her to manage but seems to be the usual method of closure in ready-to-wear blouses that she needs to wear under suits.

Sleeves also presented some problems of irritation. Over one-half of the Users ($n=5$) stated that sleeveless garments were no longer an option because they preferred not to expose the entire arm. In addition, sleeves that were too tight or too short and those that rode up the arm were considered a nuisance because they made the garment look ill-fitting and the wearer self-conscious. Any constriction in the sleeve, sleeve seam, armseye or wrist, was not acceptable. At the wrist, the preferred option was to have no fastening or elastic and to make sure the sleeve is wide enough through which to slip the hand. If decorative buttons were used, User 04 suggested eliminating the round pearl ones that make it impossible to lay the hand down flat to write. A loose waist with no darts, elastic or waistband seemed to be preferable to any fitted waist among the Users.

Many solutions were offered to reduce irritating features. Shoulder pads should lay down, be oval, removable and slightly shaped to the shoulder, not hard or flat. Blouses should have a round neck and button straight up the front. Undershirts should be attached to the main garment, with a v-neck or a lower scoop on the back to match the main garment style. Clothing could be purchased a size too large if necessary to minimize the effect of the “irritating” features. The Users who had problems with irritating features had experienced problems with all physical limitation categories.

Not all clothing is visually appealing (Dimension 9).

Six Users considered visual appeal to be a source of concern when looking for suitable clothing for work. These Users were evenly split between seeing this as a potential problem

($n=3$) and an occasional problem ($n=3$). Users approached this section as a styling and color issue, with some reference to preferred fabrics.

All Users ($n=6$) who rated visual appeal as a potential problem or a higher problem rating agreed that lack of good styling made you look “poor” and “sorry for yourself”. However, they were frustrated at the limited clothing selection locally because they shop according to features they know they can wear and their options are minimal. This supports previous research, which found that people, with all but the most severe physical disabilities, place value on the stylishness and fashionability of their clothing (Caldwell, 1999; Thoren, 1997), and that many functionally designed garments are attractive but lack fashion appeal, aesthetic appeal, and situational appropriateness (Freeman, Kaiser & Wingate, 1985-1986).

Two of the Users have proportions that do not match fitted ready-to-wear business jackets with darts and shaping through the torso. If they buy garments big enough for them in the bust, the rest of the garment is “ridiculously large and annoying”. User 03 shunned solid fabrics because they show stains.

A major point made by most Users was that, if they could find something that worked well for them and was appropriate for the work situation, they would buy several pieces in the same style and in seasonal colors and fabrications. User (02) believed that most people with disabilities like to wear a “uniform” of some type because, when “you have a disability, it becomes even more practical.” However, this “uniform” does not have to be unattractive or unsuitable. User (07) stated that the plainness of a well-constructed dress in a variety of fabrics and colors was perfect because various accessories and other features could be used to differentiate between the dresses and add individual style.

Overall styling preferences tended to be for a loose and unfitted style of garment. Neckline preferences tended to be for a plain round neckline. Although some similarities existed in solutions, specific styling needs and preferences were varied. User 08 wanted a fairly large collar at the back to cover her progressing dowager’s hump and another wanted no collar at the back because of the pressure it placed on the back of her neck. Drop or raglan sleeves were popular style choices, as were loose fitting sleeves. The majority of the Users generally discarded suggestions of details at the wrist (e.g., elastic and ruffles). Some Users considered pockets necessary because they cannot carry handbags; however, others didn’t need them but would accept them if part of the design. Fabric choices ranged from small prints to solids, with

Users almost evenly split between the two choices. Prints were preferred for dresses and solid colors were preferred for separates. A checkered pattern was also mentioned but only by one of the Users. The Users who had problems with visual appeal had experienced problems with all physical limitation categories.

Clothing Problems and Professional Clothing Needs and Preferences - Discussion

Two problems, ‘difficulty managing fastenings’ and ‘styles of clothing can be constricting and uncomfortable’, were reported by more than half the sample as significant (i.e., they received a score of two or more by over half the sample). This finding suggested to the researcher that a priority in product development would be to design a comfortable, well fitting prototype that had easy-to-manage fastenings and allowed for ease of movement.

Comparing the results in Table 11 with the physical limitations in Table 10 demonstrates that Users’ difficulties with handling and fingering might be the cause of difficulties with fasteners. Another problematic physical limitation area, lifting, reaching and carrying, might be linked to problems with constricting and uncomfortable styles of clothing. A lack of mobility required to reach with the arms would be compounded by constricting clothing styles. Comparisons to the other significant physical limitation areas, strength and stamina, cannot be made with either of the significant clothing problem areas, although they may affect donning and doffing, which received scores of at least one (potential problem) from five of the nine Users.

Product Development

According to the Users, if a basic style of garment was found to be acceptable, they would be willing to purchase it in colors and fabrication variations as if it were a “uniform” to wear to work. The researcher therefore envisioned the input of User information to produce a satisfactory prototype as a significant step in the development of a suitable product for working women with physical disabilities. Product development in this study began with completion of Instrument I Section C, which was part of the initial User interviews in Phase One. In the ready-to-wear industry, product development usually takes place after market research and line planning has been completed (Stone, 1999). The designer or product development team is traditionally not in direct contact with the potential Users of the clothing product. In contrast, during the current study, Users actively participated in the development of a prototype to suit

their needs. This process of co-design of a clothing product has been successful in previous research with a sample of women with no known disabilities (Wu, Anderson & Ulrich, 1999). The success or failure of the resulting product should demonstrate whether this co-design technique could be an integral part of specialized product development for working women with physical disabilities. Products designed by the standard ready-to-wear method were deemed unsatisfactory by a majority of the Users.

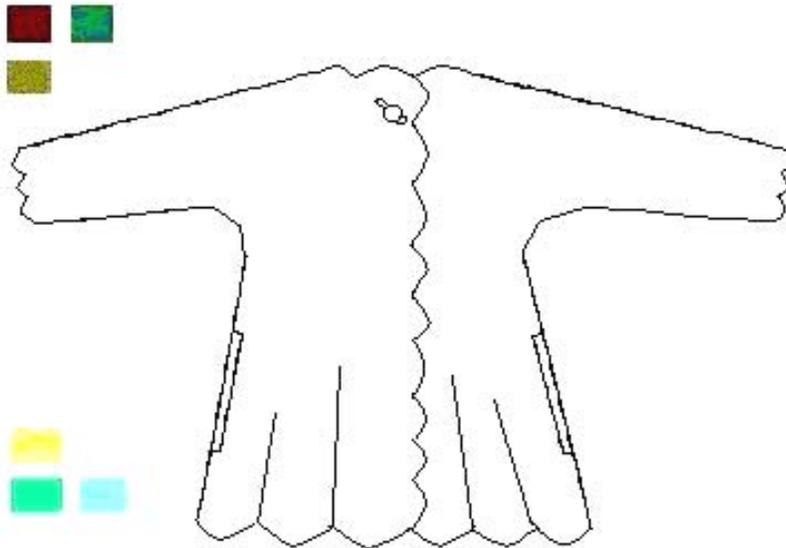
Completion of Instrument I Section C (see Appendix B) took place immediately following completion of Sections A and B (i.e., during the same interview session). After gathering information from each User regarding preferred styling and functional features for a garment suitable for work (Section B), the researcher and the User developed (i.e., co-designed) a design sketch for the prototype upper-body garment. To start the co-design process, Front and back sketches of an upper-body basic garment, were shown to the User (Instrument I Section C). This basic waist-length garment consisted of long, straight, set-in sleeves, a round neckline, bust and waist darts in the front and shoulder, and waist darts in the back. These sketches correspond to basic fitting, block patterns used as templates in industry from which more complex patterns are made (Glock & Kunz, 1990). The researcher and User used the information, given in Section B, to sketch features and style lines onto the basic sketches and change them to show features that resemble a garment, custom designed (i.e., a final design sketch) for that User. Details that could not be shown on the design sketch (e.g., fabric type, color, seam construction) were noted in text next to it.

Using the design sketches from individual User interviews, the researcher put together one sketch, which accommodated a majority of features necessary for each User to feel comfortable (functional features) and visually appealing (symbolic features). Including both types of features is recommended by Thoren (1997). The researcher had expected this section of the study to be challenging because of the different nature of each User's disability. But, in fact, the process of assimilating each User's needs and preferences into a single prototype was easier than expected because of the similarity of the physical limitation categories and professional clothing needs and preferences. Reich and Shannon (1990) had found similarity of physical limitation categories important for development of a classification system for clothing based on data collected from subjects ($n=300$) with a wide variety of disabilities. Their six Common Physical Limitations (CPLs) were defined by location on the body, but spanned a number of disabilities. In the

current study, the Universal Design principle of flexibility of use (i.e., making sure that a product serves a variety of body types) seemed initially to be the most challenging functional element in this stage, but was easily achieved. In addition, the symbolic preferences of the Users necessitated that this prototype would not make the wearer “stand out from the crowd” (i.e. the garment must not look like it has any ‘special’ disability features). This request by the Users was similar to findings by previous researchers (Caldwell, 1999; Kaiser, Freeman & Wingate, 1985; Liskey-Fitzwater, Moore & Gurel, 1993; Wingate, Kaiser, & Freeman, 1986).

A flat sketch of the garment prototype was drawn and is shown in Figure 4. A textual description of the prototype garment follows Figure 4.

Figure 4. Sketch of garment prototype developed from User interviews



Body of garment prototype.

The preferred shape of garment prototype for all Users was loose and unfitted. Most Users preferred a loose-fitting garment because it gave them the freedom of movement necessary to accommodate their physical limitation. Some Users had required that chest, waist and hip measurements in the prototype be larger or smaller proportioned than standard sized ready-to-wear clothing, supporting previous research findings relating to sizing and style for women with physical disabilities (Warden & Dedmon, 1975). The length of the prototype (i.e., covering the hips) was also preferred by a majority of the Users. This would conceal certain areas of the body, which was also noted as a modesty requirement in previous research (Kaiser, Freeman & Wingate, 1885). The hip length would also allow for differing body lengths across Users and proportions within one body. Two side slits allow for extra flexibility, and the back is slightly lower than the front to allow for extra coverage at the back, a feature preferred by some Users.

Some Users preferred to have extra layers to maintain body temperature due to poor circulation. For this reason, the garment was fully lined in self-fabric (i.e., flat-lined). The seams are double stitched as this minimizes the possibility of broken or frayed seams, mentioned in the interviews as a problem for some Users. The prototype has no defined waistline because some Users had shorter-than-standard neck to waist measurements and did not wish to bring attention to this feature. Other Users did not want the restriction of a fitted waistline. A belt is not added for the same fit concerns stated earlier, modesty, coverage, variation from standard measures.

A loose, long unfitted garment with a full lining and no defined waistline area is the resulting garment prototype. This style was seen as acceptable for the workplace by the Users. The style sketches completed in User interviews confirmed that this was a style with which all Users felt both emotionally and functionally comfortable in the workplace.

Closures and placement.

Types of closures and their locations affected how Users donned and doffed garments. For casual clothing, Users had indicated that a loose-fitting knit top with a wide neck opening was easiest to slide over the head than a garment with fastenings. However, due to the amount of reaching problems to the back and over the head identified in the first section of the study and the more formal function of this garment prototype, the researcher added a full front opening, both for functional and aesthetic reasons. Front openings were found in previous studies

(Kernaleguen, 1978; Reich & Otten, 1991) to be more satisfactory than those in the back because of the problems in movement of arms and shoulders. Top openings were rejected for similar reasons because the Users would still have to pull the garment over their heads. Envelope necklines (which expand easily to fit the head through) and wrap styles were rejected because of their lack of ability to cover the chest area. Users consistently indicated a need to feel ‘covered-up’ around the neck and chest for modesty reasons. This finding supports previous research findings about modesty (Behrens, 1963).

Once the placement of garment opening and closures was determined (i.e., center front), the types of closures were selected. Users were divided according to the types of fasteners that they would like to see on a garment. Buttons could be used if they were large enough for easy manipulation. A diagonal keyhole buttonhole was chosen, which might add to labor costs and time of production, but makes the buttons easier to manipulate, the buttons more likely to stay in the hole and the large hole less likely to gap. The diagonal keyhole was also considered acceptable for a garment worn in the workplace. Snaps and hooks and eyes did not gain a particularly enthusiastic response when presented as alternatives nor did Velcro® because of its functional problems and their unacceptability for clothing to be worn in the workplace. A ‘fake’ line of buttons with Velcro® or a strip of snaps underneath was therefore discounted. Zippers received a lukewarm response for functionality, and Users indicated they would not consider a zipper to be an aesthetic or appropriate type of closure for professional clothing.

Neckline.

A round neckline that sits low on the neck (i.e., sits level with the hollow at the front of the throat) was preferred by a majority of Users. However, two Users (02, 08) needed to have high necklines for added warmth around the neck, which was incompatible with the needs and preferences of the majority of the group. Collar selections also posed a problem. Seven Users did not need a collar, but User 05 preferred a collar that was visible only in the front of the garment (i.e. it begins at the shoulder seam). She cannot have any kind of facing or rolled edge around the back of the neck. User 08 required a collar with some bulk at the neck to hide her dowager’s hump. Again, some incompatibility was identified among the needs and preferences relating to collars. Possible solutions for future garments would be to provide “add-on” features such as collars and scarves which could be purchased separately and attached by the customer according to her preference. Users could also add a dickey as a ‘fill-in’ for this area.

Completely lining the garment seemed acceptable to the researcher to avoid any bulky edging or facing around the neck and to add warmth and modesty.

Sleeves.

After consideration of all the sleeve options presented in User interviews, a kimono sleeve was considered the most acceptable sleeve alternative. A kimono sleeve is “a sleeve cut in one with the waist of the garment” (Kopp, Rolfo, Zelin & Gross, 1997). The researcher considered that it would give the wearer a range of motion in the shoulder that cannot be gained through a regular armseye seam, as promoted in previous research (Kernaleguen, 1978; Moran, 1976; Reich & Otten, 1991; Schwab & Sindelar, 1973). Deep sleeve openings allow more ease of movement through the arm and shoulder (Kernaleguen, 1978; Moran, 1976; Reich & Otten, 1991; Schwab & Sindelar, 1973). The samples used in these studies ranged from small samples of women with various forms of disabilities, to large samples with focused disabilities.

The sleeve silhouette is full to the wrist, plain and very long, which means that Users with varying arm lengths can turn back the ends of the sleeves to their preferred length, showing the lining. This is possible only because of the flat lining of the sleeve. With a typical sleeve and cuff, this effect could not be satisfactorily achieved. Users were not interested in having any detail at the wrist, especially buttons, which are difficult to manipulate and uncomfortable when they rest their arms on a flat surface to write or rest. The kimono sleeve was presented as an acceptable form of sleeve type for clothing worn in the workplace as understood by the researcher during User interviews. It was selected by the majority of Users as both an aesthetically pleasing and functionally acceptable type of sleeve design.

Other features.

Scalloped edges were added around the front openings, hem and sleeve hems for visual interest. Pockets were mentioned frequently in the interviews for many Users. A pocket was necessary on the garment because it takes the place of a handbag, which most Users did not want to carry. They needed a space in which to transport personal effects (e.g., sunglasses, keys). Behrens (1963) had suggested a pouch pocket attached to a belt, but this was not selected when presented as an option to Users because (a) no belt was wanted on the garment and (b) it would not have been acceptable for the workplace. Pockets were located in the side seams to conceal them because not all Users wanted pockets. They were designed to be deep with plenty of room for Users to carry a variety of personal belongings if needed.

From the User interviews, several options were acceptable for fabrication and making a final selection was somewhat of a problem for the researcher. The prototype could be made from a knit construction to allow for stretch and flexibility or a woven fabric, which is more traditional for professional clothing, because most suiting-weight fabric is woven (Redwine, 1991). The researcher decided to make one prototype out of each fabric construction to compare the differences during wear-testing and evaluation. One prototype was made from white woven cotton muslin and one from dark-colored knit polyester.

This section of the study fulfilled Objective Two, the design of an upper body clothing product using Universal Design principles from data gathered in interviews with women and produce a prototype product from this design. Universal Design principles were used in forming and evaluating the clothing dimensions so that the prototype would be accessible to a wide variety of consumers.

Before wear-testing and Universal Design evaluations took place, the prototype sketch (Figure 4) became a new instrument to be used in Phase B, the industry feasibility evaluation (Research Objective 4). The researcher took the spec sheet, together with the industry evaluation instrument (Instrument IV) (see Appendix B) to the Textile/Clothing Technology Corporation [TC²]. [TC²] is a research and development organization for the soft goods industry that provides business and professional services to companies within the textile complex. Professionals at [TC²] evaluated the prototype clothing product to help determine suitability for production and marketing. The [TC²] team also evaluated the instruments to ensure that (a) the method of communication with apparel companies was compatible with and valid for industry practices and (b) the instruments would solicit the type of responses necessary to evaluate fully the feasibility of producing and marketing this product.

Apparel Industry Consultant Assessment

At the [TC²] facility, the researcher met with the Business Unit Managers for Engineering Services and Product Development and Marketing. The researcher showed the instruments and prototype garment to these managers. In the evaluation of the prototype, the consultants explored overall product development possibilities and they concluded that two options merited further exploration for this type of customer: (a) co-design and (b) mass-customization. Co-design had been the option explored in this research study, with success, in terms of gathering

User information and letting Users describe an ideal garment. Co-design had also been explored with success using a non-disabled population (Wu, Anderson & Ulrich, 1999). The current situation includes a second step in the process of co-design; whereby the researcher took User design specifications and combined them into one universally designed garment. This second step moves co-design from a simple stage of product development process to a complete production process. This research process of co-design differs slightly from previous studies with the process and further validates this process as successful in translating User needs into a final product. This process is part of the systems change recommended by Thoren (1997).

The production option of Mass Customization begins with a basic garment silhouette with added adaptable features (e.g., fastenings, trim, collar, cuffs), which could be offered as choices from a database. Body measurements are submitted, and a separate marker is made for each User's choice of garment. The Gerber pattern technology software (Made-to-Measure™) was suggested as the design technology for this method of production. Questions were raised by the Engineering manager about the practicality of this situation. For example, would it be possible for small manufacturers to adopt this strategy if expensive software solutions were needed? This option might also be used to provide the style variations requested by some Users.

The managers both agreed that, with state-of-the-art technology, the Users with a laptop computer and suitable software could be more involved with the actual design process while ordering their choice of garment, whether the option was co-design with a designer or mass-customization. Their choices could be digitally transmitted back to production facilities for marker and pattern layout, then cut pieces for various garments would be sent together either on a modular system or unit production system. Size selection could also be done online by customers. Digital technology could be used to aid the User in visualizing the finished garment on her body, using the Avatar™ body model.

Discussions then took place relating to the engineering and manufacturing feasibility of the proposed product. The design sketches showed scalloped edges around the center front edges and hem. Elimination of the scalloped edges was suggested by both managers because of the high labor cost involved in cutting them. A trim was suggested as an alternative to make it more cost-effective. The managers suggested that the pockets would have to be modified by stitching them down to the inside of the garment to secure them. The original sketch used a kimono sleeve pattern, but concerns arose for the managers about the width of fabric needed for

the kimono sleeve. A raglan sleeve seemed to offer a better production solution with similar fit capacity. A raglan sleeve is a type of mounted sleeve (Kopp, Rolfo, Zelin & Gross, 1997). In addition, the raglan sleeve was an option the researcher had encountered several times in the literature as an accessible sleeve type for people with disabilities (Kernaleguen, 1978; Moran, 1976; Reich & Otten, 1991; Schwab & Sindelar, 1973). A raglan sleeve would eliminate the need for a center back seam, which was identified as a potential irritant for most Users when presented as a design option during Phase One, and move seaming to the sleeve area, where no User mentioned difficulty of seaming.

Various suggestions were made in reference to fastenings. Even though the Users had not been enthusiastic about the use of Velcro® fastenings, the managers saw a possibility in a new generation of fasteners which could be useful for future studies involving people who had difficulties with traditional methods (e.g., zippers, buttons). These fasteners are not currently available in the ready-to-wear market.

Suggestions were also made for suitable fabrics. The Business Manager for Engineering showed the researcher an interlining fabric that could be sandwiched between the fashion fabric and the lining to regulate body temperature. This was an experimental fabric not yet on the general market, it was made with a nonwoven two ply yarn with tiny microbes which can constantly bring body temperature to equilibrium.

Marketing possibilities for the prototype product were then explored. Marketing suggestions included multiple channels of distribution (e.g., the Internet, door to door sales, home demonstration and sales) and should also include follow-up customer service. The most favored channel by the manager for product development and marketing was home demonstration and sales. The managers envisioned this as a forum where people with similar problems met at a host's house or small meeting (e.g., arthritis support group). There would be a specialized salesperson demonstrating products and taking orders, with maybe a live model demonstrating the products. The salesperson could take customer measurements and input them into a database of sizes. Measurements could be digitally transferred to a holding facility where best fit selection and further alterations take place using state-of-the-art technology (e.g., Gerber™ Made to Measure). Possible sources for future customers were discussed including hospitals, medical supply catalogs, doctors' offices, and places where people who have disabilities typically shop, not necessarily typical retail outlets.

Changes were made in the sketches before the prototype was made and wear-tested by the Users and Evaluators. Scalloped edges were eliminated from the front edges and hems. Raglan sleeves were used in place of kimono sleeves. The revised sketches are shown in Figure 5. A specifications sheet was made for the prototype, which became Instrument II for the remainder of the study. The spec sheet (Figure 6) contains all necessary information about the product including style, fabric and trim information and detailed measurements of the product.

Figure 5. Adjusted flat sketches front and back of prototype after meeting with industry consultants

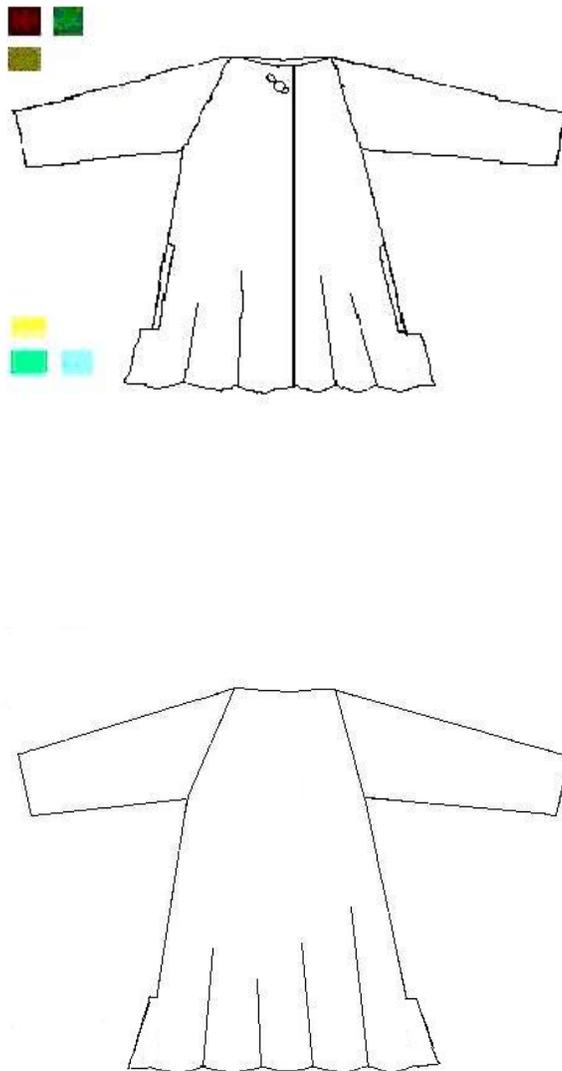
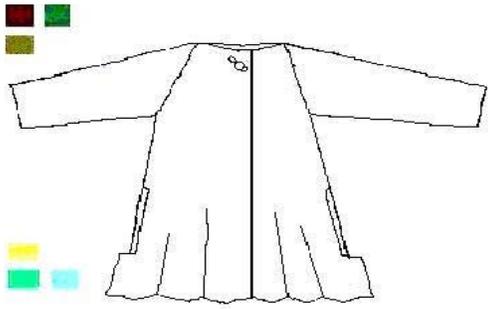
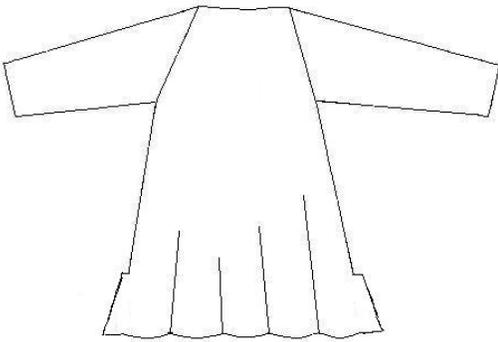


Figure 6. Sample specification sheet - Instrument II

Description of garment:	Double-layered ladies' jacket, center front opening with three diagonal keyhole buttonholes, round neckline and raglan sleeves. Sleeves narrow to wrist, body of garment flares to hips.			
Size range: 14 – 22 W	Fabrication: 100% cotton mid-weight woven fabric Full self lining	Care Machine wash Machine dry No iron:	Colors: Burgundy/Teal/ Olive Canary/Seafoam/ Cornflower	
Dimensions	Inches	Metric	Sketch and swatches	
Neck drop B	1 5/16	3.3	 <p>Front View</p>	
Neck drop F	1 7/16	3.6		
Neck width	7 1/8	18.1		
Across shoulder	8 1/2	21.6		
Across back	14 5/8	37		
Front length CF	28 3/8	72.1		
FrontlengthHP	31 1/8	79		
Back length CB	32 3/4	82.1		
Back length HPS	34 1/2	87.1		
HPS to underarm	10 3/4	27 1/2		
Across chest	23 3/4	60.3		
Half waist	25 3/4	64.8		
Shoulder to waist	18	45.7		
Side length F	20	53.4		
Side length B	22 1/2	57.2		
Bottom edge opening	53 1/2	136		 <p>Back view</p>
Armhole circumference	14	35.6		
Sleeve length from HPS	30	76.2		
Underarm seam	22 7/8	58.1		
Elbow	8 1/2	21.6		
Sleeve opening	5	12.7		
Buttonhole Center button-neck	1 1/4	3.2		
Distance apart	5	12.7		
Underarm to top of pocket	9 1/8	23.2		
Pocket opening	6	15.2		
Pocket depth	14	35.6	<p>3 x 40 lignes buttons 3 diagonal keyhole buttonholes</p>	
Pocket width	6	15.2		<p>Hanger loop inside back neck 3 inch/7.7 cm</p>
Fusible Pellon CF 2" x 28 3/8" 5.1 x 72.1 cm	Class 500 overlock safety stitch Enclosed seams			

Measurements

A second component of Instrument I Section B (see Appendix B) was the body measurement chart. Seven Users were measured by the researcher using a standard tape measure in inches and centimeters. Both standard and metric sizes were taken due to the global usage of both types of measurements and off-shore manufacturing. The measurements taken were at the bust, waist, and hips (nine inches below the waistline). Measurements were taken in order to determine the size of the prototype product. Two Users (01, 05) preferred not to have their measurements taken but gave commercial ready-to-wear dress sizes. Table 12 shows results of these body measurements.

Table 12

Body Measurements of Users Taken During Interviews

User	Bust		Waist		Hips	
	Inches	Cm	Inches	Cm	Inches	Cm
01 *	36.68	90.62	31.06	78.88	38.92	98.85
02	39	99	33	84	44	112
03	41.5	105	38	97	45	114
04	42	107	38	97	41	104
05 *	36.68	90.62	31.06	78.88	38.92	98.85
07	44	112	35.5	90	42	107
08	40.5	103	37.5	96	43.5	111
09	40	102	36	92	42	107
10	45	114	37	94	47	119

Note. Measurements for Users 01 and 05 are representative of size 14 based on ASTM standard D5586-95

After matching recorded sizes with bust, waist and hip sizes for ASTM standard D5586-95 (Standard Tables of Body Measurements for Women aged 55 and Older, 1995), the researcher determined that two sizes would be necessary for wear-testing and evaluation. The researcher selected 16 and 22 to be the best-fit sizes. No small size was necessary because the researcher considered the Users with commercial sizes 14 would be able to fit into the size 16 prototype.

Table 13

Size of Prototype Garments for Wear-Testing Based on ASTM standards for Women's Clothing

Standard Industry Sizing for Women's Clothing based on ASTM standards for Misses Figure Type							
Standard Size	Bust		Waist		Hips		User
	Inches	Cm	Inches	Cm	Inches	Cm	
16	37.22	94.53	32.57	82.73	40.03	101.67	01, 02, 05, 09
22	43.23	109.80	39.32	99.89	44.82	113.85	03, 04, 07, 08, 10

Wear Tests and Prototype Evaluation

After the prototype garment was produced in two sizes and a spec sheet was made, the researcher returned to the original group of Users for wear-testing and evaluation. This process provided data for Objective Three, to assess the success of the product using wear-testing and interview evaluation.

In the evaluation, each User tried on the prototype in a location of her choice and evaluated its success using Instrument III Section A (see Appendix B). The measure of success was dependent upon how the User had envisioned the finished prototype after giving information and helping the researcher to sketch in the initial interviews. The User was evaluating the prototype based on information she had already presented. The rating scale for Instrument III Section A was different from that used in Instrument I. The scale used for wear testing and evaluation was designed for a choice from a scale of 1 to 3 for each clothing dimension. Users ($n=9$) were asked to rate the prototype based on their expectations according to the solutions in Instrument I, Section B. If they chose 1, this rating meant that the prototype was “worse than they envisioned”. If they chose 2, it was “just as they envisioned”, and 3 was “better than they envisioned” (i.e., the prototype exceeded expectations). These ratings were based on previous clothing literature involving wear-tests (Huckabay, 1992; Prevatt, 1991; Rainer-Jeanes, 1994). The instrument also contained questions relating to purchasing practices and pricing.

Clothing dimension four, use fabrics with situational appropriateness, could not be directly evaluated during this second interview because the prototypes were made in ‘mock-up’ fabrics of cotton muslin and polyester knit. To obtain data about Users’ fabric preferences, the

question was asked in a more qualitative way. The Users were asked to specify the type of fabric in which they would most like to see the final garment.

The results for this section were shown in Table 14 and then qualitative results were reported by clothing dimension. This information is followed by results of wear-testing with working women who have no known physical limitations. Universal Design principles are assessed using the prototype. Finally, results of purchasing questions are reported for both groups of women. This section on wear-testing concludes data collection and analysis for Phase A.

Table 14

Wear-testing results of Clothing Dimensions for Users for each rating level (Frequency)

Clothing Dimension	1 worse than I envisioned	2 just as I envisioned	3 better than I envisioned
1. Uses styles that are easy to don & doff	0	5	4
2. Uses easy to manage fastenings	0	4	5
3. Adds features that allow for movement	0	4	5
4. Uses fabric with situational appropriateness *			
5. Ensures coverage in needed areas	1	6	2
6. Provides styling that is comfortable and appropriately sized	0	5	4
7. Ensures quality durable construction	1	5	3
8. Adapts features specified by User	1	5	3
9. Clothing is designed with more visual appeal	1	6	2

Note. Responses for Clothing dimension 4 are qualitative. Responses shown in bold type indicate dimensions considered significant problems in initial User interviews (see Table 11)

Before specific results are reported, some general comments are made about the overall User response to the prototype garment. Several unsolicited comments occurred during the wear-test interviews outside of the framework of the question categories that provided overall evaluation. “I like this garment a lot...I’m very pleased with it. I can see it as a winter garment in some sort of knit, like a heavy jersey of some kind. I think that there’s a lot of versatility in applications of fabric, etc.” (User 05).

The minute I put it on I felt very positive about it, I think immediately if you don’t get a good feel you feel bad about it. It gave me a very positive feeling and that helps with the scope of everything that goes into clothing and how you feel in the clothing and how you present yourself in that clothing” (User 01).

All Users felt that variables presented in the wear-test instrument were sufficient to assess their satisfaction with the prototype product.

Uses styles that are easy to don & doff (Dimension 1).

For Dimension 1, no Users rated the prototype as ‘worse than I envisioned’, five Users were satisfied with the prototype, ‘just as I envisioned’ and four thought the prototype exceeded their expectations ‘better than I envisioned.’ Users felt that the self-lining of the prototype played an important role in their ability to don and doff the prototype. The only User (02) who experienced problems in donning and doffing acknowledged that her dress had a rough texture and this created friction between the two fabrics, making it difficult to slide one fabric over another. She said, “it’s pretty easy to put on, I think it might be a little more difficult because the fabric that I have on is resistant.” User 02 was also insistent that she put the prototype on entirely by herself. She told the researcher, “let’s see if I could put it on myself, that would be the fairest way to do it. Let me do this because I haven’t been able to do it”. She was pleased with the success she had, “I just automatically put it on, I didn’t think about how much time it took.” User 03 believed it was easy to put on because the raglan sleeve allowed plenty of room for the movement necessary to don and doff, and, because she has long arms, the sleeves provided plenty of coverage. User 08 found the prototype very easy to don and doff “because it has a double lining and the lighter weight of this helps, it doesn’t stick anywhere.”

The prototype met and/or exceeded expectations for the entire sample of Users. The success in donning and doffing was noted to be because of the light weight of the garment, the full lining and the open styling of the raglan sleeves. Large neck and sleeve openings had been suggested by Reich and Otten (1991) as useful solutions to donning and doffing problems for a large sample ($N=787$) of women with arthritis. In addition to confirming their work, this finding suggests that future products should be constructed with a double layer of self-fabric, perhaps with the inner layer being a traditional smooth lining fabric to aid in the donning and doffing process.

Uses easy to manage fastenings (Dimension 2).

Users found that the large button with diagonal keyhole buttonhole was very easy to manage. No Users rated this dimension as (1), four rated it as (2), while five rated it as (3). The diagonal keyhole buttonhole was cited as being better than a regular horizontal or vertical buttonhole because the button did not pull out of the hole, yet was very easy to fasten and unfasten. Comments relating to the diagonal keyhole were as follows: “I think it’s better than a traditional buttonhole...and the size of the button is great” (05), and, “it’s a good size and didn’t hurt my fingers to manipulate it” (04). User 05 stated that the button “almost buttons itself – I

don't know if it's the size of the hole or the angle of the hole, but it's very easy. The button size could have something to do with it also." User 01 believed that the shape of the buttonhole facilitated fastening and unfastening of the button, while User 04, who does not fasten buttons the traditional way, but manages buttons by sticking her finger into the buttonhole, found this to be a satisfactory fastening. Previous studies found that changing the shape of the button and/or the buttonhole alleviated some problems with fastenings (Behrens, 1963; Frescura, 1963; Reich & Otten, 1991; Schwab & Sindelar, 1973). Samples used in previous studies ranged from large to small sample sizes and covered a span of physical disabilities. Some (e.g., Reich & Otten) focused on one disability (arthritis) and others (e.g., Schwab & Sindelar) accommodated a wide variety of disabilities. The fastenings on the prototype met and/or exceeded expectations for the entire sample of Users.

Adds features that allow for movement (Dimension 3).

All Users ($n=9$) found that the prototype met and/or exceeded expectations for freedom of movement. No Users rated this category (1), four rated it (2), and five rated it (3). The Users said that the raglan sleeve made moving easier and the overall roominess of the garment made it very acceptable. User 02 mentioned that the pockets could be bigger; however, this change would necessitate making the entire garment longer in the front to allow for the bigger deeper pockets. User (05) responded that it "allows for ease of movement; yes, very happy with that, and it allows complete ease of movement without (me) looking back and the style is fine, and to bring those two together is especially perfect, so I could give that a three."

Uses fabric with situational appropriateness (Dimension 4).

No ratings on the scale from 1 to 3 were given for this dimension. Users were asked to state their preferred choices of fabrication if this were a garment they would buy as ready-to-wear. Responses were varied in terms of the type of fabrics that were preferred. All Users responded that this garment could be used in multiple weights of fabrics. Specific suggestions included a lightweight gabardine, lightweight wool lined with a silky fabric, a versatile fabric that could go year round, a knit, a blend such as a polyester/cotton, a soft fabric that drapes nicely, and a heavy silk. Users' general fabric knowledge accounted for the variance of types of responses.

Fabric design suggestions were also varied, but solids in dark fall colors or light spring colors were mentioned most often. Only one User was interested in a floral print, while another suggested a plaid or small print.

Eight out of the nine Users were specific in their preference that the garment would only suit their needs if it required little care, (i.e., machine wash and dry, no iron). This demand presents somewhat of a problem in relation to a suitable fabric mentioned by the Users. Many of the fabrics suggested by the Users need more professional care routines than can be given in the home. Some of these comments on fabrics support previous research on fabric concerns for similar Users (Reich & Otten, 1991; Schwab and Sindelar, 1973; Warden & Dedmon, 1975). User 01 added an additional comment that the final garment should be kept “lightweight, something you could put on over whatever you’d like, a pantsuit...and wouldn’t cling to whatever you had on, and something that wouldn’t be too hot.”

Ensures coverage in needed areas (Dimension 5).

One User rated this dimension worse than she envisioned, six rated it just as they envisioned and two rated it better than they envisioned. Most Users considered that the prototype gave them coverage in needed areas. They liked the back being longer thus able to conceal body features that they might want to hide. User 08 had rated it (1) because of her concern that the prototype did not button along the entire front center opening but was held closed at the top of the garment by one large button and buttonhole. Her concern was that this would result in her becoming very cold, a concern which demonstrates the need for a measurement of coverage for warmth in the instrument as well as coverage for modesty. She would want two more buttons in the front so that it wouldn’t swing open. If it were a winter garment, she thought the neck might be cold because the prototype had no fabric on the neck area. The longer back made it easier for some Users to sit down and remain covered for modesty. Other Users liked the extended back but felt that it was too long and there was too great a difference between the front and the back to be aesthetically pleasing. Users saw some benefit from the adjustable sleeves, which could be turned up or down depending upon preferred sleeve lengths (i.e., full length, three-quarter length). Although the need for extra covering for modesty and warmth was found in previous research (Behrens, 1963), no precedent could be found in literature for the slightly longer back, single diagonal keyhole buttonhole, or adjustable turn-back sleeves, all design features that were acceptable to Users.

Provides styling that is comfortable and appropriately sized (Dimension 6).

All Users found performance of the prototype in this category met and/or exceeded expectations. During wear-testing, the researcher gave the User either the large or medium prototype based on the User's measurements and a visual assessment of what might be the appropriate sizing choice. The Users especially liked the fact that it was loose fitting, yet did not appear oversized and allowed for plenty of movement. "It's loose enough that I can move completely without binding anywhere and yet it still looks attractive, at least in my opinion" (User 10). The prototype was considered "very" comfortable by five of the Users. The sizing choices made by the researcher to accommodate all the Users in the sample seemed to work well for all Users. No-one commented that sizing was inappropriate or that fit was unsatisfactory.

Ensures quality durable construction (Dimension 7).

One User rated construction quality (1), five Users rated it (2), and three Users rated it (3). User (02) considered that the construction of the prototype was not what she had been expecting and rated it less than she had envisioned because "I like garments that are really highly defined, just so that it has a higher quality look to it and some more detail, so give it a 1." This User equated styling features (e.g., topstitching on the garment) with quality. She assumed that highly defined details visible on the outside of the garment should represent high quality and perhaps high price, as her responses in the pricing category also indicated. She did not address whether the construction of the prototype (e.g., seam construction, fastening application) suited her work needs. Five Users considered the prototype to have a level of construction that they had expected, and three considered it to have a higher level than expected. Users 03 and 10 identified the double layering as providing the basis for their high scoring in this area, and commented that the garment just felt like it would withstand some harsh treatment. "I like the double layering, I would prefer something that could be put in the washer and dried in the dryer. Something that will last" (User 10). The double stitched seams and reinforcement stitching in high stress areas followed Kernaleguen's (1978) suggestions on how to ensure quality durable construction for the stresses exerted, and this construction satisfied the Users.

Adapts features specified by User (Dimension 8).

In the data collection stage of Phase One (Instrument I Section B), this dimension was named Irritating features. The researcher felt that in designing a prototype which elevated User needs and rejected those features considered irritating as part of the design process, there would

be no need to ask Users the same question in the wear-test process. Rather, a more useful question would be to determine whether or not the prototype had incorporated the features deemed necessary by each User in initial interviews, and left out those features considered irritating. The results are reported according to this reasoning.

User (07) thought the garment had not adapted the features discussed in preliminary interviews and rated adaptation of features (1). The prototype had no collar, for which she had specifically asked. Five Users considered the prototype to have incorporated features for work and rated it (2). Specifically, these Users identified pockets, adjustable sleeve hems, raglan sleeves which facilitated donning and doffing, and lack of pulling around the neck and shoulders.

Three Users considered that the prototype exceeded expectations in adapting the features originally explained to the researcher and rated it (3). They stated that they liked the buttons, the side seam pockets, and the fact that the prototype fit in with what other women are wearing. User 03 commented, “it doesn’t necessarily jump out and say ‘what’s wrong with her that she’s wearing something like that.’” Also beneficial to the Users was that the jacket could be adapted to be worn in any season or type of situation. Wingate, Kaiser and Freeman (1986) had concluded that ‘normal’ clothing should be developed, which also contains features that are concealed but help to adapt to usage by people with physical disabilities.

Clothing is designed with more visual appeal (Dimension 9).

One User rated visual appeal as a (1), while six rated it as a (2) and two rated it as a (3). User (07) considered the prototype not to have the visual appeal that had been expected. This response came about because, for her, the fit was imperfect around the raglan sleeve seam, also she had wanted a collar in the back, for which she had originally asked to disguise the beginning of a dowager’s hump. The other Users said they were pleasantly surprised at the amount of visual appeal the prototype garment possessed. They commented that, provided the garment was fabricated the way they wanted, they would be happy to wear it to work and considered it to be perfectly acceptable for the workplace.

Additional recommended changes by individuals with physical disabilities

Additional suggestions were mentioned during the interviews. Some Users said the neckline needs to be somehow warmer. User 02 commented, “It would be nice if you could also think about a neckline that could make you warmer, that you could attach a scarf to, maybe it has just a little loop in the back, so that maybe you could put a little loop in it. I have a loop in the

back of my dresses about this wide, so you can create your own collar, and the scarf you can wear or not wear. You put the scarf in before you put the garment on and you don't have to handle it back there." Also mentioned by the Users was that the pockets could be deeper, because some Users carry everything in their pockets. The pockets could be made square, not round, for more security of contents. Users also made suggestions about the difficulty of using dresses in wheelchairs because dresses tend to catch in the wheel of the chair.

Wear-Testing by Individuals without Physical Limitations

Six individuals were used to wear test and evaluate the prototype in the same way as the first group. Women who worked in administrative capacities, serving the general public, in the College of Human Resources and Education at Virginia Tech, were contacted by email and were encouraged to participate in the study. No mention was made that the prototype had been developed from interviews with women with physical disabilities. They were told in advance to consider their favorite work clothes and try to assess this 'new' garment in terms of what they were used to wearing to work. Women in this group were reported as Evaluators. The same instrument was used for the Evaluators and the results reported the same as the User group. Evaluators rated the prototype based on what they expected for a garment to be used for work, relative to other clothing they might typically wear. Table 15 shows these results.

Table 15

Wear-testing results of Clothing Dimensions for Evaluators for each rating level (Frequency)

Clothing Dimension	1 worse than I envisioned	2 just as I envisioned	3 better than I envisioned
1. Uses styles that are easy to don & doff	0	3	3
2. Uses easy to manage fastenings	1	2	3
3. Adds features that allow for movement	1	2	3
4. Uses fabric with situational appropriateness *			
5. Ensures coverage in needed areas	0	4	2
6. Provides styling that is comfortable and appropriately sized	2	3	1
7. Ensures quality durable construction	1	4	1
8. Adapts features specified by User	0	4	2
9. Clothing is designed with more visual appeal	1	5	0

Note. Responses for Clothing Dimension 4 are qualitative. Responses shown in bold type indicate dimensions considered significant problems in initial User interviews (see Table 11)

Uses styles that are easy to don & doff (Dimension 1).

Three Evaluators rated the prototype for this dimension (2), and three rated it a (3). No Evaluator found it worse than she envisioned. The Evaluators who gave the prototype a score of (3) commented that the prototype was “very easy” to don and doff. Evaluator 002 commented that she could not give this a three rating because of the texture of the lining. According to her, a “true” lining would be a material that would slide over her clothes easier than the cotton muslin in the prototype.

Uses easy to manage fastenings (Dimension 2).

For the prototype, one Evaluator rated this dimension a (1). She stated, “It feels like the fastening doesn’t lay flat. The closure would need to overlap and come across the chest further to fasten comfortably. Two Evaluators rated it (2), and three rated it (3) and said it was very easy to use. Evaluator 002 commented that “the buttonhole is nice and roomy, and I can really

get hold of the button”, and Evaluator 005 said, “I don’t even have to think about it, it’s just a good size button to fasten.”

Adds features that allow for movement (Dimension 3).

On this dimension, Evaluator 003 rated the prototype worse than envisioned (1) and stated that, “The garment doesn’t feel comfortable across the shoulders. It’s pulling slightly at some movements.” This comment was based on the fit of the prototype not being as good as she perceived it should have been. Two Evaluators rated it (2), while three Evaluators rated it (3). “I could climb a ladder in this. I have a physical component to my job and I need garments that will allow me to move” (Evaluator 002). “It’s very easy to move in” (Evaluator 005).

Uses fabric with situational appropriateness (Dimension 4).

Suggestions for preferred fabric types were stated as follows: polyester, wool/ polyester blend, cotton, linen or a lightweight blend of natural fibers, and gabardine in polyester blended with natural fibers. Responses to questions about fabrication were mixed due to the variety of knowledge among Evaluators. Some Evaluators were familiar with fabric construction terms (e.g., wovens, knits), but others identified a preferred fabric by naming only the fibre type (e.g., polyester, cotton). Weight of construction of the fabric was varied. Anything in a lightweight fabric for summer or heavyweight for winter, and knit fabric was considered just as acceptable as a woven fabric.

Ease of care was an important issue for the Evaluators. This group stated that the garment needs to be washable and easy to care for in terms of cleaning and storing. A delicate hand wash cycle on a washing machine was a possibility, but dry clean was not considered an option by any of the Evaluators.

Color suggestions included purple, maroon and grey. The current fashion season while wear-testing was taking place was Fall so there may have been some bias. There was also a preference for other dark solid colors (e.g., navy, black or grey) which are more traditional colors for professional dress for women (Christman & Branson, 1990). All Evaluators felt that the prototype could be worn year-round if fabricated correctly. They stated that they would like it in lightweight fabrics for summer, or in a fabric that is a blend of cotton or man-made fibers.

Ensures coverage in needed areas (Dimension 5).

Four Evaluators rated the prototype (2) for this dimension, and two rated it (3). Comments included, “yes, I like the length” (001), and “yes, it covers everything” (006).

Evaluator 005 commented on how the prototype covered her “stomach and rear”, a feature which she appreciated in working clothing.

Provides styling that is comfortable and appropriately sized (Dimension 6).

Two Evaluators rated the prototype (1), three (2), and one (3) on this dimension. The Evaluator with the (3) rating related the sizing and comfort of the prototype to her typical experience of workplace clothing. She said “Yes, it’s a lot better than most women’s jackets” (003). The Evaluator who gave this a (1) noticed that there was pulling across the shoulder with certain arm movements. “If I tried it on in a store I wouldn’t buy it because of the pulling across the shoulders.” Evaluator 005 rated it as “very comfortable, but it would need to meet in front for me to be completely satisfied. I think the snug sleeves are good – they wouldn’t fall down if you pushed them up.”

Ensures quality durable construction (Dimension 7).

One Evaluator rated this dimension as a (1), because she did not like the feel of the flat lining, especially on the cotton prototype. “I would like a slicker lining to help slide over existing clothing.” Four Evaluators rated it as a (2). One rated it as a (3), mainly, because she liked the double layer of fabric. In relation to the lining, Evaluators stated that the lining makes the prototype a better quality garment, but it would also make it hotter so the fabric would have to be very lightweight to be comfortable. Buttons were also spoken of in terms of quality. “Buttons don’t stay on regular clothing, but it looks as though these would.” (005)

Adapts features specified by User (Dimension 8).

All Evaluators rated the prototype favorably for this dimension. Four rated the garment (2), and two (3). Comments were primarily directed towards the use of pockets in the side seams, which all Evaluators seemed to want in a garment of this type. Evaluator 006 commented that “side pockets are more slenderizing than ones on the front of a jacket.”

Clothing is designed with more visual appeal (Dimension 9).

One Evaluator rated visual appeal (1) because the prototype has too much fullness and made her appear larger than she likes. Five Evaluators rated it (2). Evaluator 002 stated:

Just because of the fabric I can’t really imagine it (visual appeal) right now. I wear men’s jackets (sportcoats) because they fit me better. I go to the thrift store and look for jackets. They are tailored better, and they have the extra shoulder width that I need. They are also

tighter under the arm without restricting across the bust. They fit me much better than women's jackets, so I like the look of them more.

Evaluator 005 was also not happy with the way the closure lay across her neck. "I wouldn't like tugging at it, would fold (the) lapels back and have them set there somehow". Evaluator 004 equated visual appeal with color, and stated that she would prefer it in a different color, preferably a dark one because it was destined for the workplace.

The Evaluators without physical disabilities presented a favorable picture of their satisfaction with the prototype garment, although somewhat less positive than the Users who had physical disabilities. Five clothing dimensions (i.e., use easy-to-manage fastenings, add features that allow for movement, design clothing with more visual appeal, provide clothing styles that are comfortable and sized appropriately, ensure quality durable construction of all clothing) were labeled as 'less than I envisioned' by one or more Evaluators, meaning that the garment did not meet these Evaluators' expectations as a suitable garment for the workplace. There had been no apparent interest on the part of the Users with disabilities for seasonal colors, suggesting that seasonal color schemes are not as important to these Users as they are to the group of Evaluators in the study. Four clothing dimensions (ensure coverage in needed areas, design clothing with more visual appeal, ensure quality durable construction of all clothing, adaptation of features) were judged in a similar way by Users with physical disabilities.

Evaluation of Universal Design Principles as Applied to Prototype

Section B of Instrument III (see Appendix B) consisted of a Universal Design evaluation instrument for the prototype and was used by the researcher and a faculty member who specializes in Universal Design. The Center for Universal Design at North Carolina State University outlined seven principles to be used in guiding and assessing an environment or product that is universally designed (Center for Universal Design, 1997, p.1):

In this evaluation, six principles of Universal Design (i.e., equitable use, flexibility of use, simple and intuitive use, tolerance for error, low physical effort, size and space for use) were considered in relation to the prototype garment. Principle Four, perceptible information, was eliminated from the list because the researcher and faculty specialist did not consider it applicable to clothing products as their purpose is not to communicate any information directly to Users. The degree to which the garment prototype satisfied the remaining six principles was

evaluated by the researcher and the Universal Design specialist. Discussion of how the prototype met each principle is presented as part of these evaluations. An overall assessment of the success of the prototype as a universally designed product was then made. Results are covered in the following section and reported by principle.

Equitable use.

Equitable use refers to whether the design is useful and marketable to any group of Users. The prototype was evaluated as having equitable use because it was found to be useful and marketable to both the Users and the Evaluators. Working women with and without physical disabilities found the prototype to be a product they would wear to work and would be willing to purchase it if it was made in a fabric that appealed to them. Additionally, working women within the User group with varying physical limitations as measured by Instrument I Section A found the prototype acceptable. The prototype could be marketed not only to women with varying degrees of disability, but also to women without any physical disability.

Flexibility of use.

Flexibility of use refers to whether the design accommodates a wide range of individual preferences and abilities. The prototype satisfied the principle of flexibility of use because it incorporated a wide range of features. These features were based on the description presented to the researcher during interviews with nine women with disabilities and were then, with the assistance of these women, translated into one garment. These women also had varying levels of physical ability. During wear-test evaluation, the prototype was evaluated ‘just as envisioned’ or ‘better than envisioned’ for most clothing dimensions not only by the women with various physical disabilities but also by women with no known physical disabilities.

Simple and intuitive use.

This principle determines whether the design is easy to understand, regardless of the User’s experience, knowledge, language skills, or current concentration level. The prototype was judged to have simple and intuitive use because it was easily donned and doffed, fastened and unfastened, and worn by both Users and Evaluators during wear-test evaluations. However, other comments made during wear-testing evaluations indicated a potential problem with the prototype for broader applications with other consumers. The flat lining led to confusion as to the right and wrong sides of the garment with one User and one Evaluator. Currently, only a button distinguishes the outside of the garment. Either lining with a contrasting fabric, a label to

indicate the inside of the garment or an interior pocket would be necessary in a finished product, to avoid any confusion in how to wear it.

Tolerance for error.

This principle evaluates whether the design minimizes hazards and the adverse consequences of accidental or unintended actions. For the prototype, this principle was interpreted as to how the prototype would function as a garment if the buttons are not fastened correctly (i.e., accidental or unintended action). All fifteen Users and Evaluator easily found, fastened, and unfastened the button on the prototype. The prototype was considered to satisfy the principle of tolerance for error.

Low physical effort.

This describes whether the design can be used efficiently and comfortably and with a minimum of fatigue. The prototype was judged to be a garment of low physical effort. All Users and Evaluators donned, doffed and wore the garment without any noticeable or verbalized fatigue. The prototype was rated at a high score for the dimensions of donning and doffing, ease of movement, and style comfort, especially with the group of Users. Two Evaluators stated that the prototype did not meet expectations for comfort, but this was due to sizing not style deficiencies. One limitation of the study in the assessment of low physical effort is that the wear-testing only lasted for approximately 20 minutes for both groups. A longer period of time would be necessary to assess whether low physical effort could be maintained during a full work day.

Size and space for use.

This principle assesses whether a design provides for appropriate size and space for approach, reach, manipulation, and use regardless of User's body size, posture, or mobility. The prototype was judged to have adequate size and space for use. All fifteen Users and Evaluators were content with the amount of coverage and were able to move around in the prototype comfortably. Evaluator 002 indicated a preference for more buttons in the center front of a finished product to prevent it from "gapping" open. Another Evaluator (003) had a slight problem with pulling across the shoulders because of her broad shoulders. In general, a majority of Users and Evaluators appeared to have adequate size and space for reach, manipulation, and use despite variance in body size, posture and mobility levels.

Visual appeal.

Visual appeal is not part of the Universal Design principles as listed in this study. However, because visual appeal are an essential component of Universal Design assessment in other areas where Universal Design is typically used (e.g., housing, interior design and household products), it should be considered in relation to this product. Visual appeal is also an important component of clothing, as well as to these other areas. Clothing Dimension Five (i.e., Design clothing with visual appeal), was used to assess the visual appeal of this product. One User found visual appeal to be nothing like she envisioned and eight found it just as envisioned or better. In the non-disabled group, one Evaluator found it nothing like she envisioned, leaving five Evaluators who found it just as envisioned or better. The problem for the disabled User was that the garment had asked for certain stylistic features that were incompatible with the requests of all other Users; therefore, these requests were not included in the final prototype. In the non-disabled group, the prototype garment lacked visual appeal for one User because it made her body appear larger than normal. Overall, the prototype was considered to have visual appeal by a majority of Users and Evaluators.

Current Acquisition Options by Individuals with Physical Limitations

Purchasing or acquisition options for the Users were deemed important research questions for this part of the study to complete the information about product development and marketing for the prototype product (i.e., Thoren's final use stage, 1997). Determining the price that consumers would be willing to pay for this type of product would help manufacturer and retailer set a target price point for production and sale. Objective 1 stated that the researcher would gather this information about current acquisition options from the sample of working women with physical disabilities. Table 16 shows the choices made by Users when asked to identify preferred methods of purchasing the garment if it were available in the ready-to-wear market. Six options were given which encompassed a variety of methods of purchasing ready-to-wear clothing, and a seventh option allowed for other options not thought of by the researcher. Users were allowed to select as many options as they wished.

Table 16

Acquisition choices made by Users

Current purchasing practice	Frequency
Traditional brick and mortar store	9
Online Shopping	0
Catalog Shopping	5
TV Shopping	0
Home demonstration and styles	5
Custom designed	4
Other	0

Traditional brick and mortar.

This type of traditional shopping method was selected by all nine Users. Reasons stated for preferring this over other methods were varied. They included more availability of styles, the option to feel fabric and the possibility of trying on a garment. “The feel is the first thing that hits me. I’ll buy something that may not necessarily look trendy but it feels good. I’ll try on the apparel and feel how it performs while sitting, standing, stretching, bending and walking (User 05).”

Disadvantages of the traditional brick and mortar store were reported as being a lack of facilities for people in wheelchairs and on crutches, and sales assistants being ignorant about people with disabilities. One User (04) related the following experience:

I had a friend with me and I borrowed a transportation service wheelchair. This sales assistant kept bringing up dresses and saying to my friend ‘do you think she’s going to like these?’ I finally got angry with her and told her that I was the one buying the dresses so she should talk to me, not my friend.” (User 04).

Another problem with brick and mortar stores was the inaccessibility of fitting rooms in stores. “The accessibility in some of these stores in some of the dressing rooms leaves something to be desired...I take time in dressing rooms - sitting, standing, stretching, bending - I really want to try and get a feel of how it will feel once I’ve worn it a few hours” (User 05). These types of problems have also been evident in other studies involving consumers with disabilities (MacDonald, Majumder & Bua-Iam, 1994).

Online shopping.

Privacy issues such as giving out a credit card number over the Internet or over the telephone were mentioned as detrimental factors that affected this clothing acquisition choice. Users were also not enthusiastic about an acquisition method which did not allow them to see the product first-hand before a purchase decision is made. These findings represented common complaints about Internet shopping (Miyazaki & Fernandez, 2001; Reichheld, Markey & Hopton, 2000).

Catalog shopping.

This method of acquiring apparel was acceptable for five Users. Advantages of buying from a catalog, as opposed to another method, included availability of a toll-free number to call for ordering and customer service, ease of returning products, availability of good quality specialty clothing in special sizes, ability to plan a wardrobe over a long period of time before placing an order, and reliability in sizing and apparel quality.

Disadvantages included variation in fit, lack of aesthetically pleasing clothing, variation in quality, and stockouts. “There are some catalogs whose quality I trust and whose sizes I’m familiar with. With Land’s End, I know what I’m getting in the sizes though I don’t like their styles. Other catalogs I like their styles but I don’t know what I’m getting” (User 08). These Users also wanted to be able to handle garments. “I look through catalogs but hardly ever buy anything because touching and feeling the garment is so important to me” (User 10). Catalogs are an important source of information about products for people with physical disabilities and have been recommended for purchasing by other researchers (Koester & Leber, 1984).

Home demonstration and sales.

This method of clothing acquisition was popular with five Users. Reasons given for choosing this method included privacy, meeting other people with similar problems, product-educated salespeople, the ability to try something on without feeling pressured to buy, and perceived longer decision-making time than other methods. Perceived disadvantages of this method included a dislike of getting together with other women to buy apparel and feeling pressured to buy. These contrasting ideas of the advantages and disadvantages might suggest that Users are not as familiar with this method as the other methods offered as choices and that more education about this method might encourage more people to consider it as a purchasing option.

Custom design.

This method was chosen by four Users, mainly based on their personal experiences. Personal experiences included living in other countries where custom design and production is expected and inexpensive for professional clothing, having an arrangement with a manufacturer to design custom pieces, and having mothers and grandmothers who had always constructed apparel for them. User (05) who had international experiences was concerned about using similar methods in this country. She said, “then again you can get wonderful results too. I haven’t tried custom work in this country, it would seem so expensive to me.”

The primary reason Users did not choose custom design as an acquisition option was the lack of availability of affordable custom dressmakers in the area. User 09 stated, “I would probably have it custom designed if I could find someone.” Johnson, Littrell and Reilly (1991) had found that 65.5% of their surveyed population (not physically disabled) expected that a clothing item made by custom sewing service would be priced more highly than a ready-to-wear product. Typically, consumers of customized sewing services tend to have a higher income and education level (Watson, 1998). Income and education level were not assessed in this study.

Price Range

Users were varied as to how much they would expect to pay for a universally designed garment in their size and fabrication that was going to be used for work (see Table 17). User 04, who chose the lowest price category, was very conscious about the lack of spending power for people with severe physical disabilities like herself. She said “it would depend on how much money I have. Right now under \$25 would be right, but please remember that only about 31% of people with disabilities have jobs, which puts them into the lowest category. You do have to think about that.” These Users were typically part of a higher income bracket so User 04’s comments would not apply, but are important when considering clothing prices for the population in general. Five Users chose a potential price between \$26 and \$75 because they typically spent that much on a jacket for work and related the prototype closely to this type of garment. User 05 stated that she never spends more than \$50 on a jacket and always shops the sales, which limits her choice of styling. User 08 compared the garment to brands that she usually purchased and equated quality with these brands, thereby placing a similar price tag on

this garment. User 10 was accustomed to paying more than \$50 because she assumed larger sizes meant higher prices. Table 17 shows the price ranges selected by Users.

Table 17

Price range preferred by Users

Price range preferred	Frequency
\$0-\$25	1
\$26-\$50	3
\$51-\$75	2
\$76-\$100	0
>\$100	3

Three Users stated a willingness to pay more than \$100 for the product, including User 07 who was “just happy to find a garment that she liked, could wear comfortably, and which looked good” on her. “If this was a sapphire blue, flowing kind of thing and it had a \$150 price tag on it, I would pay it.” User 02 equated price with workmanship and how the garment would be manufactured. She said “That’s something I would have to think about. If something really appeals to me and fits me I don’t mind paying a good price. If it was made of a good fabric with good workmanship I would easily pay between \$100 - \$125 for this one piece”. Comments on pricing were dependent upon type of garment, function of garment, color and fabrication of garment. These results support Feather’s findings (1976) that people with disabilities are willing to pay more because they are used to not finding any clothes that accommodate their needs.

Phase B Results – Apparel Industry Issues

Apparel Industry Issues - Overview

The objective for Phase B of the study was to explore issues embedded in production and distribution of the prototype with appropriate personnel at a variety of clothing companies (Manufacturers). This portion of the study was intended to understand how further development and marketing of this product might be impacted by Manufacturer constraints. The researcher saw potential in exploring this objective as a result of a literature search, which yielded little concrete evidence that Manufacturers had been included in the group of individuals whose decisions would be crucial in the complete product development process.

The researcher selected a group of Manufacturers who made or contracted and distributed a product similar to the prototype. Thirty-seven companies (i.e., women's sportswear) were contacted. Five representatives from companies, involved in producing a product similar to the prototype, responded and Instruments II and IV were forwarded to them, resulting in two responses indicating non-interest in participation and no response from the other three. In addition, a selection of local manufacturers and alumni were contacted in a second attempt to collect data. Of these ($n=24$), 10 responses were received indicating an interest in the study. Instruments II and IV were sent out and six individuals (Manufacturers) responded with pertinent information. The initial search for Manufacturers was made during the month of August 2001, and materials sent at the beginning of September 2001 just prior to the terrorist attacks on New York City and the Pentagon. Based on the impact of the terrorist attacks on their companies, most of the original group of manufacturers, who had indicated a willingness to participate, withdrew from the study. The nonparticipation of the purposive selection of manufacturers resulted in a small, biased sample of Manufacturers ($n=6$). The final sample included only three companies that matched the profile of the original sample.

In addition to sample selection bias in Phase B, a data collection bias was inadvertently inserted into data collection. The cover letter sent to manufacturers, with Instruments II and IV, included identification of the Users as women with physical disabilities. The letter included the phrase that the research dealt with "...the problem of finding useful and wearable ready to wear clothing for special populations, in this case, working women with disabilities" (See Appendix C). This phrase may have biased the results of Manufacturer data collection process. With these limitations, the researcher, in Phase B, was only able to infer the existence of general issues related to product development and marketing for the prototype, and these are presented below. Specific production and marketing questions were asked of Manufacturers (see Instrument IV); however, detailed results are not reported.

Manufacturer profile.

Company A was a lifestyle oriented men's, women's and children's sportswear manufacturer/retailer with a young, active, carefree image. Company B was a swimwear company with its own production facilities and supplies discount retail stores with a variety of lines of swimwear. Company C manufactured sportswear and had licenses from other companies. Company D manufactured knit active sportswear and customized sports uniforms.

Company E manufactured men's shirts, neckties and formal wear. Company F manufactured women's classic-styled suits and jackets for business and business casual. Individuals participating in this stage received a Virginia Tech coffee mug in return for their time.

Apparel Industry Issues

This section of the study attempted to fulfill Research Objective Four (Explore the issues embedded in production and distribution potential of the clothing product with appropriate personnel at a variety of clothing Manufacturers). Assessment of issues relating to manufacturing and marketing feasibility was made by addressing four areas for new product development outlined by Cohen (1991). The four areas were (a) Company Operations, (b) Engineering and Production, (c) Financial, and (d) Concept Marketability. These areas were expanded by a series of specific questions (Instrument IV, Appendix B). The areas and questions were validated by the business managers at [TC²]. The issues are reported in Table 18, based on Manufacturers' responses within the four areas of the instrument.

Table 18

Manufacturing and marketing issues based on Manufacturers' responses

Company Operations	Engineering and Production	Financial	Concept Marketability
<ul style="list-style-type: none"> • Compatibility with current product categories • Compatibility with current target market • Interruption of manufacturing activities • Interruption of engineering activities • Interruption of marketing activities • Ability to provide after-sales service to retail stores • Ability to provide after-sales service to consumers • Use of Quick Response • Appropriateness for current facilities 	<ul style="list-style-type: none"> • Technical capability to make product • Costing assessment based on volume • Costing assessment based on cost and amount of materials • Costing assessment based on labor costs • Target price point for target consumer • Availability of materials • Lead time • Season • Color run • Storage facilities for raw materials • Storage facilities for finished product • Testing and quality inspection capability 	<ul style="list-style-type: none"> • Profit margin • Size of production run • Payment to vendors • Pay back time • Break-even point • Wholesale price • Retail price • Materials cost • Shipping cost • Labor cost • Target price point 	<ul style="list-style-type: none"> • Current channels of distribution • Indicators of product's unique use • Qualified sales personnel • Manufacturers reps • Promotional methods • Addition of new market • Brand image • Listen to customer • Flexibility in strategy • Adaptation to change

Apparel Industry Issues – Discussion

Table 18 shows the issues related to company operations, engineering and production, financials and concept marketability, as raised by Manufacturers in response to interview questions (see Instrument IV, Appendix B). Many issues were raised within each of the four areas but overlap existed between each area according to the interpretation of questions by Manufacturers.

Compatibility of the prototype with current company operations raised a number of issues. Compatibility with product categories and target market became two separate issues, whereas Cohen had only asked about current product lines. Issues were raised about interruption of manufacturing, engineering and marketing strategies in line with Cohen's instrument. After-sales activities were split between retail customers and consumers, whereas the instrument had not specified to whom after-sales service would be made available. Appropriate facilities and the use of Quick Response were raised as issues, which had not existed in the instrument.

Engineering and production issues for making a specialized product involved having the technical capability to make the product. Cohen's questions had included marketable cost, but Manufacturers broke costing down into small segments. They needed to know more about: costing based on volume, amount and type of materials, labor, lead time, season and colors. Issues about storage facilities for raw materials and finished product were raised, in addition to having facilities for testing and quality inspection.

Financial questions had originally included return on investment, but again the instrument should have been more specific for this group of Manufacturers. Issues raised included: size of production run, terms of payment to vendors, costing the product based on the amount and volume of materials, the labor cost, price of product wholesale and retail, shipping cost and price point based on what the market would bear. Other issues to be considered were company profit margins, pay-back time (how long before the product made a profit) and break-even point (how many units would need to be sold to make a profit). Having available capital was in the list of questions but was not an issue for any Manufacturer.

Concept marketability issues included: assessing suitability of current channels of distribution, indicating the product's unique use, (not in the instrument), assessing the need for qualified sales personnel, suitable promotional methods, research of the new market, being flexible with strategies, and adapting to change and brand image.

The issues raised by this group of Manufacturers warrants comparison with a similar study performed by Kallal and Lamb (1993), in which factors representative of industry constraints, which had the potential to impact merchandising and retail, were highlighted. These factors were: ability to retail, brand image, calendar, company success, competition's past performance, costing and availability of resources and skills, line plan "formula", past product performance, product quality, product sell-through and the response to market changes. To obtain these retail constraints, Kallal and Lamb gathered information from three companies with in-place product lines and found, that typically, companies "used past performance of their own and their competitors' products as a gauge for projecting new product development" (p.4). The researcher had initially considered that some of the factors identified by Kallal and Lamb would not apply to the prototype in this study, but according to Manufacturer response, companies judge feasibility for new products based on a similar and traditional formula. All the factors identified by Kallal and Lamb were similar to issues raised in this study, with perhaps the exception of past product performance, for which Manufacturers had no comparable product. Line plan 'formula' was not an issue, but one Manufacturer had mentioned the benefit of seeing the prototype as part of a line instead of an isolated product.

According to Manufacturer feedback, more information was required in order for them to make a full assessment of the production and marketing feasibility of the prototype. The information needed was stated as (a) cost of materials and engineering, (b) size of production run, (c) target price point (marketable cost for this population), (d) time study, (e) labor costs, (f) shipping costs, and (f) season. Although the Users had found it an acceptable garment to wear year-round, Manufacturers said they would need to distinguish seasons to determine fabric type and cost. Suggestions were made in specific areas, including the use of catalogs as a distribution vehicle. Koester and Leber (1984) in a study of physically disabled men and women ($n=91$) found that catalogues were a preferred method of communication about clothing products for the disabled consumer. Catalogues were not as popular an acquisition method as brick and mortar retailers in this study, but received the second highest frequency rating (five out of nine Users would use them as a clothing acquisition method for this product).

CHAPTER SIX

Summary, Conclusions and Recommendations

This research study addressed a specialized product development problem faced by a specific group of individuals or target customers: working women with physical disabilities. In order to be included in a productive society, these individuals (the Users) wanted to have comfortable and appropriate clothing to wear to work. Currently little choice exists for them in the traditional retail environment. This study in specialized product development examined the process of developing a clothing product to satisfy User needs within the ready-to-wear framework. The constraints of the Manufacturers were explored in order to more fully define the constraints of specialized clothing product development from an industry standpoint and to seek potential solutions.

Within the context of the study, Thoren's (1997) four points of systemic change were addressed. These pertinent points for consideration included increased clothing choice, development of clothing that addresses both symbolic (aesthetic) and functional levels, cost-effectiveness in production and marketing, and communication about available choices. Within the framework of assessing User needs and applying systemic change, the concept of Universal Design was also explored to determine if this might be a suitable product development method of obtaining optimum satisfaction for both multiple Users and for Manufacturers. A resulting framework for specialized product development, which could be extended to a broader range of future specialized products within the ready-to-wear industry, served as a model for the study. This framework (Figure 3 in Chapter 3) was modified based on the results of this study.

Research Questions and Objectives

The specific research questions were as follows:

1. What are the specific physical limitations of a sample of employed women and how do these limitations impact their ability to find, purchase and wear currently available ready-to-wear clothing for the work situation?
2. What are the desirable clothing features that allow adaptability for specific physical limitations and maintain a suitable appearance for this sample of women?

3. Can all these selected features be incorporated into an upper body clothing product and still maintain universal appeal and functionality?
4. What issues exist in the production and marketing areas of the clothing industry that might impact or limit further development of this specialized type of product?

In order to answer these four research questions, the following objectives were developed (with designation of Thoren's [1997] four aspects of systemic change in parentheses):

1. Gather detailed information about specific physical limitations, professional clothing needs, preferences and current acquisition options from a sample of working women who are affected by a variety of physical disabilities (clothing choice, functional and symbolic needs, communication). (Addresses research questions 1 and 2).
2. Universally design an upper body clothing product using data gathered in interviews with women to produce a prototype (functional and symbolic needs). (Addresses research question 3).
3. Assess the success of the product with the women using wear-testing and survey evaluation (functional and symbolic needs). (Addresses research question 3).
4. Explore the issues embedded in production and distribution potential of the clothing product with appropriate personnel at a variety of clothing companies (cost-effectiveness in production and marketing, communication). (Addresses research question 4).

Summary of Results

For Objective One, detailed information about physical limitations was gathered during User interviews demonstrating a variety of limitations distributed throughout the sample of Users ($n=9$). These physical limitations had been itemized based on reports in the literature, the Enabler model (see Figure 2) and assistance from an occupational therapist. Analysis of the results showed that upper body strength, difficulty lifting, reaching or carrying, difficulty handling & fingering and limitations of stamina were major problem areas for Users. Limitations of head movement, difficulty with range of motion of upper body and incoordination were the second most common problem areas.

For Clothing Dimensions relating to professional clothing needs and preferences (Objective One), constricting styles and difficult to manage fastenings caused the most consistent problems with all nine Users. Clothing dimensions were developed from past clothing literature

(see Table 7). These findings about clothing dimensions suggest that the researcher's priority, in designing a prototype product for these Users was to find a design solution that generated a comfortable, well-fitting garment that allowed for ample ease of movement with easy to manage fastenings. According to the Users, if this basic style of garment was acceptable, they were willing to purchase the same basic style in various colors and fabrications as if it were a "uniform" to wear to work. In an analysis of possible connections between physical limitations and clothing dimension problems, no connections could be found between the degree of problem with the nine physical limitations and the type of rating given to clothing dimensions and Users' professional clothing needs and preferences.

Upon analysis of current acquisition options (Objective One), traditional brick and mortar stores were listed by every User ($n=9$) as the location at which they were most likely to shop for clothing. Other popular acquisition options ($n=5$) included catalog shopping and home demonstration and sales. Home demonstration and sales were the most favored channels of acquisition by the Manager of Product Development and Marketing at [TC²]. Custom design was also mentioned as a possibility ($n=4$). Online shopping, TV shopping and other option categories were not listed by any User as possible acquisition options, although the Managers at [TC²] had suggested multiple channels of distribution for the prototype. Privacy issues such as giving out a credit card number over the Internet or over the telephone were mentioned as factors that affected Users' choice of acquisition options, along with their desire to have hands-on experience before a purchase decision was made.

For Objective Two, the researcher created a single design sketch that accommodated the features suggested during the User interviews by each User to feel comfortable (functional features) and also the aesthetic features that they had indicated they would prefer (symbolic features). The researcher had expected this section of the study to be challenging because of the different nature of each User's disability, but, in fact, the process of assimilating each User's needs and preferences into a single prototype garment was easier than expected because of the similarity of the body and clothing problem areas. Two prototypes were made in two sizes according to the measurements taken during User interviews. They were constructed in two fabrics, a white cotton muslin and a dark-colored polyester knit. A spec sheet was made for the prototype with flat sketches of front and back. This garment was slightly modified after the

interviews with professionals at [TC²] (i.e., scalloped edges were eliminated and raglan sleeves were substituted for kimono sleeves).

To assess the success of the product (Objective Three), two groups of consumers were used. One was the original group of Users with physical disabilities, and the other was a group of working women with no known physical disabilities. Both groups positively evaluated the prototype. The original group of Users found the following categories “better than they had envisioned”: Easy-to-manage fastenings and Ease of movement. Clothing dimensions that received the one low score included Coverage, Visual Appeal, Construction and Adaptation of features. For the sample of non-disabled women, Donning and doffing, Fastenings, Coverage of the body, Coverage in needed areas, and Adaptation of features, were most often rated as exceeding expectations. Visual appeal and Construction were given a low score by both Users and Evaluators. Fastenings were consistently rated as exceeding expectations for both groups of women. Table 19 shows the dimensions exceeding and not meeting User and Evaluator expectations.

Table 19

Clothing Dimensions receiving High and Low Ratings from Users and Evaluators

	Exceeded expectations (High)	Did not meet expectations (Low)
Disabled sample (Users)	Fastenings Ease of movement	Visual Appeal Construction Coverage Adaptation of features
Non-disabled sample (Evaluators)	Fastenings Donning and doffing Coverage of the body Coverage in needed areas Adaptation of feature	Visual appeal Construction

Note. Dimensions common to both groups shown in bold

Another element of assessing success of the product was to determine its success as a universally designed product (Objective Three). Six principles of Universal Design were considered in relation to the prototype garment by the researcher and a Universal Design faculty expert. These six principles were: equitable use, flexibility of use, simple and intuitive use, tolerance for error, low physical effort, and size and space for approach and use. These

principles were adapted from the seven principles listed on the website of the Center for Universal Design at North Carolina State University (1997). One of the original seven principles, perceptible information, was eliminated from the list because the researcher and Universal Design expert did not consider it applicable to clothing products. The degree to which the prototype garment satisfied these six principles was evaluated by the researcher and the Universal Design faculty expert, with discussion of how each principle applied to the prototype. An overall assessment of the prototype as a Universal Design product was then made. The prototype generally worked well as a universally-designed garment. Visual appeal was also considered as a component of Universal Design not included in the original list. The prototype was considered to have satisfied most Users' aesthetic needs for a working garment.

The issue of size in clothing in relation to the principles of Universal Design poses the question of whether a one-size-fits-all philosophy should be followed for clothing products. Does the idea of multiple sizing violate the true nature of Universal Design? By definition, Universal Design represents "products and environments usable by all people...without the need for adaptation or specialized design" (Center for Universal Design, 2001, p.1). Does this difference in the product necessitate an amendment in the Universal Design philosophy? Universal Design is a concept that has not previously been applied to the development of clothing products. The researcher proposes that clothing represents a different environment from those typically associated with Universal Design (e.g., housing, appliances, household products); therefore, the issue of fit and sizing may need to be approached from a different point of view, maybe one that has not yet been raised in a Universal Design context. This environment that is closer to the body than any other is expected by consumers to be sized appropriately for them. Clothing is our "most intimate environment" (Watkins, 1984, p.xv); therefore, it encloses one in a way that household products do not have to perform. It has to move with a person, provide modesty covering, and trap warmth. Above all it has to conform to certain aesthetic standards. Correct fit is of prime importance to all these functions. The researcher proposes that if the product is designed to satisfy a majority of needs and preferences, but an assortment of sizes are available, the Universal Design principles such as flexibility and equitable use, would be applied. This area of conflict impacts to some extent the degree to which the flexibility of true Universal Design can be achieved in clothing, when differences in personal needs and preferences in terms of styling and visual appeal surpass the ability of a garment to incorporate all Users.

To explore the issues involved with production and distribution of the clothing product (Objective Four), appropriate personnel at a variety of clothing companies were contacted. Six clothing companies participated by answering questions related to new product development feasibility, as developed by Cohen (1991). The questions were grouped into four sections including (a) Company Operations, (b) Engineering and Production, (c) Financials, and (d) Concept Marketability. Analysis of the Manufacturer responses revealed the following. The product was not compatible with Manufacturers' operations, mainly because the Manufacturers did not produce or market similar types of products and would not have the support necessary to meet any after-sales requirements that customers might need. However, the Manufacturers felt that the product would be easy to engineer and produce, and that they would have the capabilities to make it, the available raw materials to cut and sew it, and the storage space for raw materials and finished product. Responses from the financial section of the instrument showed that more information was needed for Manufacturers to make an accurate assessment of costing of production for the prototype and an accurate retail price point. More information should have been provided about (a) cost of materials and engineering, (b) size of production run, (c) target price point (marketable cost for this population), (d) time study, (e) lead time, and (f) season. An assessment of given profit margins demonstrated that costs would need to be cut at some stage of either the production or distribution phases of the product to accommodate all Users' given financial constraints.

Marketing feasibility was not compatible with five out of the six Manufacturers because they had neither the current channels of distribution in place to market the product nor qualified sales personnel. Suggestions were made that catalogs would be a good vehicle for marketing. Manufacturers stated that, if produced and marketed by their company, the product would add a new market for them.

Conclusions – Research Questions

Research Question 1. (What are the specific physical limitations of a sample of employed women and how do these limitations impact their ability to find, purchase and wear currently available ready-to-wear clothing for the work situation?)

Specific physical limitations that are common to this group ($n=9$) of employed women can be grouped into six categories. Two categories are (a) range of motion, (b) motor planning,

(c) strength, (d), sensory, (e) stamina, and (f) other. Some categories that presented the most common problems, strength and stamina, impact both the wearing of clothing and styling of clothing. The clinical definition of a disease appears to be unrelated to the identification of physical limitation categories. This finding supports previous clothing research by Yep (1977), Reich and Shannon (1980), and Newton (1984-85) who arrived at similar conclusions with different categories of physical limitations. New divisions within categories of physical limitations were identified in this study. One example would be sensory, which was approached by the Users as describing touching and feeling activities and as describing the body's sensitivity to temperature. These might be divided into two separate categories.

Physical limitations impact the ability of women to find suitable work clothing in a number of ways. According to the clothing dimensions used in Instrument I Section B, significant problem areas for the Users were in finding clothing that does not constrict them and finding clothing that has easy-to-manage fastenings. The problem with constricting styles could be solved with designing garments that have plenty of room built into them for ease of movement. New generations of fastenings need to be developed that are more User-friendly and can be manipulated by people with a broad range of abilities. Some mention of these types of fastenings was made by the apparel industry consultants at [TC²]. They mentioned, to the researcher, new types of Velcro® fastenings not yet on the market that might be useful for future product development.

Some of the clothing dimensions need to be more highly defined. One example would be the issue of quality in construction. A response from a User showed confusion between construction quality and styling features, leading to two conclusions: (a) more work needs to be done in future studies to further define quality and style, or (b) User perceptions of visual appeal and quality in construction are too diverse and elusive for one garment to encompass.

No specific category of physical limitations impacted Users' ability to find, purchase and wear clothing for the workplace. All categories affected selection and use. All Users wanted to find clothing that was easy to move in, easy to don, doff and fasten, and which maintained a suitable appearance for the work place. They wanted to be able to shop for this clothing in brick and mortar stores but might be prepared to use catalogs, home demonstration and sales, and custom design to acquire satisfactory clothing. As one User stated, "women with physical disabilities want clothing that does not set them apart from other women."

Research Question 2. (What are the desirable clothing features that allow adaptability for specific physical limitations and maintain a suitable appearance for this sample of women?)

Using a Universal Design framework and co-design techniques, the researcher established common clothing features preferred among Users, which could be put into a clothing product. These included a loose, unfitted shape; a full lining; no defined waistline area; a front opening with diagonal keyhole buttonholes and large sized buttons; a round neckline with no collar; a raglan sleeve; large, deep pockets; removable shoulder pads; and a washable lightweight fabric in a dark solid color. With the acknowledged lack of linkage between specific disability and limitations, these features could be used for clothing for populations with a range of physical disabilities in future applications. Specific features mentioned by individual Users (e.g., a collar that came down low on the back of the garment, topstitching on the front of the garment) could be added to the design from a database of additional features if a mass-customization approach is used to manufacture and distribute this type of product, as suggested by the consultants at [TC²].

Research Question 3. (Can all these selected features be incorporated into an upper body clothing product and still maintain universal appeal and functionality?)

All the selected features were incorporated into an upper body clothing product produced as a prototype in this study as a result of co-design with Users. Wear-test evaluations by both the original Users and the Evaluators demonstrated that universal appeal and functionality could be maintained. Ratings of the prototype in all clothing dimensions were generally good. The majority of women in the evaluation stage found the prototype just as they envisioned or better than they envisioned for a garment that they would wear to work.

Research Question 4. (What issues exist in the production and marketing areas of the clothing industry that might impact or limit further development of this specialized type of product?)

Production and marketing issues were assessed by gathering input from apparel manufacturers regarding the prototype product. The Manufacturers who gave input determined that the product would be easy to engineer and produce; however, marketing the product would not be feasible for them, mainly because it was not perceived as part of their established product lines or company image. Manufacturers stressed the need to understand and adapt to customer needs; however, they were not willing to progress beyond their established marketing frameworks to satisfy a customer they saw as needing “specialized” treatment in terms of sales

and after-sales assistance. Price point was another issue that would impact this prototype. Costs suggested by Manufacturers for production and marketing based on apparel industry standards would be too high for this market of Users. Production and/or marketing costs would have to be reduced. One way of doing this would be to reduce margins by removing the brick and mortar retailer and sell to the customer direct from the manufacturer. Manufacturers generally were unsure about whether production of this type of product would generate enough sales to turn a profit. The Manufacturers were aware that the product had been designed with women with physical disabilities in mind as potential Users. This may have biased Manufacturer responses in this section of the study because they tended to see the market as small and separate. In addition, this works against the idea of Universal Design, a concept which promotes successful outcomes for all types of Users.

Conclusions - Universal Design

The researcher concludes that a Universal Design framework for clothing design is suitable for producing clothing that addresses a variety of User needs. Using co-design to generate initial ideas about design features allowed the researcher to compile a list of common acceptable features and incorporate them into one clothing product. The product was assessed to have satisfied the six principles of Universal Design and to possess visual appeal for the majority of Users and Evaluators. The issue of fit in clothing needs to be addressed as an aspect of Universal Design. As no research has explored the possibilities of Universal Design as applied to clothing products, the fit issue is unexplored and unresolved in this study, as two sizes of prototype had to be made in order to satisfy all Users and Evaluator in wear-test evaluations.

As applied in this study, Universal Design is a system that could be used to address the clothing needs of the disabled population. In this study, the ready-to-wear clothing system, from design to distribution, was assessed using small samples of Users and Manufacturers, placing the target consumer User at the heart of the system, and emerging with a product that was satisfactory to the Users in all aspects and to Manufacturers in production only. Thoren's (1997) recommendation that a potential product has to be satisfactory to all parties involved in its development and use. This study starts to address several aspects of Thoren's clothing system paradigm shift, including: (a) provision of sufficient choice of suitable clothing products for a variety of situations (development of a product for disabled Users for the workplace), (b)

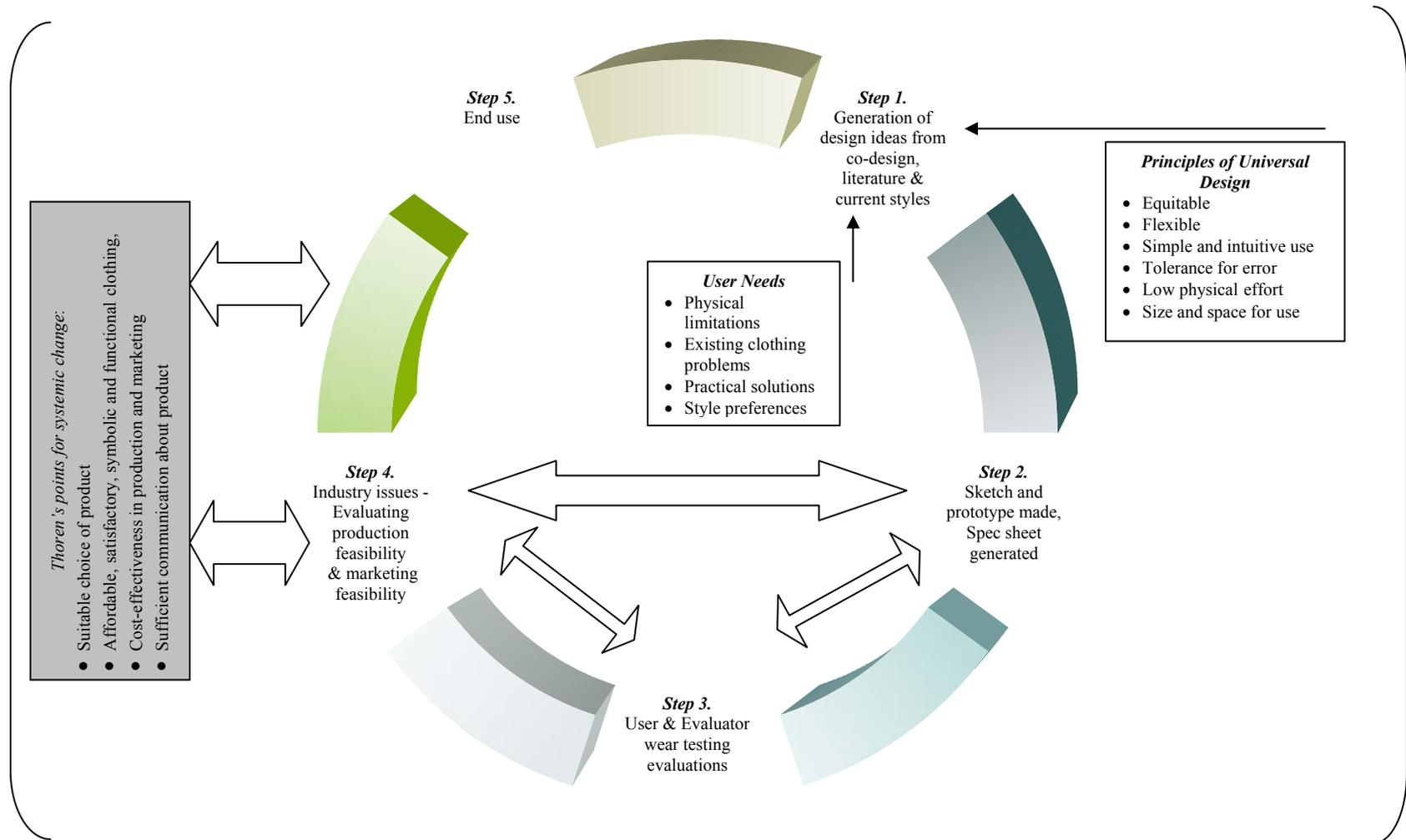
development of a system that will produce affordable and satisfactory clothing for the physically disabled consumer at both a symbolic and functional level (co-design incorporating design solutions which satisfy a number of common problem areas), (c) maintenance of cost-effectiveness in production and marketing (designing a product that is feasible for production and would be feasible for marketing with the right channel of distribution), and (d) communication about available clothing products. One way to address the need of these consumers is for the industry to become more consumer-centric and supportive of populations outside of their traditional market base.

Conclusions – Revised Product Development Framework

As a conclusion, the framework was revised to reflect the actual process as experienced in the study. Figure 7 shows the revised product development framework. Based on findings, this process was experienced more like a continuous cycle rather than a linear and sequential process. Both User needs (i.e., physical limitations, existing clothing problems, practical solutions, style preferences) and principles of Universal Design (i.e., equitable, flexible, simple and intuitive use, tolerance for error, low physical effort, size and space for use) impacted the generation of design ideas (Stage 1). After the ideas were generated, the sketch and prototype was made (Stage 2). User and Evaluator wear-testing then took place (Stage 3). The prototype was considered a success and the cycle moved forward into industry evaluation of production feasibility and marketing feasibility. If at this stage (3) the prototype had not been successful, the process would have to cycle back to Stage 2, sketch and prototype, to generate another solution. Industry feasibility was then obtained (Stage 4). This prototype was successful from a production point of view, but not from a marketing point of view. Had the product been unsuccessful from a production point of view, the process would have to cycle back to Stage 2 for the generation of new solutions (double-headed arrows denote flow back and forth for verification). However, marketing problems in this study represented a different perspective separate from the product development process, one that is more wrapped up in Thoren's systemic change than in the specific stages of this cycle, because it is based on overall company orientation rather than product characteristics. In this product development cycle, the end-User was already identified; however, marketing to the end-User presented problems for the Manufacturers. The issues raised by Manufacturers are system concerns, which call for an

expansion of the model based on further research. If the product had been considered satisfactory from both a production and marketing point of view, the process would cycle through to Stage 5, End Use. Further suggestions for improvements from the consumer should be incorporated into the development of new products, which would generate new ideas for Stage 1.

Figure 7. Revised model for specialized clothing product development



Recommendations

For future studies, the following recommendations are made. The first group of recommendations explains ways that future studies could validate and extend the present study and the second group of recommendations describes new ideas that could be explored to further expand the research applications and literature base.

Validate and Extend Present Study

1. The number of individuals comprising the User sample of working women could be increased in number and in variety of physical disabilities.
2. The identification of common ‘problem’ clothing dimensions indicates the potential for a more focused and quantitative method of data collection to be used with the User sample. One example of this might be the use of a survey questionnaire with a large sample, which could be analyzed to determine statistical significance using regression techniques or analysis of variance (ANOVA). An experimental research design might consist of a stamina/endurance study of donning and doffing clothing, which varies with disease, activity, environment, and time. This study could be analyzed using a four-way analysis of variance (ANOVA).
3. Descriptors of the words ‘potential’, ‘occasional’ and ‘impossible’ should be used so that confusion will not arise regarding definitions for these rating levels. Some Users were unable to distinguish between a potential problem (i.e., something which might become a problem in the future) and an occasional problem (i.e., something which currently causes problems intermittently).
4. The physical limitation area of lifting, reaching and carrying should not be treated as one area. All Users ($N=9$) mentioned a difficulty in considering lifting, reaching and carrying activities as one area. Difficulties in lifting and carrying objects were generally due to lack of strength; however, these Users had no problems reaching with the arms, which related more to range of motion. The confusion was compounded when the researcher attempted to place the initial physical limitation areas into the six modified limitation categories. Lifting, reaching and carrying became part of the revised area of strength (category 3), whereas reaching could have easily been considered as a part of range of motion (category 1).

5. One clothing dimension that needs clarification in the instrument is coverage of the body. When the researcher approached this dimension as a question to the Users, she assumed that coverage of the body would relate only to modesty issues. After interviewing the Users, coverage for warmth was also found to be an important concern among the Users and a separate issue from modesty. Coverage for warmth should be included as a separate category.
6. Wear-testing should take place for a longer period of time to allow Users and Evaluators to experience a full work day while wearing the garment, which could be analyzed using repeated measures.
7. The instrument based on Cohen's (1991) feasibility for new product development questionnaire should be tailored to suit issues pertinent to the apparel industry. This would yield more applicable answers which would facilitate analysis of the data.
8. The industry analysis component of the study should consist of two samples. One group of Manufacturers who are aware that the prototype is for consumers with disabilities, and the other who are unaware of the physical limitations of the target consumer.
9. Upon analysis of the Manufacturers' responses to some questions, the researcher found that information they reported as necessary to answer questions (e.g., fabric yardage) could have been determined from the spec sheet included with the instrument. In future studies these answers should be included with the questions.

Further Exploration of New Ideas

1. Suggestions from the Users made during and after wear-testing evaluation to enhance the prototype (e.g., a scarf holder in the back of the neck) could be incorporated into the final product.
2. Evaluators should have an opportunity for co-design of the prototype as well as Users.
3. Future applications of the research findings might utilize a line of garments with minimum variability from the prototype developed in this study, fabricated in a variety of ways. Users had mentioned that they would be happy with a "uniform" of products which were comfortable and suitable for their individual needs.
4. The issue of comfort in clothing, both physical and psychological, should be addressed from the point of view of the Users and Evaluators.

5. The researcher should be removed from the wear-testing component of the study because of the potential for bias. The Users and Evaluators have worked with the researcher in developing the prototype and may not give an objective viewpoint about the finished product.
6. Future studies attempting to replicate this one should not make the identification to the Manufacturers that the product has been developed for Users with physical disabilities, because this may contaminate Manufacturer responses.
7. The sample of participating apparel companies could be drawn from manufacturers who make similar products to the prototype.
8. With a larger sample size of Users and a cross-section of apparel companies, some determinant of size of company (e.g., number of employees, annual sales volume) or other organizational demographics could be analyzed to determine statistical significance in a company's approach to specialized product development.
9. Industry professionals suggested the following issues that should be addressed in industry surveys for future studies of a similar type: (a) forecasted production volume, (b) lead-time, (c) direct sales from manufacturer, and (e) production of a full line rather than single garment.
10. Future studies should address the option of co-design, which was raised by industry consultants. The Business Managers at [TC²] suggested that Users, with the help of a laptop computer, could be more involved with the actual design process while ordering their choice of garment. Their choices could be digitally transmitted for marker and pattern layout. Cut pieces could be sent together either on a modular system or unit production system for assembly. Digital technology could also be used to aid the User visualize the finished garment on her body, using the Avatar™ body model.
11. Future studies could focus on fabrication issues. Industry consultants made suggestions for innovative fabrics in this study. The Business Manager for Engineering showed the researcher an interlining fabric that could be sandwiched between the fashion fabric and the lining. This was an experimental fabric not yet on the general market which would regulate body temperature, bringing it constantly to equilibrium.
12. Retail companies should be part of the sample to assist research into the sales feasibility of the product.

13. Future studies could explore the pre-concepts that manufacturers have about marketing to consumers with disabilities.

This study has linked working women with physical disabilities to a product and an industry. As a design concept for clothing, Universal Design succeeds from the point of view of consumers and producers. At issue is the acceptance of the apparel industry of marketing to consumers they perceive to be a 'specialized' group. This perception contradicts all that is positive about Universal Design, and remains a stumbling block in the pathway between consumer, or User-oriented product development, and the industry that has to meet consumer needs.

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APPENDIX A

IRB FORMS FOR HUMAN SUBJECTS RESEARCH

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
 Informed Consent for Participants
 in Research Projects Involving Human Subjects

Title of Project Specialized clothing product development for working women with physical disabilities

Investigator(s) Katherine Carroll, Dr. Doris H. Kincade

I. Purpose of this Research/Project

The purpose of this project is to determine whether appropriate clothing for professional women with physical disabilities can be manufactured and marketed using existing ready-to-wear methods. The anticipated contributions of the findings are to further expand the literature on clothing for individuals with physical disabilities and on manufacturing and marketing for specialized clothing and textile products, and to move towards a practical solution to the problem of clothing accessibility for people with physical disabilities.

The subject pool will consist of ten to twenty working women between 20 and 65 years of age with an upper body physical limitation of some kind, which affects interaction with clothing products in some way. Each subject must also be employed or formerly employed in a job where clothing is of some importance to the position. Single gender selection is being used here because of existing industry divisions and technology differences between men's and women's clothing manufacturing and marketing processes.

The subject pool will also consist of a small group of working women (N=5) without physical disabilities, who will wear test the clothing product prototype in order to help evaluate the universal design aspects of the product.

II. Procedures

The procedures involving the human subjects are in two stages. Stage One involves semi-structured interviews with the women with physical disabilities by the researcher. In these interviews, the women will be asked to identify clothing problems that they experience due to their upper body physical limitations and will co-design an upper body garment by sketching with the researcher their 'ideal' type of clothing product. Stage Two involves a wear-test evaluation of a prototype clothing product by the disabled and non-disabled subjects. During these evaluations, both groups of women will try on the prototype product to evaluate its success as a universally designed clothing product. Questions will be asked pertaining to various clothing dimensions (e.g., comfort, fit, style features).

In Stage One, the interview interactions will last one hour and will be conducted by the researcher, at a location decided upon by the subject in order to alleviate mobility problems. The subjects will be expected to answer specific questions related to the product development and marketing of a specialized clothing product. Body measurements of chest, waist, hips and back length will also be taken at this stage. The wear-testing interaction (Stage Two) will last one hour and will be conducted by the researcher at a location deemed acceptable by the subject in order to alleviate mobility problems. The subjects will be expected to put on, wear and take off a

prototype clothing product and answer questions related to its ease of use, and specify preferred marketing methods.

III. Risks

This study presents no more than minimal risks to the participants. In the event that emergency help is needed during any of the sessions with subjects described above, emergency services are available on the campus of Virginia Tech, and throughout the town of Blacksburg.

IV. Benefits

Benefits to the sample of women in the study focus on industry progress towards fully accessible clothing that will help this population succeed in the workplace. No promise or guarantee of benefits has been made to encourage participation in this project. Subjects may contact the researcher at a later time for a summary of the research results.

V. Extent of Anonymity and Confidentiality

Each subject will be given a code number (01, 02, etc) to identify individuals during interview notetaking, transcriptions, audiotaping and reports. At no time will names or names of companies be recorded for use in the study. Transcripts will be made from field notes and audiotapes recorded during in-person interviews, wear-testing and telephone interviews, by the researcher. The code number of the recorded participant will identify these tapes. The codebook will be kept in a secure place inside the office of the researcher's adviser. Only the researcher and advisor will have access to the codebook, the tapes and the transcripts. The codebook, tapes and transcripts will be destroyed after three years. The researcher will be performing the transcriptions from the audiotapes. At no time will the researchers release the results of the study to anyone other than individuals working on the project without the subject's written consent.

VI. Compensation

Each disabled participant will be given a package of useful information about aids to dressing and altering clothes. These instructions have been compiled from about 50 years of research by rehabilitation and clothing professionals, and should be beneficial to the participants.

VII. Freedom to Withdraw

Subjects are free to withdraw from a study at any time without penalty. Subjects are free not to answer any questions or respond to experimental situations that they choose without penalty. There may be circumstances under which the investigator may determine that a subject should not continue as a subject.

VIII. Approval of Research

This research project has been approved, as required, by the Institutional Review Board for Research Involving Human Subjects at Virginia Polytechnic Institute and State University, by the Department of Near Environments

<u>7 May, 2001</u>	<u>7 May 2002</u>
IRB Approval Date	Approval Expiration Date

IX. Subject's Responsibilities

I voluntarily agree to participate in this study.

I have the following responsibilities:

Participate in a face-to-face interview.

Have body measurements taken from four areas of the body.

Put on and take off a clothing product.

Answer questions relating to that clothing product.

X. Subject's Permission

I have read and understand the Informed Consent and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent:

_____ Date _____
Subject signature

Should I have any questions about this research or its conduct, I may contact:

<u>Kate Carroll</u>	<u>231-6832/kacarrol@vt.edu</u>
Investigator(s)	Telephone/e-mail

<u>Dr. Doris H. Kincade</u>	<u>231-7637/kincade@vt.edu</u>
Faculty Advisor	Telephone/e-mail

<u>Dr. LuAnn Gaskill</u>	<u>231-6164/lagaskil@vt.edu</u>
Departmental Reviewer/Department Head	Telephone/e-mail

<u>David M. Moore</u>	<u>231-4991/moored@vt.edu</u>
Chair, IRB	Telephone/e-mail
Office of Research Compliance	
Research & Graduate Studies	

Subjects must be given a complete copy (or duplicate original) of the signed Informed Consent.

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
Informed Consent for Participants
in Research Projects Involving Human Subjects

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The subject pool will consist of personnel from forty or less U.S. clothing corporations who are skilled in manufacturing and/or marketing a similar type of clothing product to the one under investigation. These professionals will be contacted so that they might answer some questions relating to product development and marketing of a specialized clothing product. Obtaining this type of information from industry practitioners will expand the literature base for this topic and will add credibility to this study.

II. Procedures

The procedures for this study that involve industry personnel take the form of telephone interviews. Initial contact with the companies will be made via email and follow-up phone call, in order to determine interest of the company to participate and to determine a contact person. This contact person will be the subject for this study. An interview guide consisting of questions to be asked during the telephone interview, together with a sketch and specifications sheet for the prototype product, will be sent to the subject. A telephone interview will be scheduled for one week later. During the telephone interview, the subject will be asked open-ended questions relating to the manufacturing and marketing of the prototype product. These questions will cover areas related to industry issues (i.e., company operations, engineering and production, financial issues and concept marketability). Detailed explanations of each area will be given in the interview guide. The telephone interview should take one half hour for each subject. The researcher will record notes by hand. No other recordings will be made of the conversation. Transcripts will be made of the notes by the researcher. Only a code number assigned to each transcript will identify subjects and companies. No record will be kept which relates the company or subject's name to the information in the transcript.

III. Risks

This study presents no more than minimal risks to the participants.

IV. Benefits

Benefits for the companies and subjects participating in this study are twofold. First, by having access to a set of clothing specifications that have been directly developed from a user perspective, they may gain some insight into the complex process that goes into product development that addresses the needs of a specific population. Second, the company has access to marketing needs and preferences of a potential new customer and market segment.

No promise or guarantee of benefits has been made to encourage participation in this project. Subjects may contact the researcher at a later time for a summary of the research results.

V. Extent of Anonymity and Confidentiality

The researcher will transcribe researcher notes from the telephone interview. Each transcript will be assigned a code number (001, 002, etc) to identify the transcripts for later data analysis and report writing. At no time will names or names of companies be recorded for use in the study. Only the researcher and advisor will have access to the researcher notes and the transcripts. The notes and transcripts will be destroyed after three years. At no time will the researchers release the results of the study to anyone other than individuals working on the project without the subject's written consent.

VI. Compensation

Each subject participating in the study will be sent a Virginia Tech souvenir as compensation for the time spent being interviewed.

VII. Freedom to Withdraw

Subjects are free to withdraw from a study at any time without penalty. Subjects are free not to answer any questions or respond to experimental situations that they choose without penalty. There may be circumstances under which the investigator may determine that a subject should not continue as a subject.

VIII. Approval of Research

This research project has been approved, as required, by the Institutional Review Board for Research Involving Human Subjects at Virginia Polytechnic Institute and State University, by the Department of _____

_____ 7th May 2001 _____ 7th May 2002 _____
 IRB Approval Date Approval Expiration Date

IX. Subject's Responsibilities

I voluntarily agree to participate in this study. I have the following responsibilities:
 Answer questions in telephone interview.

X. Subject's Permission

I have read and understand the Informed Consent and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent:

_____ Date _____
 Subject signature

Should I have any questions about this research or its conduct, I may contact:

_____ 231-6832/kacarrol@vt.edu _____
 Investigator(s) Telephone/e-mail

_____ 231-7637/kincade@vt.edu _____
 Faculty Advisor Telephone/e-mail

_____ 231-6164/lagaskil@vt.edu _____
 Departmental Reviewer/Department Head Telephone/e-mail

_____ 231-4991/moored@vt.edu _____
 Chair, IRB Telephone/e-mail
 Office of Research Compliance
 Research & Graduate Studies

Subjects must be given a complete copy (or duplicate original) of the signed Informed Consent.

APPENDIX B
INSTRUMENTS

Instrument I – Section A
Upper body limitations
Protocol

Good morning/afternoon!

As you know, this interview has the purpose of finding out some information about clothing challenges you might have.

Before we address specific clothing issues, I would like to ask you some information about physical limitations you might be experiencing at this time.

This information is for descriptive purposes only. You will not be identified by name or any other potentially identifying factors.

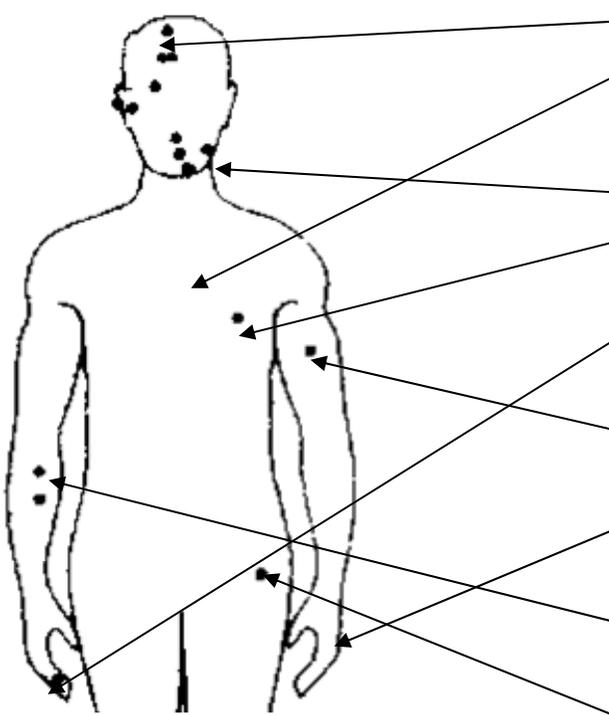
I am going to read to you a list of nine areas of potential upper body limitations. After I read each one, I will give a short explanation for clarification purposes. I would like you to tell me whether this area applies to you by ranking the level of difficulty with that area. You may rank from zero to four. Zero corresponds to no problem, while four corresponds to impossibility. The mid-point, two, corresponds to occasional problems. I will record the rank on this chart (show chart).

If you rank the level of difficulty with an area with anything higher than a zero ranking, I would like you to give me a short explanation of your condition, which I will also record (show sheet).

Your answers are being audio-taped. This is for the purpose of clarification in the transcription of this interview process only. All tapes will be securely and confidentially stored. No-one except my advisor and myself will have access.

Now let's begin.

Instrument I – Section A
Upper body limitations



Area of physical limitation	0 No problem	1 Potential problem	2 Occasional problem	3 Problem	4 Impossibility
1. Incoordination					
2. Limitations in upper body strength					
3. Limitations of head movement					
4. Limitations of stamina					
5. Limitations of sensation					
6. Difficulty lifting, reaching or carrying					
7. Difficulty handling & fingering					
8. Inability to use upper extremities					
9. Difficulty with range of motion of upper body					
10. Other					

Instrument I – Section A

Explanation of Enabler categories Qualitative explanation of User limitations

A Incoordination

Limited control in placing or directing extremities.

B Limitations in upper body strength

Strength in upper part of body is limited in terms of force exerted and/or duration of force exerted.

C Limitations of head movement:

Difficulty looking up, down, or to the side. In severe cases, field of vision and upper extremity movement may be effectively limited.

D Limitations of stamina:

Fatigue, shortness of breath, or abnormally elevated blood pressure from even very mild exertion.

E Limitations of sensation:

Impaired ability to detect heat, pain or pressure.

F Difficulty in lifting, reaching or carrying:

Impaired mobility, range of motion, or strength of upper extremities.

G Difficulty in handling or fingering:

Impaired hand or finger mobility, range of motion, or strength.

H Inability to use upper extremities:

Severe incoordination, complete paralysis, or bilateral absence of upper extremities

I Difficulty with range of motion of upper body

Limitations exist in part or all of upper body in terms of variation from ‘normal’ range of movement.

Instrument I – Section B
Potential clothing problems, body measurements

Protocol

Now I would like to ask you some specific questions about clothing issues you might be experiencing.

I am going to read you a list of problems, which have been found in previous research to be problematic for people with physical limitations.

Again, after each one, I will read a short description for clarification purposes, and then I would like you to rank them from zero to four. Zero means that you have no problem in this area, while four means that it is impossible. The mid-point, two, corresponds to a potential problem, or occasional problem.

Please imagine that we are dealing with an upper body garment while you are considering your answers to the questions. Once again, I would like you to explain any answers that get a ranking greater than zero. I will record the answers on this sheet of paper (show sheets). The interview will continue to be tape-recorded.

After we have completed this section, I am going to take measurements of your bust, waist, hips and back length. This will help to determine the size of the prototype product that I will be making with the help of this data.

If at any time you feel uncomfortable with the interview, please let me know, and we will discontinue the process.

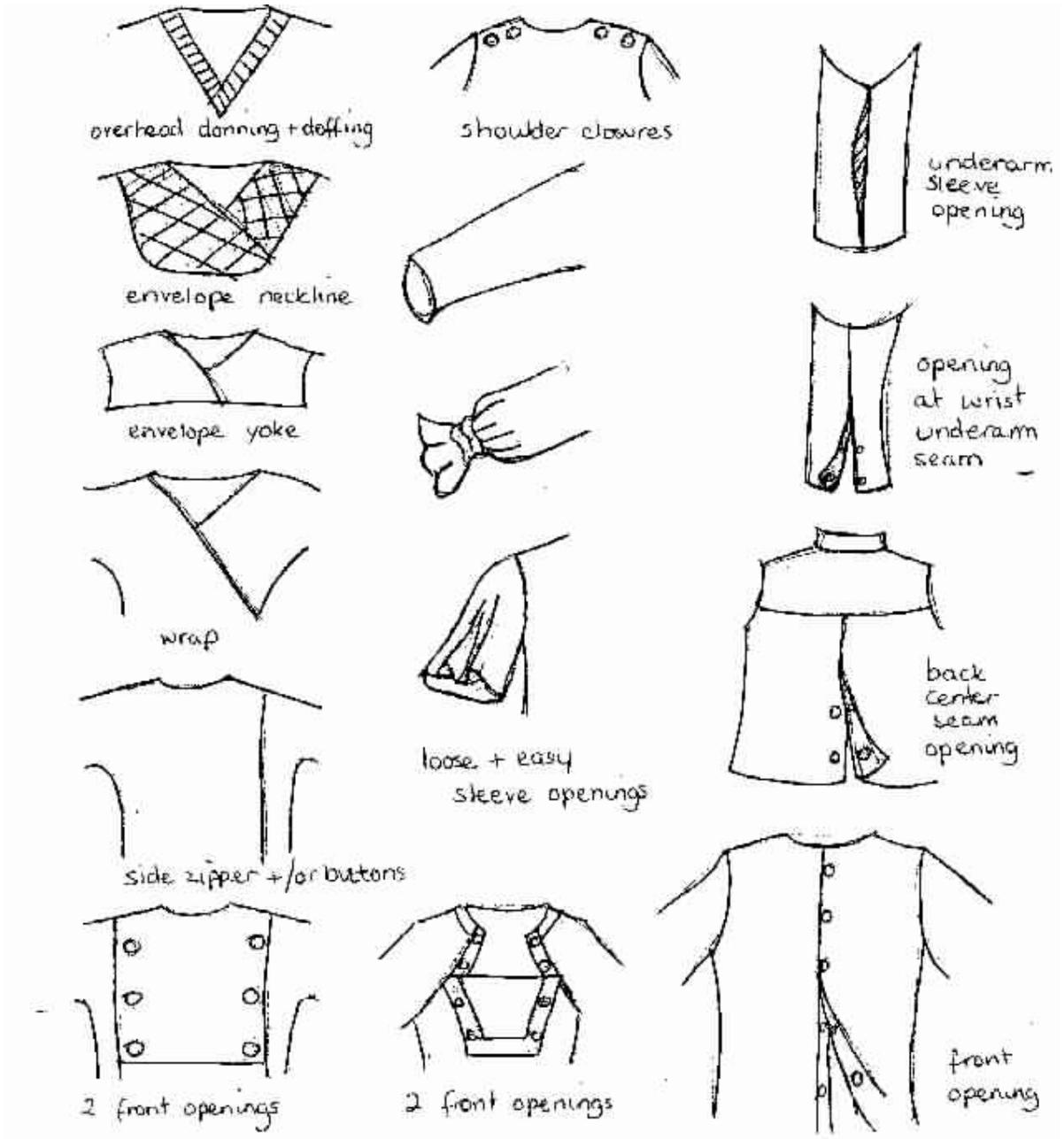
Let's begin.

Instrument I – Section B – Professional clothing needs and preferences, body measurements

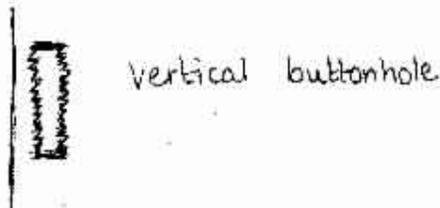
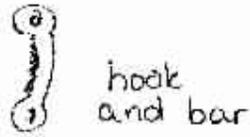
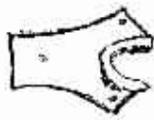
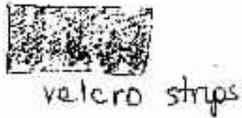
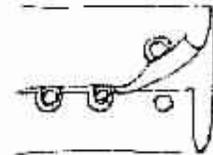
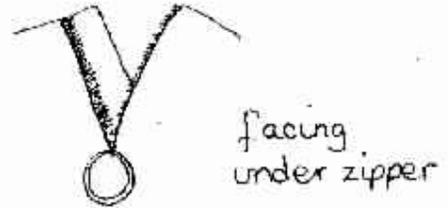
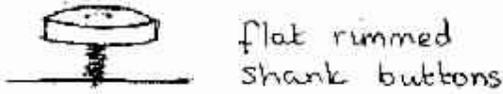
Clothing dimension	Ranking 0=independent 2=moderate assistance 4=impossibility (100% assistance)	Solution (Refer to following sketches for descriptions of features)
Difficulty donning and doffing clothing (Taking it off and putting it on)	0-1-2-3-4	Use styles that are easy to don and doff
Difficulty managing fastenings (E.g., hooks and eyes, zippers, buttons, due to restricted use of hands and lack of mobility)	0-1-2-3-4	Use easy-to-manage fastenings
Lack of freedom of movement (For a variety of activities, e.g., crutch walking, sitting in a wheelchair)	0-1-2-3-4	Add features that allow for movement
Inappropriate and uncomfortable fabric	0-1-2-3-4	Use fabrics with situational appropriateness
Inadequate coverage of the body (E.g., for body coverage in a wheelchair)	0-1-2-3-4	Ensure coverage in needed areas
Styles of clothing can be constricting and uncomfortable (especially during temporary changes in size)	0-1-2-3-4	Provide clothing styles that are comfortable and sized appropriately
Construction quality inadequate for stress exerted by User	0-1-2-3-4	Ensure quality durable construction of all clothing
Some features are irritating and get in the way	0-1-2-3-4	Adapt features
Not all clothing is aesthetically (visually) pleasing	0-1-2-3-4	Design clothing with more visual appeal

Measurements in inches/cm			
Bust	Waist	Hips	Back length – neck to waist

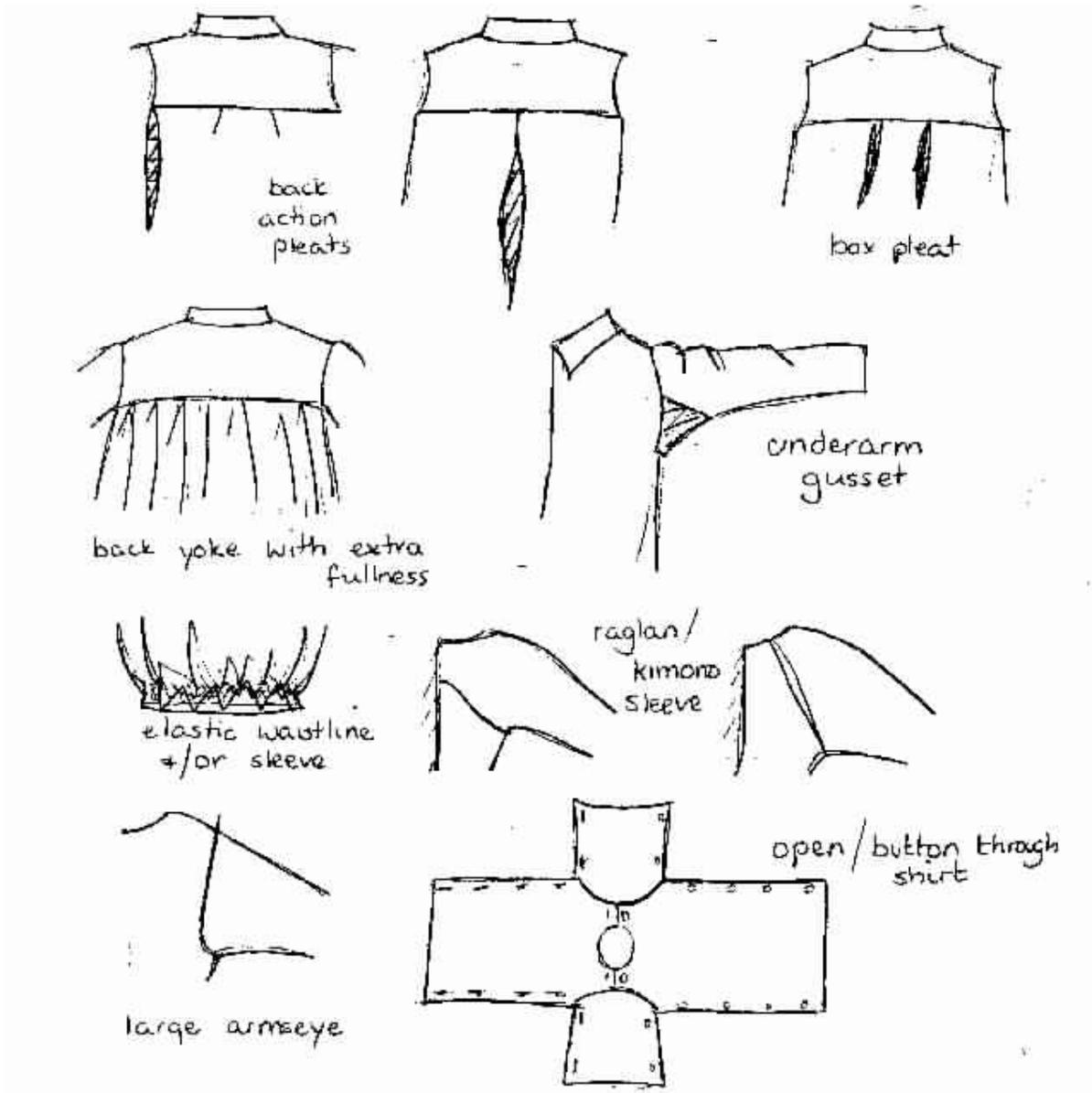
Instrument I – Section B Addendum
Sketches of functional features
Use styles that are easy to don and doff



Instrument I – Section B Addendum
Sketches of functional features
Use easy-to-manage fastenings



Instrument I – Section B Addendum
Sketches of functional features
Add features that allow for movement



Instrument I – Section C
Sketch development
Protocol

Now I will show you some possible some solutions to the clothing problems you have been experiencing, together with some clothing styles that are currently on the market (show sketches of solution/features and style book – Addendum to Section C).

A. For problem X that you listed, this is the solution (show chart) and these are some of the features that have been found to solve the problem (show sketches). Would you like to now choose a feature that you think would work best for you, and I will sketch this on the bodice front and back.

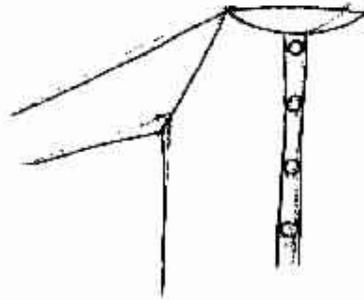
Would you now like to identify current styling that might work best for you in a work situation, that we might be able to combine with the feature you have chosen?

(Repeat A for each problem area identified in Section B chart).

Now we have a listing of features and preferred styles. We will try to incorporate as many as possible into this sketch of a bodice front and back. If at any time you feel I am misrepresenting your choice, please let me know.

We should end up with a sketch that incorporates all your needs.
Let's begin.

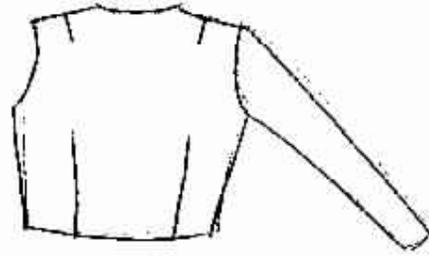
Instrument I – Section C Addendum
Sketches of current styles



Instrument I – Section C
Sketch development



Front



Back

Instrument II - Sample specification sheet

Description of garment:			
Size range:	Fiber content:	Care:	Colors:
<u>Materials</u>	Sketch and swatches		
Body:			
Trim:			
<u>Details</u>			
Buttons:			
Zipper:			
Beltloops:			
Hanger loops:			
Thread:			
Pellon:			
Other:			
Stitch class:			
Seam class:			
Special sewing instructions:			
	<u>Garment Measurements and Tolerances</u>		
	(will be dependent upon the type of product chosen by Users)		

Instrument III –Section A
Evaluation of product prototype, acquisition methods

Protocol

- Good morning/good afternoon.
- I have here a prototype of the product that was made according to the information received during the original interviews. I have determined from looking at your measurements taken during the interview that you will best fit a size (small/medium/large). I would like you to try the product on at this time.
- I will be making a visual assessment of the overall appearance of the clothing. The tape recorder will be running while I ask you questions in order to verify your responses while I transcribe the notes later in the study.
- As with the interviews, all information will remain strictly confidential and you will be identified by code number only for the entire research process.
- I will begin to ask you some questions about the product when you are comfortable.
- I will give you a clothing dimension (e.g., donning) and I would like you to respond by ranking the performance of the prototype you are currently wearing. If the prototype is nothing like you envisioned, please rank it at one. If it is just as you envisioned, give it three, if it is better than you envisioned for that particular dimension, give it five. Additional comments and explanations are welcomed.

Instrument III –Section A
Evaluation of product prototype, acquisition methods

Clothing dimension	1 worse than I envisioned	2 just as I envisioned	3 better than I envisioned	Additional Comments
1. Uses styles that are easy to don & doff				
2. Uses easy to manage fastenings				
3. Adds features that allow for movement				
4. Uses fabric with situational appropriateness *				
5. Ensures coverage in needed areas				
6. Provides styling that is comfortable and appropriately sized				
7. Ensures quality durable construction				
8. Adapts features specified by User				
9. Clothing is designed with more visual appeal				

- Now I would like to ask you some questions relating to the purchasing of your career clothing. What is your acquisition preference for this product and why do you choose this over any others?
 1. Traditional “brick and mortar” store
 2. Online shopping
 3. Catalog shopping
 4. TV shopping
 5. Home demonstration and sales
 6. Custom designed
 7. Other preference – please explain

What price would you be willing to pay for your business clothing?

\$0-\$25	
\$26-\$50	
\$51-\$75	
\$76-\$100	
>\$100	

Instrument III –Section B
Universal Design

<u>Principle</u>	<u>Comments</u>
-------------------------	------------------------

Equitable use

Flexibility in use

Simple and intuitive use

Tolerance for error

Low physical effort

Size and space for use

Instrument IV Industry Issues

Interview Guide

- I am conducting research to assess the feasibility of manufacturing and marketing a specialized clothing product for women with physical disabilities. As a manufacturer and/or distributor of ladies' clothing, I would appreciate your feedback about this concept from an industry viewpoint.
- Please take some time to look over the following questions, which relate to your company operations, engineering and production, financial feasibility and marketability of the product.
- If you feel that you would be able to answer all or some of these questions in relation to the sketch and specs of the product enclosed with this information, I would like to arrange a time when we might talk via telephone in more detail.
- If you feel, after examining the enclosed materials, that other factors not included here might have more weight in the feasibility decisions to be made about the product, please include these when you give me feedback.
- Please understand that all responses you choose to give will remain confidential. Any transcripts made from the interview will be coded with a number only for identifications purposes. At no time will the name of your company or other identifying features be used in relation to this research project. Transcripts will be stored in a secure environment at Virginia Polytechnic Institute and State University.

Instrument IV Industry Issues

The list of questions below relate to the enclosed clothing product. During the upcoming telephone interview, I will collect information from you concerning the feasibility of producing and selling this product commercially to consumers with physical disabilities.

Questions

Company Operations

- 1a. How compatible is the concept with your current product lines?
- 1b. Would it unreasonably interrupt manufacturing, engineering, or marketing activities?
- 1c. Could you meet the after-sales service requirements that would be demanded by customers?

Engineering and Production

- 2a. What is the technical feasibility of the product?
- 2b. Do you have the technical capability to produce it?
- 2c. Can it be manufactured at a marketable cost?
- 2d. Will the necessary production materials be readily available?
- 2e. Do you have the production capabilities to build it?
- 2f. Do you have adequate storage facilities for the raw materials and completed product?
- 2g. Do you have adequate testing devices for proper quality control of the product?

Financial

- 3a. What is your required return on investment?/for this product?
- 3b. Do you have the available capital?
- 3c. What would be the pay-back period?
- 3d. What is your break-even point?
- 3e. What would be a feasible price for this product?

Concept Marketability

- 4a. Would the product normally be sold through your current distribution channels, or would you have to make special arrangements?
- 4b. Do you have qualified sales personnel?
- 4c. Do you have a suitable means by which to promote the product?
- 4d. What would you anticipate to be the life expectancy of the product?
- 4e. In addition, how would this product impact the following established company practices?
- 4f. How would this product fit current brand image?
- 4g. How would the company respond to market changes?

APPENDIX C

INDUSTRY COVER LETTER

Katherine E. Carroll, Ph.D. Student
Department of Near Environments
248 Wallace Hall
Virginia Tech
Blacksburg, VA 24060

Name
Company

Date, 2001

Dear

Your name has been given to me as a possible contact person at Company XXXXX. I am conducting my doctoral dissertation research on the problem of finding useful and wearable ready to wear clothing for special populations, in this case, working women with disabilities. In order to assess the feasibility of producing and distributing specialized clothing for these women, the professional opinions of industry leaders such as yourself are essential. I would like you to examine the enclosed materials concerning the product and consider participating in a telephone interview with me in about a week's time to discuss the production and marketing feasibility of the product.

I will contact you by telephone to determine your willingness to participate and to set up a time for the interview. If telephone contact is not the most convenient channel of communication for you at this time, I suggest that we communicate via email. Please respond to this letter by contacting me at kacarrol@vt.edu, indicating that this is your preference

You may be assured of complete confidentiality. Each interview transcript will have an identification number for data analysis purposes only. Yours and the company name will never appear on any materials related to this study. Transcripts of telephone interviews will be stored in a secure location accessed only by myself and my advisor at Virginia Tech, Dr. Doris H. Kincade. By agreeing to the telephone interview, you agree to participate in the study and to allow me to collect data.

Thank you for your time and willingness to help in this study, which will benefit a previously neglected but rapidly growing specialty market segment. I am looking forward to working with you on this project.

Sincerely,

Katherine E. Carroll
Enc.

Katherine Emma Carroll
Vita

EDUCATION

Ph.D., Clothing and Textiles (Business and Economics Track)

Department of Near Environments (December, 2001)

Virginia Tech, Blacksburg, VA

Dissertation: *Innovations and improvisations: A study in specialized product development focused on career clothing for professional women with physical disabilities*

Advisor: Dr Doris H. Kincade

M.A., Clothing and Textiles (History and Museum Studies Track)

Department of Human Environment and Design (May 1991)

Michigan State University, East Lansing, MI

Research Project: *Advice for women on working apparel from 1890-1900: A content analysis of Ladies' Home Journal and Harper's Bazaar*

Advisor: Dr Sally Helvenston

B.A. (Hons), Art History (20th C. Painting, 18th C. English Costume Specializations)

Department of Art History and Museum Studies (June 1987)

The University of Manchester, England

Thesis: *Prime time for art? An analysis of television coverage of the visual arts from the 1950's to the present day*

TEACHING

2001-2002

Instructor

Department of Near Environments

Virginia Tech, Blacksburg, VA

- Teaching classes
- Committee duties

1998-2001

Graduate Assistant

Department of Near Environments

- Teaching and assisting teaching classes

1993-1995

Professor

Department of Fashion and Department of Art History

Savannah College of Art and Design (SCAD) Savannah, GA

- Teaching classes
- Advising students
- Committee duties
- Admissions duties
- Outreach and development

1992-1993

Chair

Department of Fashion

Savannah College of Art and Design, Savannah, GA

- Administration of department
- Teaching classes
- Advising students
- Committee duties
- Admissions duties
- Outreach and development

1991-1992

Professor

Department of Fashion

Savannah College of Art and Design, Savannah, GA

- Teaching classes
- Advising students
- Committee duties
- Admissions duties
- Outreach and development

1989-1991

Graduate Assistant

Department of Theatre

Michigan State University, East Lansing, MI

- Designing and building costumes for theatre productions
- Running and managing shows
- Supervising undergraduate students in shop and during productions

Fall Semester 1989

Adjunct Professor

Department of Theatre

The University of Michigan, Flint, MI

- Teaching class

BUSINESS EXPERIENCE

1989-Present

Freelance Design Work

- Functional dresses for women with physical disabilities
- Wedding, bridesmaids, and mother of the bride dresses
- Reproduction clothing for interpretive staff of historic houses and museums
- Children's theatre productions

1996-1997

Personal Shopper and Sales Associate

Parisian, Inc.

Savannah, GA

- Sales associate for career wear, ladies' sportswear division
- Shopping for clients
- Visual merchandising

1995-1996**Development Assistant****Savannah Symphony Society**

Savannah, GA

- Managing multiple donor databases
- Managing and organizing fund drives and volunteers
- Preparation of proposals for government, corporate and private grants and donations
- Assisting with grant writing for Federal, State and Local government monies

CLASSES TAUGHT**Classes with full responsibility****Virginia Tech**

- *NECT 1404 Basic Apparel Assembly*; 3 credit hours, Spring 2002
- *NECT 2604 Introduction to the Fashion Industry*; 3 credit hours, Spring 2000, Spring 2002
- *NECT 3404 Advanced Apparel Assembly*; 3 credit hours, Fall 2001
- *NECT 4604 Fashion Analysis and Communication*; 3 credit hours, Fall 2001
- *NECT 4634 History of Costume*; 3 credit hours, Spring 2001
- *NECT 4984 Merchandising Strategies*; 3 credit hours, Spring 2002

Savannah College of Art and Design

- *FD 100 Sewing Technology and Basic Pattern Manipulation*; 3 credit hours, Fall 1991-Summer 1993
- *FD 105 Introduction to Textiles*; 3 credit hours, Summer 1992-Spring 1994
- *AH 247/FD 247 History of Fashion*; 3 credit hours, Spring 1992-Spring 1994
- *FD 320 Introduction to Theater Costuming*; 3 credit hours, Spring 1992, Spring 1994
- *FD 321 Introduction to Millinery*; 3 credit hours, Summer 1992
- *FD 409 Fashion Seminar*; 3 credit hours, Spring 1993
- *AH 106 Survey of Western Arts*; 3 credit hours, Fall 1993, Winter 1994, Spring 1994

University of Michigan – Flint

- *THR 3001 History of Costume*; 3 credit hours, Fall 1989

Classes assisted**Virginia Tech**

- *NECT 4614 Economics of the Apparel and Textile industry*; 3 credit hours, Fall 2000
- *NECT 6614 International Apparel and Textile Production and Trade*; 3 credit hours, Fall 2000
- *NECT 3604 Concepts of Retailing*; 3 credit hours, Fall 1999
- *NECT 5004 Orientation to Research*; 3 credit hours, Fall 1999
- *NECT 2444 Idea Development and Creativity*; 3 credit hours, Fall 1998, Spring 1999
- *NECT 4634 History of Costume*; 3 credit hours, Spring 1999
- *NECT 4404 Draping*; 3 credit hours, Fall 1998

Curriculum development**Savannah College of Art and Design**

Co-responsibility for the development of Bachelor of Fine Arts in Fashion Design program, curriculum adopted 1991-1992

Courses developed**Savannah College of Art and Design**

Responsible for development of FD 100 Sewing Technology, FD 105 Introduction to Textiles, AH 247/FD 247 History of Fashion, FD 320 Introduction to Theatre Costuming, and FD 321 Introduction to Millinery courses between 1991 and 1994

RESEARCH

REFEREED PRESENTATIONS

- Carroll, K., Kincade, D. & Quesenberry, P. (2000, November). Use of the World Wide Web to access current industry developments in an undergraduate introductory fashion class. Paper presented at the annual conference of the International Textiles and Apparel Association, Cincinnati, OH.
- Giddings, V., Kincade, D., Jackson, R. & Carroll; K. (2000, November). Investigation of consumer preference for Internet shopping. Paper presented at the annual conference of the International Textiles and Apparel Association, Cincinnati, OH.
- Carroll, K. Burr, S., Ruth, B. & Kincade, D. (2000, April). Consumer attitudes towards imported apparel: A descriptive study of four urban communities. Poster session presented at the annual Graduate Research Symposium, Blacksburg, VA.
- Carroll, K. Burr, S., Ruth, B. & Kincade, D. (1999, November). Consumer attitudes towards imported apparel: A descriptive study of four urban communities. Poster session presented at the annual conference of the International Textiles and Apparel Association, Santa Fe, NM.
- Allen, A., Carroll, K. Felton, M. & Passworn, J. (1999, April). The usage of home computers to access global information technology by households in southwest Virginia. Poster session presented at the annual Graduate Research Symposium, Blacksburg, VA.

NON-REFEREED PRESENTATIONS

- Carroll, K. (2001, November). Clothing options for women with physical disabilities. Paper presented at the first INEEDS Multidisciplinary Universal Design Forum, Virginia Tech, Blacksburg, VA.
- Carroll, K. (2001, March). Use of classification system to relate physical disability to clothing problems. Abstract presented at the College of Human Resources and Education Graduate Research Day, Blacksburg, VA.
- Carroll, K. (2000, April). Current state of the research into the design and manufacture of clothing for individuals with physical limitations, and possibilities for dissemination and application to the area of special needs clothing. Abstract presented at the College of Human Resources and Education Graduate Research Day, Blacksburg, VA.
- Carroll, K., Ruth, B. & Tan, Q. (1999, March). Clothing product development: Development and evaluation of an all-round athletic training shoe. Abstract presented at the College of Human Resources and Education Graduate Research Day, Blacksburg, VA.

RESEARCH INTERESTS

- Specialized product development in the global textile and apparel complex
- Global marketing and trade issues for specialized products
- Global and domestic apparel and textile production and trade

- History as a source for product development
- History of apparel and textile industries
- Textile surface design

SCHOLARSHIPS and AWARDS

- **James T. Moran Scholarship**, College of Human Resources and Education, April 2001, \$750
- **Neil Cahill Scholarship**, Department of Near Environments, Virginia Tech, April 2001, \$
- **Graduate Student Assembly Graduate Research Development Program**, Virginia Tech, April 2001, \$500
- **Outstanding Graduate Student, College of Human Resources and Education**, Virginia Tech, February 2001, \$500
- **Special Commendation, Outstanding Graduate Teaching Assistant Award**, Virginia Tech, February 2001
- **Graduate Student Assembly Travel Fund Scholarship**, Virginia Tech, October 2000, \$300
- **International Textiles and Apparel Association Student Fellowship**, August 2000, \$1,000
- **Faculty Campaign Award Graduate Student Scholarship**, College of Human Resources and Education, Virginia Tech, April 2000, \$1,000
- **Graduate Student Assembly Travel Fund Scholarship**, Virginia Tech, September 1999, \$300
- **Lois Gurel Scholarship**, Department of Near Environments, Virginia Tech, April 1999, \$500

GRANTS

- **CEUT Instructional Enhancement Mini-Grant**, Virginia Tech, January 2002, \$280. Proposal authors: Kate Carroll and Peggy Quesenberry. Grant used for purchase of Instructional Software for Apparel CAD lab in Dept. of Near Environments.

IN-KIND DONATIONS

- Donation of fashion focus trendbooks valued at approx. \$5,000 from The Doneger Group, Inc., to Near Environments Department, Virginia Tech, December 1999
- Donation of historic costume collection from Charleston Museum to SCAD, 1993; private donations of books and other artifacts to SCAD Fashion Department, 1992-94

SERVICE AND OUTREACH

LEADERSHIP

- **Graduate Teaching Assistant Training Workshop, Panelist**, Virginia Tech, August 2001
- **Near Environments Graduate Students Association, Founder & First President**, Virginia Tech, April 1999-September 2000
- **Clothing and Textiles Advisory Board, Graduate Student Representative**, Virginia Tech, 1998-2000
- **Council of Graduate Students, Department Representative**, Michigan State University, East Lansing, MI, 1989-1991
- **Council of Graduate Students, International Students' Representative**, Michigan State University, East Lansing, MI, 1989-1990

EXHIBITS CURATED

- Vince Quevedo: An Expression of Creative Process. Department of Near Environments, Virginia Tech, April – May 2001 (co-curator)
- Boys and Girls Come Out to Play. Department of Near Environments, Virginia Tech, March – May 2001 (co-curator with Dr. S. Schofield-Tomschin)
- Decorative Surfaces – Asian Style. Department of Near Environments, Virginia Tech, January - March 2001 (co-curator with Dr. S. Schofield-Tomschin)
- Costumes of Celebration: Michigan Dresses Up. Inaugural exhibit, State of Michigan Historical Museum, Lansing, June – September 1989 (exhibit assistant)

PROFESSIONAL DEVELOPMENT

- *Working with groups: Building community in the classroom*, workshop hosted by Centre for Excellence in Undergraduate Education, Virginia Tech, Blacksburg, VA, November 2001
- *Writing Intensive Courses: An Introduction*, workshop hosted by Center for Excellence in Undergraduate Education, Virginia Tech, Blacksburg, VA, October 2001
- *CAD training on Lectra Systems' U4ia and Modaris design and production software for the textile and apparel industry*, Virginia Tech, Blacksburg, VA, September 2001
- *Marcia Baxter-Magolda Workshop on self-authorship for undergraduate students*, one day workshop hosted by Center for Excellence in Undergraduate Education, Virginia Tech, Blacksburg, VA, May 2001
- *Grant-Writing for Non-Profit Organizations*, one day seminar arranged and given by the Savannah Foundation, Savannah, GA, May 1995
- *The First-Year College Student*, one day seminar arranged and given by John Gardner, University of South Carolina, Columbia, SC, May 1993

COMMUNITY AND INDUSTRY OUTREACH

- **Milliken and Co., Barnwell, SC; King Finishing (Spartan Mills), Dover, GA:** connections established between 1991 –1994 to take undergraduate fashion students on field trips around vertical and finishing mills
- **Costume Society of America:** arranged and hosted South East Region tours of SCAD Historic Costume Collection, Savannah, GA, March 1994
- **Focus on Fashion Weeks:** organizational duties included; bringing in speakers, setting up exhibitions, recruiting students as ambassadors, running fashion shows, and providing events for the general public, Savannah, GA, 1992 –1993
- **Community Service** at SCAD College Fairs, Sidewalk Art Festivals, Phone-a-thons; admissions work for the college at high schools in England and Michigan; volunteer work at Memorial Medical Center Children's Hospital, Savannah, GA, 1993-1994
- **Volunteer Museum Work**, cataloguing historic costume collections
 - Telfair Museum, Savannah, GA, 1994
 - Juliette Gordon Low House, Savannah, GA, 1993-1994
 - State of Michigan Historical Museum, Lansing, MI, 1989
 - R.E. Olds Transportation Museum, Lansing, MI, 1988