Proposed sizing for young South African women of African descent with triangular shaped bodies

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By

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DECLARATION

I declare that the dissertation, which I hereby submit for the degree M. Consumer Science: Clothing Management at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

Amukelani Muthambi
September 2012

DEDICATION

I dedicate this dissertation to my mother Elspeth A. Muthambi, I would not be where I am today without her endless love; my grandmother Ethel S. Muthambi for her loving support; and to the memory of my late grandfather Henry J. Muthambi. I hope I made you proud.

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And to our heavenly father, “I give you thanks, O Lord with all my heart…” (Psalm 138:1).

ABSTRACT

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In South Africa, a representative anthropometric study of South African women has never been undertaken, as such little is known about the body shapes of South African women. Nevertheless, research on the body shapes of South African women is ongoing (Makhanya, 2012). According to the preliminary findings of Makhanya's (2012) research, 59.26% of South African female students of African descent have a triangular body shape. The triangular body shape differs from the ideal body shape that ready-to-wear apparel sizing is presently based on, and is a contributing factor to the problems experienced with the quality of fit of ready-to-wear apparel by South African women of African descent. Therefore, the aim of this exploratory study was to develop experimental size specifications for the body measurements required for a basic sheath dress for South African female students of African descent with a triangular body shape. The students were of medium height, aged between 18 and 25 years, in the size 6/30 to size 14/38 size range, and enrolled at the University of Pretoria. The experimental size specifications were developed by statistically analysing an anthropometric database of female students of the University of Pretoria using regression analysis. Thereafter, the quality of fit attained from the experimental size specifications and the traditional (i.e. current) size specifications was evaluated to determine whether the experimental size specifications offer the unit of analysis with improved overall quality of fit. A panel of professionals with experience in apparel fit evaluation evaluated the quality of fit of the test garments. The test garments developed from the experimental size specifications were considered by the panel of professionals to offer the unit of analysis with improved overall quality of fit. The findings of the study suggest that South African ready-to-wear apparel sizing needs to accommodate the different body shapes found in South Africa.

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OVERVIEW OF THE STUDY

1.1 INTRODUCTION AND BACKGROUND TO THE PROBLEM

Consumers have moved from mostly wearing apparel custom-made to fit the individual, to wearing mass-produced ready-to-wear apparel sized according to apparel sizing systems[1] (Mullet, Moore & Prevatt-Young, 2009:2; Bye, LaBat & DeLong, 2006:66; Brown & Rice, 2001:423). Apparel sizing systems guide apparel manufacturers in the sizing and proportioning of ready-to-wear apparel with the aim of providing the majority of consumers, whose precise body measurements are not known, with a well-fitted garment (Salusso, Borkowski, Reich & Goldsberry, 2006:96; Pisut & Connell, 2007:368; Schofield & LaBat, 2005a:13; Chun-Yoon & Jasper, 1993:28).

In the 20th century, a goal of the ready-to-wear apparel industry was to supply apparel for all consumers (Kidwell & Christman as quoted in Bye *et al*., 2006:66). Since the middle of the 20th century, in industrialised nations the ready-to-wear apparel industry has been the primary source of apparel for consumers (Salusso *et al*., 2006:96). Regardless of the apparel industry being the main source of apparel for consumers, Bye *et al.* (2006:66) are of the opinion that "even into the 21st century we have not achieved the goal of providing the same quality of fit for 'everybody'", as past research on apparel fit satisfaction has revealed (Keiser & Garner, 2008:368).

Findings of studies conducted on apparel fit satisfaction have repeatedly shown that women are dissatisfied with the fit of ready-to-wear apparel (Kurt Salmon Associates in Bye, LaBat, McKinney & Kim, 2008:79; Pisut & Connell, 2007:375; LaBat 1989 in Ashdown, Loker & Adelson, 2005:1; Loker, Ashdown & Schoenfelder 2005:12; Goldsberry, Shim & Reich, 1996:129). The biggest complaint concerning apparel products, according to Keiser and Garner (2008:368), is that consumers cannot find apparel that fits. In the United States of America (US), research findings indicate that contemporary apparel sizing systems offer acceptable quality of fit[2] to approximately 50% of American women (Kurt Salmon Associates in Bye *et al*., 2008:79; Pisut & Connell, 2007:375; LaBat 1989 in Ashdown *et al*., 2005:1;

[1] A sizing system is defined in section 1.7.

[2] Quality of fit refers to the conformance of the garment to the shape and size of the human body (Keiser & Garner, 2008:368; Chen, 2007:132; Yu, 2004a:31; Brown & Rice, 2001:153).

Loker *et al*., 2005:12; Goldsberry *et al*., 1996:129). In Africa, findings of recent studies have similarly indicated that contemporary sizing systems are inadequate at providing African women with acceptable quality of fit (Mastamet-Mason, 2008:204; Zwane & Magagula, 2007:287). According to Mastamet-Mason (2008:204), in Kenya 65% of women reported problems with the fit of apparel at various fit points of the upper and lower torso.

The apparel industry and consumers alike have dismissed the notion of the "unique body and expect all bodies to fit into standard-sized garments" in the same manner (Bye *et al*., 2006:66). The problems experienced with the fit of ready-to-wear apparel may be attributed to ready-to-wear apparel being designed to fit women with an ideal body shape (Zwane & Magagula, 2007:283; Rasband, 1994:12). In the ideal body shape, the body appears well balanced due to the upper body and the lower body being similar in proportion (Mastamet-Mason, 2008:57; Zwane & Magagula, 2007:283; Joseph-Armstrong, 2006:22; Rasband, 1994:12; LaBat & Delong, 1990:44). Apparel sizing systems at present indicate that women's bodies closely resemble the ideal body shape; consequently, the apparel industry at present predominately produces apparel for consumers with an ideal body shape (Zwane & Magagula, 2007:283; LaBat & Delong, 1990:44; Rasband, 1994:12). However, according to findings of recent anthropometric studies the majority of women do not have an ideal body shape (Mastamet-Mason, 2008:154; Keiser & Garner, 2008:352; Lee, Istook, Nam & Park, 2007:387-389).

At present, a representative anthropometric study of South African women has never been undertaken (Strydom & De Klerk, 2006:88), as such little is known about the body shapes of South African women. Subsequently, research on the body shapes of South African women is ongoing (Makhanya, 2012). According to the preliminary findings of Makhanya's (2012) research, 59.26% of South African female students of African descent have a triangular body shape. Furthermore, in popular South African media the triangular body shape has been acknowledged as the prevalent body shape found amongst South African women of African descent (Ntlati, 2011:4). The triangular body shape unlike the ideal body shape appears unbalanced since the lower body is larger than the upper body (Connell, Ulrich, Knox, Hutton, Woronka, Bruner & Ashdown, 2003:4; Rasband, 1994:12). The triangular body shape differs from the ideal body shape that ready-to-wear apparel sizing is based on, and according to Ntlati (2011:4), is a contributing factor to the problems experienced with the quality of fit of ready-to-wear apparel by South African women of African descent.

At present, apparel sizing systems are inadequate at meeting the needs of the general population with body shapes that differ from the ideal body shape, as fit satisfaction research

has shown. Consumers wearing the same size cannot be assumed to have the same shape (Pisut & Connell, 2007:370; Connell, Ulrich, Brannon, Alexander & Presley, 2006:82). Furthermore, a garment of the same size cannot be expected to fit equally well on consumers with different body shapes, since most apparel fit problems arise because of anatomical differences (Petrova & Ashdown, 2008:230; Pisut & Connell, 2007:370; Schofield, Ashdown, Hethorn, LaBat & Salusso, 2006:148; Joseph-Armstrong, 2006:23; Strydom & De Klerk, 2006:81; Kwong, 2004:196). Strydom and De Klerk (2006:81) are of the opinion that "body measurements must therefore be considered together with proportions to enable a decent fit for different people". Sizing that reflects the proportions and dimensions of the consumer needs to be developed in order to improve the quality of fit of ready-to-wear apparel.

1.2 STATEMENT OF THE PROBLEM

The foundation of an effective sizing system as well as good fitting apparel is representative anthropometric data (Mastamet-Mason, De Klerk & Ashdown, 2008:10; Schofield, 2007:152; Cooklin, 1995:116). A publicly available anthropometric study of South African women has never been undertaken, as such South African sizing systems for women's apparel are adapted from British anthropometric data published in 1957 (Zwane & Magagula, 2007:283; Strydom, 2006:217; Strydom & De Klerk, 2006:88; Beazley, 1998:263). Apparel sizing systems are often copied from one country to the next with an anticipation of attaining the quality of fit that is attained in the country of origin (Winks, 1997:4). However, the quality of fit attained in the country of origin may not be attainable because body shapes and body sizes differ from country to country and between different cultural groups (Lee *et al.,* 2007:375; Yu, 2004b:183; Le Pechoux & Ghosh, 2002:3; Giddings & Boles, 1990:25). The sizing systems used in South Africa are based on out-dated anthropometric data, which does not reflect the shapes and the dimensions of contemporary South African women, and these differences are most likely to contribute to the problems experienced with the fit of ready-to-wear apparel in South Africa[3]. According to Van Rooyen (2007:67), European sizing systems are not suitable for South Africans due to the differences in body shapes and body sizes.

With the absence of representative anthropometric data of South African women, there is little information available on the body dimensions of South African women and the changes that occur in their body dimensions from one size to the next. Therefore, the aim of this

[3]Research on fit satisfaction in South Africa is ongoing (Makhanya, 2012). In the absence of conclusive findings at the time of writing, it may be postulated that fit problems are also prevalent in South Africa. According to Van Rooyen (2007:67), the single biggest reason for apparel returns in South Africa is due to problems with fit.

exploratory study was to develop experimental size specifications for the body measurements required for a basic sheath dress for South African female students of African descent with a triangular body shape. The experimental size specifications specify the body measurements required for a basic sheath dress in the size 6/30 to size 14/38 size range and the changes that occur in the body measurements from one size to the next. The experimental size specifications were developed for South African female students of African descent of medium height with triangular body shapes, aged between 18 and 25 years, falling into the size 6/30 to size 14/38 size range, and enrolled at the University of Pretoria. Thereafter, the quality of fit attained from the experimental size specifications and the traditional[4] size specifications was evaluated to determine whether the experimental size specifications offer South African female students of African descent with triangular body shapes with improved overall quality of fit.

In view of the aim of the study, the objectives of the study were formulated as follows:

Objective 1: To develop experimental size specifications for the body measurements required for a basic sheath dress for South African female students of African descent with triangular body shapes in the size 6/30 to size 14/38 size range.

Objective 2: To evaluate the quality of fit attained from the experimental size specifications and the traditional size specifications to determine whether the experimental size specifications offer South African female students of African descent with triangular body shapes with improved overall quality of fit.

1.3 RATIONALE OF THE STUDY

The findings of the study are expected to contribute towards the understanding of apparel sizing for South African women with a triangular body shape, and may consequently lead to the improvement of the quality of fit of ready-to-wear apparel for South African women with triangular-shaped bodies.

Quality of fit is an important factor in consumer satisfaction, as such well-fitting apparel is one of the most important consumer needs (Strydom & De Klerk, 2006:80; Marshall, Jackson,

[4] Traditional is defined in section 1.7.

Stanley, Kefgen & Touchie-Specht, 2004:311). One of the most frequently stated problems with apparel is dissatisfaction with fit (Mastamet-Mason *et al.*, 2008:10). According to Lifestyle Monitor (2002), 85% of women indicate apparel fit as the main reason they dislike an item of apparel after purchase (Connell, Ulrich, Knox, Hutton, Bruner & Ashdown: 2004). Garments with poor quality of fit are seldom worn and lead to consumer dissatisfaction (Brown & Rice, 2001:153). Furthermore, consumers describe apparel fit as synonymous with quality, and use apparel fit as a means of evaluating the quality of a garment (Bougourd, 2007:130). Improved quality of fit may increase the perceived quality of apparel (Bye, 2010:159), and may thus lead to increased levels of satisfaction with apparel.

An awareness of fit is important for the success of a company in the apparel industry (Brown & Rice, 2001:153). Poor quality of fit affects retailers negatively because of lost sales, lost consumer loyalty, excessive markdowns, and financial losses due to returned merchandise (Le Pechoux & Ghosh, 2002:1; Brown & Rice, 2001:153). Improved apparel sizing systems have the potential of creating better fitting apparel and should interest women who have struggled to find apparel that fits (Loker *et al.*, 2005:14). Apparel sales may thus be expected to increase with improved quality of fit, as consumers' often state poor quality of fit as the reason for deciding not to purchase apparel (Gupta, 2008; Ashdown *et al.*, 2005:1).

The return of apparel due to poor quality of fit is cited as the prime reason for apparel returns and is a burden to the apparel industry and to consumers (Bye, 2010:159; Bougourd, 2007:108; Van Rooyen, 2007:67; Bye *et al.*, 2006:77; Yu, 2004b:177). With improved quality of fit, the apparel industry may expect a reduction in the percentage of apparel returned due to poor quality of fit, and a "reduction in unsold or discounted garments" (Ashdown *et al.,* 2005:2). The apparel industry by improving sizing systems may be able to increase consumer satisfaction and keep present customers loyal while attracting new consumers with the improvement in the quality of fit of ready-to-wear apparel (Strydom & De Klerk, 2006: 80; Brown & Rice, 2001:153).

1.4 RESEARCH DESIGN AND METHODOLOGY

The study was cross-sectional and exploratory in nature, and served as a pilot study. A quantitative evaluative experimental research design was selected for the study. In the study, the experimental size specifications for the body measurements required for a basic sheath dress for female students with triangular body shapes were developed by statistically analysing an anthropometric database of female students of the University of Pretoria using regression analysis. Thereafter, the quality of fit attained from the experimental size

specifications and the traditional size specifications was evaluated using the one-group pretest-posttest pre-experimental design. The quality of fit attained from the experimental size specifications and the traditional size specifications was evaluated on one participant per size. A panel of professionals with experience in apparel fit evaluation evaluated the quality of fit of the test garments on a questionnaire adapted from Yu's fit evaluation scale (Yu, 2004a:39).

1.5 DELINEATIONS AND LIMITATIONS OF THE STUDY

It would be ideal to develop experimental size specifications for different body shapes, for varied population groups, and for different types of apparel; however, it would be unreasonable to expect one study to address all of the above. The study was therefore limited to developing experimental size specifications for the body measurements required for a basic sheath dress for South African female students of African descent with triangular body shapes. The experimental size specifications were developed for female students of the University of Pretoria, aged between 18 and 25 years, in the size 6/30 to size 14/38 size range, and of medium height. The study was limited to students aged between 18 and 25 years at the University of Pretoria because the anthropometric database used in the study consists of data gathered from students aged between 18 and 25 years at the University of Pretoria, and therefore does not represent the general South African population. The development of experimental size specifications for other types of apparel, body shapes, and population groups are reserved for further study.

The study focused on a limited size range because most of the anthropometric data used in the study in the development of the experimental size specifications fell into the size 6/30 to size 14/38 size range.

The study was limited to students of medium height since 68.16% of the anthropometric data used in the study fell into the medium height group, with only 15.82 % of the anthropometric data in the short height group, and 16.02% of the anthropometric data in the tall height group[5].

The quality of fit attained from the experimental size specifications and the traditional size specifications was only evaluated up to size 12/36 as there were no individuals wearing size 14/38 willing to participate in the study.

[5] The distribution of the anthropometric data into different height groups is shown in table 4.9.

In the study, the British sizing system is used as a reference because South Africa's sizing for women's apparel is adapted from British sizing (Zwane & Magagula, 2007:283; Strydom, 2006:217).

For any sizing system to be successful in producing garments with acceptable quality of fit across the entire size range, the sizing system has to be based on representative anthropometric data (Mastamet-Mason *et al.*, 2008:10). Determining representative anthropometric data for the South African population is out of the scope of the study due to time and financial constraints, and the exploratory nature of the study.

A non-representative sample was used to evaluate the quality of fit of the test garments, as the quality of fit was evaluated on one participant per size. Due to the lack of representative anthropometric data, the limited size of the sample used during fit evaluation, and the exploratory nature of the study, the findings of the study cannot be generalised onto to the entire South African population. Exploratory research, according to Zikmund and Babin (2007:42), is conducted with the expectation that further research will be needed to provide conclusive evidence.

1.6 UNDERLYING ASSUMPTIONS OF THE STUDY

In the study, the test garments sized according to the traditional size specifications (i.e. sizing currently used in the apparel industry) were developed from a master pattern that was designed to fit the *Figure Forms* dress form that is used widely in the South African apparel industry and then graded into different sizes using a commonly used grading system. Thus, the traditional test garments[6] are assumed representative of current sizing used in the apparel industry since the *Figure Forms* dress form is widely used in the South African apparel industry and the grading system is similar to the grading systems used in the apparel industry.

[6] Traditional test garments are defined in section 1.7.

1.7 DEFINITION OF KEY TERMS

This section briefly defines some key terms that are used throughout the dissertation. All other concepts are defined throughout the dissertation as they are discussed.

Cardinal point

Cardinal points are defined as the key points on the pattern to which grading increments are applied to change the pattern from one size to the next (Mullet *et al.*, 2009:213; Ridgway-Sharp & Hencken-Elsasser, 2005:22; Taylor & Shoben, 1984:28).

Experimental test garments

The experimental test garments are the test garments sized according to the experimental size specifications developed in the study.

Grade

Grade has three definitions, being used as a verb and as a noun (Mullet *et al.*, 2009:14). The first definition of grade, as a verb, refers to the systematic process of creating production patterns for the full size range from the sample-sized master pattern (Mullet *et al.*, 2009:14). The second definition of grade, as a noun, refers to the numerical difference between each size (Mullet *et al.*, 2009:213). The third definition of grade, as a noun, refers to the incremental size change that occurs at each cardinal point on the pattern piece (Mullet *et al.*, 2009:213).

Grading system

A grading system is a collection of grade rules that specify the distribution of the increase or decrease from size-to-size throughout a pattern piece (Mullet *et al.*, 2009:14). Pattern grading systems are designed to translate the changes that occur in the human body from size-to-size to garment patterns (Mullet *et al.*, 2009:1).

Sample size

The sample size, also referred to as the model size or base size, is the size in which design prototypes are developed according to, and the size from which other sizes are derived from (Keiser & Gamer, 2008:372; Hudson, 1988:122-123).

Size specifications

Size specifications are size charts that are developed by an apparel manufacturer for the manufacturer's target market (LaBat, 2007:89; Taylor, 1990: 58).

Sizing standard

Sizing standards are size charts published by a governing standards organisation such as the South African Bureau of Standards, voluntarily guiding apparel sizing for a specific type of garment or group of the population (LaBat, 2007:88; Schofield, 2000:80-81).

Sizing system

An apparel sizing system consists of a series of size charts, with each size chart designed to serve the apparel sizing requirements of each body shape category found within the population (Schofield & LaBat, 2005a:13; Cooklin, 1992:4).

Traditional test garments

The traditional test garments are the test garments sized according to the traditional size specifications (i.e. sizing currently used in the apparel industry).

Traditional

Traditional, in terms of the study, refers to current industry practice.

Unit of analysis

South African female students of African descent with triangular body shapes.

1.8 OUTLINE OF THE DISSERTATION

This introductory chapter provided a brief overview of the study. The rest of the dissertation is structured as follows:

Chapter 2 – Theoretical Background

This chapter outlines the theoretical foundations of the study. A review of contemporary literature on apparel fit and apparel sizing is presented in chapter 2.

Chapter 3 – Overview of the research design

The study has been divided into two phases. The methods and procedures for phase one and phase two are discussed and presented together with the findings of each phase in chapter 4 and chapter 5 respectively. The general approach used to conduct the study including the measures employed to enhance the quality of the data, in terms of its validity and reliability, and how ethical concerns were addressed are discussed in chapter 3.

Chapter 4 – Phase One: The development of the experimental size specifications

This chapter begins by introducing the general systems theory as the theoretical perspective that was used to guide the development of the experimental size specifications for South African female students with triangular body shapes. In the study, the experimental size specifications were developed through statistical analysis of anthropometric data of South African female students of African descent with triangular body shapes. The findings of the statistical analysis and the resulting experimental size specifications are also presented in this chapter.

Chapter 5 – Phase Two: Fit evaluation

The chapter begins by discussing the methods and procedures that were used to evaluate the quality of fit attained from the traditional size specifications and the experimental size specifications. The findings of the fit evaluation are presented in the latter part of the chapter.

Chapter 6 – Conclusions, implications, and recommendations for further study

A coherent summary of findings is presented in the concluding chapter. The implications of the findings, the shortcomings of the study, and the recommendations for further research are also covered in the concluding chapter.

An adapted version of the Harvard method of referencing as compiled by the Department of Consumer Science at the University of Pretoria was used throughout the dissertation; the dissertation is written in English (UK).

CHAPTER 2

THEORETICAL BACKGROUND

2.1 INTRODUCTION

With the well-documented dissatisfaction with the quality of fit of ready-to-wear apparel (Kurt Salmon Associates in Bye *et al*., 2008:79; Pisut & Connell, 2007:375; LaBat 1989 in Ashdown *et al*., 2005:1; Loker *et al*., 2005:12; Goldsberry *et al*., 1996:129), the improvement of the quality of fit of ready-to-wear apparel has become a priority for the ready-to-wear apparel industry as considerable research has been undertaken to address the inadequacies of current sizing systems for women's apparel (Gupta, 2008). The findings of this study are expected to contribute towards the understanding of apparel sizing for the South African triangular body shape, and may consequently lead to the improvement of the quality of fit of ready-to-wear apparel for South African women with triangular-shaped bodies. Apparel fit, as such, forms an important aspect of this study as the findings of the study are expected to contribute towards the improvement of the quality of fit of ready-to-wear apparel.

In view of the above, this chapter begins by conceptualising apparel fit since the findings of this study are expected to contribute towards the improvement of the quality of fit of ready-to-wear apparel. With the purpose of the study being to develop sizing for South African female students of African descent with triangular-shaped bodies, the chapter moves onto discussing the different aspects of developing an apparel sizing system and the influence of the design of the sizing system on the quality of fit attained from ready-to-wear apparel.

2.2 APPAREL FIT

Apparel fit is defined as the conformance of the garment to the shape and size of the human body (Keiser & Garner, 2008:368; Chen, 2007:132; Yu, 2004a:31; Brown & Rice, 2001:153). It is difficult to define universally a well-fitted garment since the concept of appropriate fit is influenced by fashion trends, the fit preferences of the individual, and many other factors (Song & Ashdown, 2010:263; Pisut & Connell, 2007:368; Ashdown & O'Connell, 2006:137; Yu, 2004a:31; Stamper, Humphries-Sharp & Donnell, 1991:295). Well-fitted garments are comfortable to wear, allow sufficient ease for freedom of movement, and are free of undesirable wrinkles (Song & Ashdown, 2010:263; Stamper *et al*., 1991:295). In

describing and evaluating apparel fit, the principles of apparel fit and the standards of apparel fit provide objective criteria for describing and evaluating apparel fit.

2.2.1 Principles of apparel fit

Apparel fit problems, according to Chen (2007:132), arise when there is an incongruent relationship between the garment and the human body. Chen (2007:132) is of the opinion that whether the garment conforms to the shape and size of the human body depends on the five principles of apparel fit. The five principles of apparel fit (ease, line, set, balance, and grain) are present in every garment and provide a framework to describe good fit (Petrova & Ashdown, 2008:230; Stamper *et al.*, 1991:297; Erwin, Kinchen & Peters, 1979:166). Good fit is present when all five principles of apparel fit are present and is lacking if any of the five principles of apparel fit is absent (Hudson, 1988:119).

2.2.1.1 Ease

Ease is defined as the difference between the measurements of the garment and the measurements of the body (Keiser & Garner, 2008:369-370; Stamper *et al.*, 1991:298; Hudson, 1988:119). Ease is divided into functional ease and design ease (Keiser & Garner, 2008:370). Functional ease refers to the extra space allowed into a garment to allow the wearer to breathe and move comfortably (Kincade, 2008:239; Keiser & Garner, 2008:370; Rasband, 1994:20; Hudson, 1988:119). A garment should be slightly larger than the corresponding measurements of the wearer's body, unless the garment is made of stretch fabric, to allow the wearer to move comfortably in the garment (Stamper *et al.*, 1991:298; Hudson, 1988:119). Design ease refers to the extra fullness inserted into a pattern to create the desired style effects and is greatly affected by the prevailing fashion trends (Keiser & Garner, 2008:370; Marshall *et al.*, 2004:321; Brown & Rice, 2001:159; Stamper *et al.*, 1991:298).

2.2.1.2 Line

Line, in terms of apparel fit, refers to "the alignment of the structural lines of the garment with the natural lines" of the human body (Brown & Rice, 2001:158). In a well-fitted garment, the basic seam lines of a garment should follow the silhouette of the body (Stamper *et al.*, 1991:298-299; Erwin *et al.*, 1979:166). Side seams should hang straight down the side of the body, with the garment's vertical lines parallel to centre front and centre back, and the garment's horizontal lines parallel to the floor (Keiser & Garner, 2008:369; Brown & Rice,

2001:158; Hudson, 1988:119; Erwin *et al*., 1979:167). Lines that encircle the body should be gradually curved to follow the contour of the body they are intended to fit, lying smooth and flat against the body (Keiser & Garner, 2008:369; Brown & Rice, 2001:158; Stamper *et al*., 1991:299).

2.2.1.3 Set

Set is described as the absence of undesirable wrinkles when the garment is on the body (Stamper *et al.,* 1991:299; Hudson, 1988:120). Well-fitting garments have smooth set, fitting over the body without any undesirable wrinkles (Marshall *et al.,* 2004:319; Erwin *et al*., 1979:168). Wrinkles caused by poor fit cannot be removed by ironing the garment and signal that the garment needs to be altered in some way (Marshall *et al*., 2004:319-321; Brown & Rice, 2001:157). Set wrinkles are indicative of a garment that is too large or too small in the area where the fabric is pulling or sagging (Keiser & Garner, 2008:369; Brown & Rice, 2001:157). Horizontal wrinkles are indicative of a garment that is too tightly fitted, while vertical wrinkles are indicative of excess ease in the garment (Stamper *et al*., 1991:299; Hudson, 1988:121). Diagonal wrinkles on the other hand are generally directed towards the problem area and suggest there is insufficient or too much fabric over that area of the body (Hudson, 1988:120-121). Poor posture can create wrinkles in a garment but wrinkles are most likely caused by a garment that is either too loose or too tight, or the wrong shape for the wearer (Marshall *et al*., 2004:319).

2.2.1.4 Balance

Balance in terms of apparel fit occurs when a garment hangs symmetrically on the human body (Keiser & Garner, 2008:369; Stamper *et al.,* 1991:300; Erwin *et al*., 1979:168). Poor balance in a garment is often caused by poor posture or an asymmetrical body, however, problems in patternmaking and inaccurate construction can create poor balance (Keiser & Garner, 2008:369).

2.2.1.5 Grain

To ensure good fit, a garment has to be cut on the grain (Brown & Rice, 2001:156). Grain, in terms of apparel fit, refers to the alignment of the lengthwise grain and the crosswise grain in the garment (Hudson, 1988:104). In a garment cut on grain, the lengthwise grain is parallel to centre front and centre back whilst being perpendicular to the floor, with the crosswise grain

running parallel to the floor at the bust, chest, upper back, hips, and hem [7] (Keiser & Garner, 2008:368; Marshall *et al.*, 2004:321). A garment cut on grain hangs evenly without skew and appears balanced (Keiser & Garner, 2008:368; Marshall *et al.*, 2004:321).

Grain is a key factor in well-fitted garments and in defining fit problems as it interacts and affects other aspects of fit (Stamper *et al.*, 1991:297). A garment cut off grain may twist or hang crooked because the fabric on each half of the garment behaves differently (Keiser & Garner, 2008:368; Brown & Rice, 2001:156). For instance, the hem of a garment cut off grain may ripple and sag after a couple of washings, affecting line, set, and balance (Stamper *et al.*, 1991:297).

The five principles of apparel fit are interrelated (Kincade, 2008:238), and cannot be viewed in isolation. As each principle of apparel fit "interacts with all others, it is often hard to define one component without referencing another" (Petrova & Ashdown, 2008:230). A change in one of the principles will affect another principle; in figure 2.1 insufficient ease over the hip area created set wrinkles and distorted the grain, with distorted grain the garment also became out of line and out of balance (Brown & Rice, 2001:156).

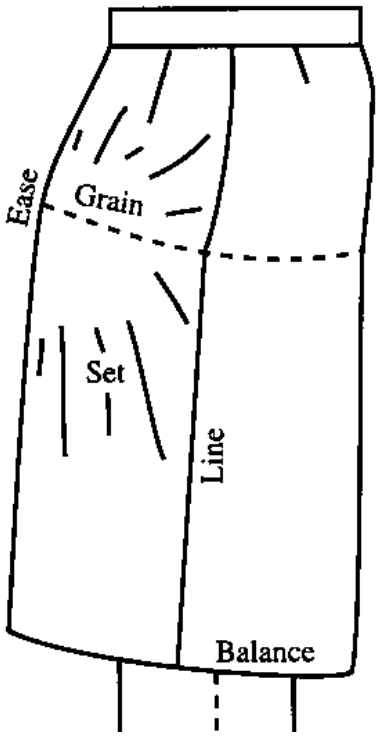


FIGURE 2.1: FIT PROBLEMS (Brown & Rice, 2001:157)

[7] With the exception of garments cut on the bias.

2.2.2 Standards of apparel fit

In addition to the five principles of apparel fit, several standards of apparel fit have been formulated for the evaluation of the quality of fit of apparel. The standards of apparel fit are basic rules that describe how specific areas of a garment should fit (Myers-McDevitt, 2009:242). The standards of apparel fit, though describing the fit for specific areas of the garment, are based on the principles of apparel fit, as the principles of apparel fit are present in every garment and are therefore applicable to any area of the garment[8]. The principles of apparel fit provide a generic framework to evaluate apparel fit, as they are not rules that describe how specific areas of a garment should fit. The standards of apparel fit, however, provide objective criteria for evaluating the fit of the different areas of the garment. In figure 2.2, a few standards of a well-fitted garment are shown.

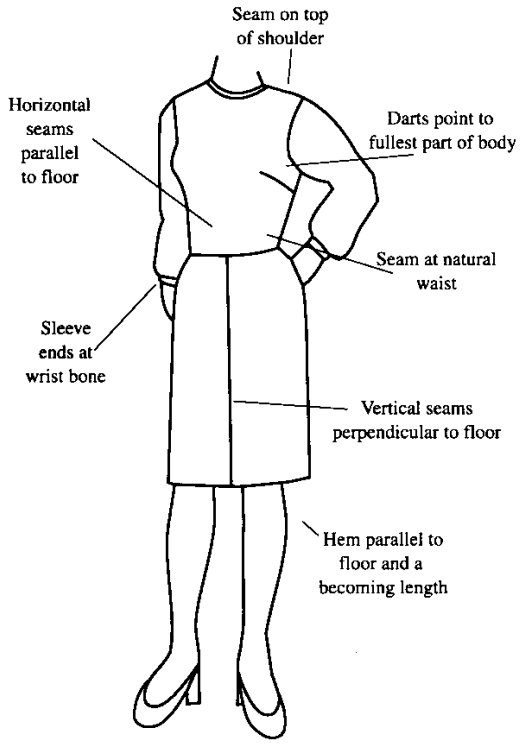


FIGURE 2.2: STANDARDS OF APPAREL FIT (Brown & Rice, 2001:160)

2.3 APPAREL SIZING SYSTEMS

Apparel sizing systems guide apparel manufacturers in the sizing and proportioning of ready-to-wear apparel with the aim of providing the majority of consumers, whose precise body

[8] For instance the standard "hem parallel to floor and a becoming length" is based on line and balance.

measurements are not known, with a well-fitted garment (Salusso *et al.*, 2006:96; Pisut & Connell, 2007:368; Schofield & LaBat, 2005a:13; Chun-Yoon & Jasper, 1993:28). An apparel sizing system consists of a series of size charts, with each size chart designed to serve the apparel sizing requirements of each body shape category found within the population (refer to figure 2.3) (Schofield & LaBat, 2005a:13; Cooklin, 1992:4). A size chart consists of a table of average body measurements artificially divided into different sizes, with each size representing a particular combination of body measurements (refer to figure 2.8) (Petrova, 2007:57; Schofield & LaBat, 2005a:18; Beazley & Bond, 2003:8; Cooklin, 1995:116; Cooklin, 1990:43; Solinger, 1980:86). The goal of any sizing system is to find the optimal number of size groups that will provide the majority of consumers with a well-fitted garment (Mullet *et al.*, 2009:4; Petrova, 2007:59; Hsu & Wang, 2005:669; Yu, 2004b:185; Ashdown, 1998:325). Apparel fit and apparel sizing are interrelated, since the fit of a garment is vastly influenced by the measurements of a garment (Sindicich & Black, 2011:449).

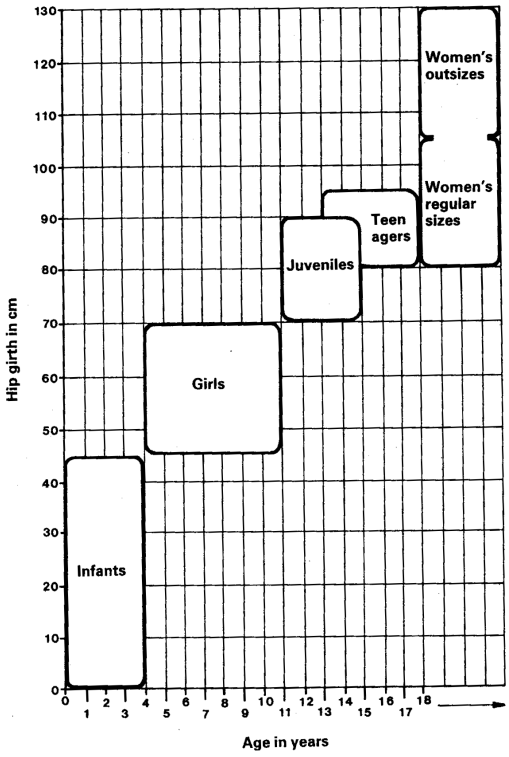


FIGURE 2.3: SIZING FOR THE FEMALE POPULATION (Cooklin, 1990:15)

In describing sizing systems, the terms sizing system, sizing standard, and size specifications are often used interchangeably (LaBat, 2007:88). However, these terms are different yet related as they all refer to different types of size charts (LaBat, 2007:88). Sizing standards are size charts published by a governing standards organisation, such as the South African Bureau of Standards, voluntarily guiding apparel sizing for a specific type of

garment or group of the population (LaBat, 2007:88; Schofield, 2000:80-81). Sizing standards are often based on the findings of major anthropometric surveys (Schofield, 2000:80). A sizing system, according to LaBat (2007:89), may officially be documented and validated as a sizing standard or a series of sizing standards. Size specifications are size charts that are developed by an apparel manufacturer for the manufacturer's target market (LaBat, 2007:89; Taylor, 1990: 58). Size specifications are often adapted from published apparel sizing standards to suit the needs of the manufacturer's target market (Taylor, 1990:58; Hudson, 1988:122). Size specifications may be developed for body measurements or for finished garment measurements (Mullet *et al.*, 2009:4; LaBat, 2007:89; Taylor, 1990: 58). A manufacturer's size specifications are colloquially referred to as sizing systems in the apparel industry.

2.3.1 Developing sizing systems

In developing sizing systems, various researchers (Mpampa, Azariadis & Sapidis, 2010; Hsu, 2009; Salusso *et al.*, 2006; Hsu & Wang, 2005; Gupta & Gangadhar, 2004; McCulloch, Paal & Ashdown, 1998; Ashdown, 1998; Beazley, 1998) have proposed different methodologies for developing sizing systems; however, according to Petrova (2007:66) and Schofield (2000:81), the basic methodology of developing a sizing system is as follows:

- Collection of anthropometric data
- Dividing the anthropometric data into different body shapes based on key dimensions
- Determining the size range of the sizing system
- The calculation of the values of the secondary dimensions and the grade between secondary dimensions
- The communication of the sizing system

2.3.1.1 Collection of anthropometric data

The development of a sizing system begins with the collection of anthropometric data of the population in question (Petrova, 2007:65; Le Pechoux & Ghosh, 2002:20). Anthropometry, "derived from the Greek roots for 'man' and 'measurement'" (Cooklin, 1990:9), refers to the measurement of the physical characteristics of the human body (Strydom & De Klerk, 2006:82; Yu, 2004b:169; Le Pechoux & Ghosh, 2002:11). Anthropometric data forms the foundation of an effective sizing system as well as good fitting apparel (Mastamet-Mason *et al.*, 2008:10; Strydom & De Klerk, 2006:80; Le Pechoux & Ghosh, 2002:11). Accurate anthropometric data is crucial to the apparel manufacturing process because the size and fit

of ready-to-wear apparel depends upon the accuracy of anthropometric data (Hsu, 2009:199-200; Beazley & Bond, 2003:1).

In South Africa, a representative anthropometric study of South African women has never been undertaken (Strydom & De Klerk, 2006:88). Furthermore, the South African Bureau of Standards has never published a standard for the sizing of women's apparel[9]. With the lack of an official sizing standard and a publicly available anthropometric database, South African sizing for women's apparel is based on British anthropometric data published in 1957 (Zwane & Magagula, 2007:283; Strydom, 2006:217; Beazley, 1998:263). However, small anthropometric surveys of South African women have been conducted by large South African companies in the apparel industry; the findings of these anthropometric surveys are not available to the general apparel industry but only to the companies sponsoring the surveys (Strydom & De Klerk, 2006:82). South African women as a result experience problems with the quality of fit of ready-to-wear apparel due to the unavailability of representative anthropometric data and sizing guidelines. Strydom and De Klerk (2006:80) are of the opinion that it is not possible to address the apparel fit problems experienced by consumers without accurate body measurements.

2.3.1.2 Dividing the anthropometric data into different body shapes based on the key dimensions

An apparel sizing system consists of a series of size charts, with each size chart designed to serve the apparel sizing requirements of each body shape category found within the population, as such the shape of the human body is a fundamental aspect of any effective apparel sizing system (Glock & Kunz, 2005:139; Schofield & LaBat, 2005a:13; Cooklin, 1992:4; O'Brien & Shelton, 1941:1). When creating a sizing system, the first step is to divide the anthropometric data of the population into different categories of body shapes based on the ratio between key dimensions (Schofield & LaBat, 2005a:17; Yu, 2004b:185; Ashdown, 1998:325).

A key dimension is defined as a measurement that serves as a predictor of other body measurements as it has a strong relationship with other body measurements, and may thus be used to separate the population into different sizes (Petrova, 2007:63; Strydom & De Klerk, 2006:81; Yu, 2004b:187; Le Pechoux & Ghosh, 2002:16,20; Chun-Yoon & Jasper,

[9] However, the South African Bureau of Standards published a Code of Practice for the sizing of men's apparel in 1972, with the Chamber of Mines of South Africa publishing the findings of an anthropometric study of 669 male mine workers of African descent in 1981 (Yu, 2004b:175-176).

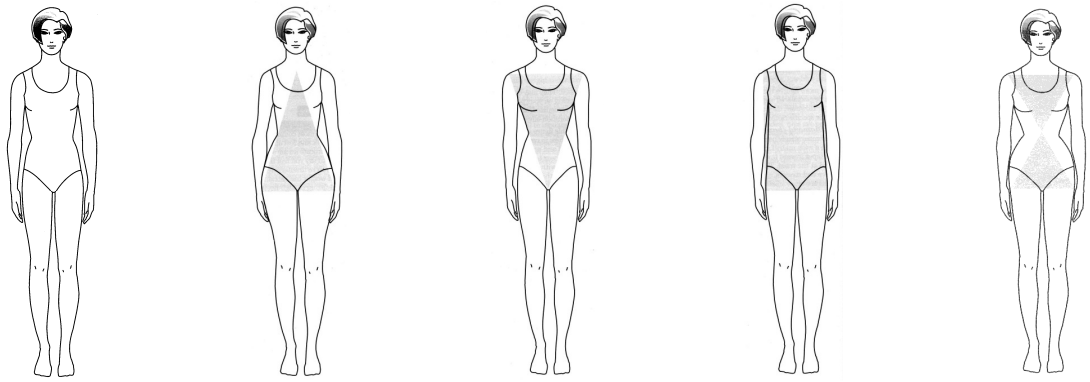
1996:90; O'Brien & Shelton, 1941:1). The key dimension, according to Petrova (2007:63), separates the population into different sizes along the body measurement considered the most important for a specific type of garment. Key dimensions are not only important in dividing the population into different sizes, key dimensions are also essential for defining the shape of the body. When selecting key dimensions they "should be chosen so that they are (also) able to describe the body shape of the individual for whom a garment is being made" (Petrova, 2007:66).

Findings of anthropometric studies indicate that there is no key dimension related to both horizontal and vertical measurements; as horizontal measurements were found to be almost entirely unrelated to vertical measurements (Faust & Carrier, 2010:93; Mpampa *et al.*, 2010:57; Petrova, 2007:67; Schofield & LaBat, 2005a:17; Gupta & Gangadhar, 2004:463; Le Pechoux & Ghosh, 2002:20; Schofield, 2000:82; Beazley, 1998:268; Chun-Yoon & Jasper, 1996:90; Taylor & Shoben, 1984:16; O'Brien & Shelton, 1941:1). For good fitting garments, researchers have suggested selecting a pair of key dimensions that are located in different planes – one for horizontal measurements and another for vertical measurements, as horizontal measurements generally correlate well with each other, and vertical measurements generally correlate well with each other (Mpampa *et al.*, 2010:57; Gupta & Gangadhar, 2004:463; Petrova, 2007:67; Chun-Yoon & Jasper, 1996:90; O'Brien & Shelton, 1941:1). With a pair of key dimensions that are located in different planes, each secondary dimension can correlate with at least one of the key dimensions; furthermore, the shape of the body is being described in more than one dimension geometrically (Petrova, 2007:67).

In identifying the shape of the body, there are two approaches that are used to identify the shape of the body (Petrova & Ashdown, 2008:230). The first method of identifying body shape is based on the visual identification of the front view and the side view of the body (Petrova & Ashdown, 2008:230), and the second method is based on drop values (Gupta & Gangadhar, 2004:464; Ashdown, 1998:325). Drop values, according to Gupta and Gangadhar (2004:464), "identify distinct relationships between key dimensions that determine body shape".

Women have a greater variation in body shape compared to men, and their body shapes tend to be classified with reference to simple geometric shapes based on visual evaluation and the ratios between key dimensions (Bougourd, 2007:120; Le Pechoux & Ghosh, 2002:4). Researchers have identified five prevalent body shapes, the ideal body shape, the hourglass body shape, the rectangular body shape, the triangular body shape, and the inverted

triangular body shape, as shown in figure 2.4 (Connell *et al.*, 2006:88; Zwane & Magagula, 2007:283; Marshall *et al.*, 2004:141).



IDEAL BODY SHAPE | **TRIANGULAR BODY SHAPE** | **INVERTED TRIANGULAR BODY SHAPE** | **RECTANGULAR BODY SHAPE** | **HOURGLASS BODY SHAPE**

FIGURE 2.4: PREVALENT BODY SHAPES IN THE FEMALE POPULATION (Rasband, 1994:14-15)

The ideal body shape appears well balanced with no area of the body exaggerated (Mastamet-Mason, 2008:57; Rasband, 1994:12). The bust and the hips of the ideal body shape are similar in proportion and taper to a moderately indented waist (Mastamet-Mason, 2008:57; Connell *et al.,* 2006:88; Rasband, 1994:12). The ideal body shape has minimal hourglass characteristics (balanced bust and hips with a moderately indented waist) from which the four other body shapes (hourglass, rectangular, triangular, and inverted triangular) diverge, as shown in figure 2.5 (Connell *et al.,* 2006:88). Clothing, according to Rasband (1994:12), is often designed to fit the ideal body shape.

In the hourglass body shape, the body appears balanced due to the bust and the hips being similar in proportion (Mastamet-Mason, 2008:72; Connell *et al.*, 2003:4; Rasband, 1994:13). The bust and the hips of the hourglass body shape taper to a well-indented waist (Mastamet-Mason, 2008:72; Connell *et al.*, 2003:4; Rasband, 1994:13). The hourglass body shape is balanced above and below the waist, however, the hourglass body shape "is not considered ideal because the very small waist makes the bust and hips appear proportionally larger than they are" (Rasband, 1994:13). The rectangular body shape appears nearly the same width at the bust, waist, and hips (Mastamet-Mason, 2008:70; Connell *et al.,* 2006:88). In the rectangular body shape, the body appears balanced below and above the waist (Mastamet-Mason, 2008:70; Connell *et al.*, 2003:4; Rasband, 1994:12); however, the waist is barely indented at the sides therefore appearing wide in proportion (Rasband, 1994:12). The inverted triangular body shape is an unbalanced body shape, as it appears larger above the

waist and smaller below the waist due to a large bust and narrow hips (Mastamet-Mason, 2008:66; Connell *et al.*, 2003:4; Rasband, 1994:12). The triangular body shape is also an unbalanced body shape, since the lower body appears larger than the upper body due to the hips being significantly wider than the bust (Mastamet-Mason, 2008:64; Connell *et al.*, 2003:4; Rasband, 1994:12).

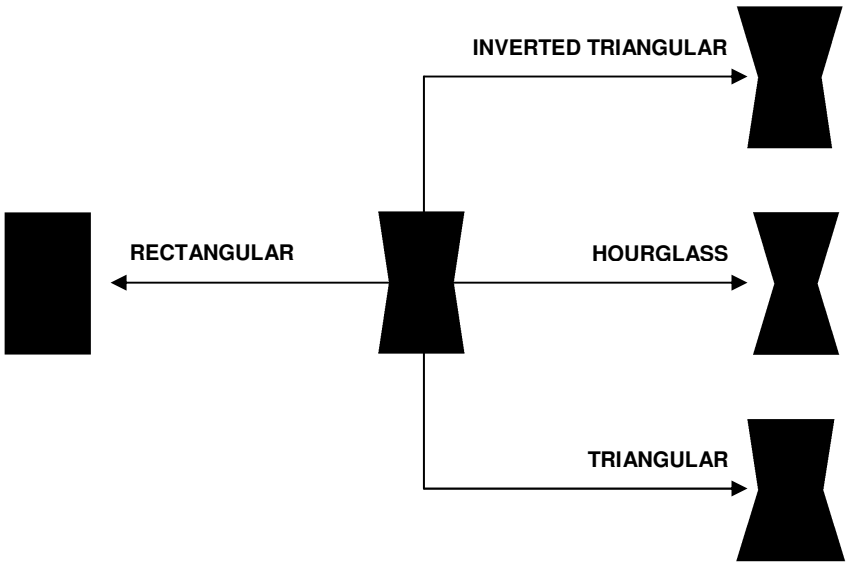


FIGURE 2.5: BODY SHAPE CONTINUUM (Adapted from Connell *et al.,* 2006:88)

With most apparel fit problems arising because of anatomical differences (Lee *et al.*, 2007:375; Joseph-Armstrong, 2006:23; Kwong, 2004:196), the shape of the body has to be considered in the development of an effective sizing system. With apparel mostly designed to fit the ideal body shape (Rasband, 1994:12), women with other body shapes may experience apparel fit problems due to the anatomical differences between the ideal body shape and the other body shapes. Women with a triangular body shape may experience loose fit in the upper body when a garment fits the lower body due to the upper body being smaller than the lower body (Mastamet-Mason, 2008:64). On the other hand, women with an inverted triangular body shape may experience loose fit in the lower body when a garment fits the upper body due to the upper body being larger than the lower body (Mastamet-Mason, 2008:67). The rectangular body shape with its barely indented waist may experience tight fit around the waistline (Mastamet-Mason, 2008:70), on the contrary, the hourglass body shape may experience loose fit around the waist due to the well indented waist (Mastamet-Mason, 2008:72).

Prior to developing a sizing system, the population has to be first divided into different body shape categories. With the division of the anthropometric data into body shape categories, each body shape has a specially developed size chart within the sizing system (Schofield & LaBat, 2005a:17). A specially developed sizing chart will meet the sizing requirements of each body shape in terms of the dimensions and the proportions of the body. However, South African sizing systems do not include the classification of body shapes since South African sizing systems are designed for the "average figure" (Strydom, 2006:213). Classification of body shape, according to Mastamet-Mason (2008:224), is a "core component of a successful sizing system".

2.3.1.3 Determining the size range of the sizing system

After the key dimensions of the sizing system have been selected and the body shapes encountered in the population have been identified, the ranges of sizes that will accommodate most of the population need to be determined (Petrova, 2007:72). Sizing systems, according to Petrova (2007:64), do not include all possible sizes; sizing systems include only those sizes that are the most populated and will collectively achieve the predetermined accommodation rate of the sizing system. The accommodation rate refers to the percentage of the population that is catered for by a sizing system and typically falls between 65% and 85% (Petrova, 2007:64). A goal of any sizing system is to divide the population in such a way that a limited number of sizes accommodate most of the individuals in the population (Mullet *et al.*, 2009:4; Petrova, 2007:59; Hsu & Wang, 2005:669; Yu, 2004b:185; Ashdown, 1998:325).

In determining the size range, the accommodation range of the sizing system needs to be first determined by establishing the maximum and minimum values of the key dimension as well as the size interval (Petrova, 2007:64). A size interval refers to the measurement difference between two adjacent sizes (Cooklin, 1990:42). The value of the size interval together with the desired accommodation range defines the number of sizes in the sizing system (Petrova, 2007:72).

With the range of body measurements to be accommodated by the key dimension and the size interval on hand, the measurement value of the key dimension for each size may then be determined (Petrova, 2007:64). The measurement values for the key dimension for each size are generally evenly distributed from the smallest size to the largest size and are dependent on the measurement range of the key dimension as well as the size interval (Ashdown, 1998:325).

2.3.1.4 Calculation of the values of the secondary dimensions and the grade between the secondary dimensions

- **Calculation of the values of the secondary dimensions**

Once the values of the key dimensions for each of the various sizes have been determined, the values of the additional body measurements that are needed to construct a garment have to be calculated and tabulated together with the value of the key dimension for each size (Petrova, 2007:64). The additional dimensions are referred to as secondary dimensions, and describe the human body in the detail necessary to construct a garment that will fit the human body (Petrova, 2007:75).

To calculate the values of secondary dimensions in a sizing system, regression analysis, a statistical technique that estimates the relationship between two variables is commonly used to calculate the values of secondary dimensions (Shin & Istook, 2007:136; Anderson, Sweeny & Williams, 2003:566; McCulloch *et al*., 1998:492). With regression analysis, the values of secondary dimensions for any known values of the key dimension may be estimated (Shin & Istook, 2007:136; Anderson *et al.,* 2003:567; Le Pechoux & Ghosh, 2002:20). In a sizing system where the secondary dimensions are based on regression analysis it should be noted that the success of the sizing system is dependent on the true linearity of the regression since regression analysis does not establish a causal relationship between variables (Petrova, 2007:76; Anderson *et al*., 2003:568). Regression analysis only indicates how variables are associated with each other (Anderson *et al.,* 2003:568).

- **Calculation of the grade between the secondary dimensions**

Sizing in the apparel industry is currently based on the pattern grading process to develop garments in different sizes (McCulloch *et al.,* 1998:492). In the ready-to-wear apparel industry, the design of garment patterns in different sizes begins with a master pattern designed to fit the dimensions of the sample size as specified in the size chart (Liu & Harlock, 1995:11). The sample size, also referred to as the master size, model size, or base size, is the size in which design prototypes are developed according to (Hudson, 1988:122), and “represents the body measurements from which the full size range is developed” (Keiser & Gamer, 2008:356).

Garment fit and styling is first perfected on the sample sized master pattern prior to developing patterns for other sizes (Mullet *et al*., 2009:1). Patterns for other sizes in the size

range are then derived from the master pattern through a process referred to as pattern grading (Mullet *et al.*, 2009:1; Keiser & Gamer, 2008:372). Pattern grading is a systematic process of increasing and decreasing the dimensions of a sample-sized master pattern according to the body measurements in a given size chart to obtain patterns for a full size range (Mullet *et al.*, 2009:1; Beazley & Bond, 2003:61; Cooklin, 1990:40; Liu & Harlock, 1995:10; Handford, 2003:vii). The apparel industry uses the pattern grading process to save time and to reduce product development costs; without the pattern grading process, each pattern for each size in the size range would have to be made and tested separately (Defty, 1984:2).

Grading is achieved by applying grading increments at the cardinal points of a pattern piece to create a pattern piece in the next size (as shown in figure 2.6) (Schofield & LaBat, 2005b:135-136; Beazley & Bond, 2003:62). A grading increment, also known as the grade, refers to the measurement difference between two sizes (Beazley & Bond, 2003:61), and differs according to the type of measurement in order to accommodate the size-to-size variations in circumference, width, and length (Keiser & Garner, 2008:374; Price & Zamkoff, 1996:8; Zangrillo, 1990:171). When determining the grade, "the increase or decrease made to the (sample) size to obtain another size" needs to be computed from the body measurements specified in a size chart (Hudson, 1988:124).

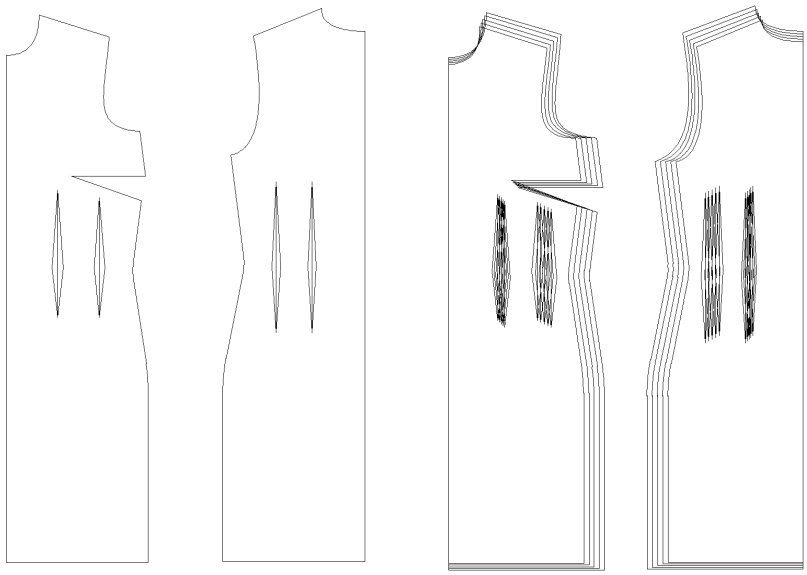


FIGURE 2.6: PATTERN GRADING

The circumference grade refers to the grade for the various girths of the body such as the bust, waist, and hips (Keiser & Garner, 2008:374). The value of the circumference grade varies from one country to the next and from one manufacturer to the next, but the circumference grade usually assumes values of either – 1-inch/ 2.54 cm, 1½-inches/ 3.81 cm, or 2-inches/ 5.08 cm between sizes[10] (Mullet *et al.*, 2009:15; Cooklin, 1990:21). The circumference grade may differ from "country to country or from size range to size range" (Cooklin, 1990:21), however, "it is widely accepted that the" bust, waist, and hips have the same circumference grade (Cooklin, 1990:21). However, Marshall *et al.* (2004:141) are of the opinion that the three major girths of the body may not change by the same amount from one size to the next, since with weight gain the different body shapes tend to increase the most in size where the silhouette of the body is already the heaviest. Marshall *et al.* (2004:141) do not indicate the specific amounts that the three major girths of each body shape increase by with increase in size. Within the South African context and in terms of the study, there is no knowledge available on how the three major girths of South African women with a triangular body shape change from size-to-size.

The cross grade denotes to the measurement that needs to be added to a cross-body area, such as the across shoulder area, in order to increase the width of a pattern in that area (Mullet *et al.*, 2009:15; Price & Zamkoff, 1996:9; Zangrillo, 1990:171). The cross grades for areas above the bust "tend to be quite small in comparison to" the grades for other areas of the body (Keiser & Garner, 2008:375).

The length grade refers to the measurements to be added to the length of the pattern as the pattern is graded into other sizes (Keiser & Garner, 2008:375; Price & Zamkoff, 1996:8). The length grade does not vary much from size-to-size because the vertical measurements of the adult body do not change much from size-to-size as compared to the change that occurs in the horizontal measurements (Mullet *et al.*, 2009:17; Keiser & Garner, 2008:375-376).

In the apparel industry, to accommodate a wider range of height into one size range, sizing systems increase the vertical measurements as the horizontal measurements of the body increase (Keiser & Garner, 2008:375; Shin & Istook, 2007:136; Schofield, 2000:95-96). The smaller sizes are assumed to cater for shorter women, while the larger sizes are assumed to cater for taller women (Schofield, 2000:95). Apparel manufacturers are of the opinion that if the vertical measurements are increased, "the market will widen and more of the population

[10] With the different types of circumference grades – 1-inch/ 2.54 cm, 1½-inches/ 3.81 cm, or 2-inches/ 5.08 cm differences may be expected in the quality of fit of a garment (Mullet *et al.*, 2009:15). A smaller circumference grade will reduce the interval between sizes and will create garments with a closer fit, while a larger circumference grade will increase the interval between sizes and will create garments with a looser fit.

can be served because" a garment can easily be shortened if it is too long (Taylor & Shoben, 1984:16). With the vertical measurements being increased as the horizontal measurements of the body increase, existing sizing systems result in garments that are suitable for a limited percentage of the population (Mpampa *et al.*, 2010:57; Gupta & Gangadhar, 2004:463).

Findings of anthropometric research suggest that the vertical measurements do not increase as the horizontal measurements increase, since there is a poor correlation between the vertical measurements and the horizontal measurements (Faust & Carrier, 2010:93; Mpampa *et al.*, 2010:57; Petrova, 2007:67; Schofield & LaBat, 2005a:17; Gupta & Gangadhar, 2004:463; Schofield, 2000:82; Beazley, 1998:268; Chun-Yoon & Jasper, 1996:90; Taylor & Shoben, 1984:16). The horizontal measurements of an individual may vary throughout adulthood with changes in body weight, however, the vertical measurements do not vary as much since height relatively remains constant in adulthood, as shown in figure 2.7 (Keiser & Garner, 2008:375-376). In any size chart, one of the control factors has to be height (Defty, 1984:1). The height group must be predetermined and stay the same throughout the size range, as it is not possible to cater for all height groups in one size chart (Defty, 1984:1; Taylor & Shoben, 1984:15-16). As adults do not become taller when horizontal measurements increase (Defty, 1984:1), there is no need to increase the vertical measurements as the horizontal measurements increase.

FIGURE 2.7: PREDICTED WEIGHT-LOSS VISUALIZATION (Textile/Clothing Technology Corporation, 2011)

Within the apparel industry, there are two types of grading systems that are in use to distribute the grade around the pattern during the pattern grading process, the simplified two-dimensional grading system and the complex three-dimensional grading system (Mullet *et al*., 2009:6-7). The simplified two-dimensional grading system is based on the assumption that changes between sizes occur equally in the front and the back of the body; as such, the grade rules for corresponding cardinal points are the same for the front and the back patterns (Mullet *et al*., 2009:9-10). In simplified two-dimensional grading systems, half of the total circumference grade is placed in the front and the other half is placed in the back[11], thus the front patterns and the back patterns are graded by the same amount (Mullet *et al*., 2009:9-10). Complex three-dimensional grading systems utilise arc measurements to distribute the circumference grade instead of splitting the circumference grade equally between the front pattern and the back pattern (Mullet *et al*., 2009:9).

With a simplified two-dimensional grading system, fitting problems will occur in the extreme sizes of a wide size range because the front and the back of the body do not grow at the same rate (Taylor & Shoben, 1984:51-62). The differences between the front and the back of the body are small; however, the accumulative effect of the small differences over a wide size range is apparent in the extreme sizes of the size range (Mullet *et al*., 2009:7; Cooklin, 1990:43; Taylor & Shoben, 1984:124). Simplified two-dimensional grading systems are suitable for producing a limited size range, as the imperfections of a simplified two-dimensional grading system are not always apparent in a limited size range (Taylor & Shoben, 1984:124). Simplified two-dimensional grading systems are used by most ready-to-wear apparel manufacturers, because they are easy to learn and use (Mullet *et al*., 2009:8-10; Taylor & Shoben, 1984:28).

In complex three-dimensional grading systems, the front patterns and the back patterns are graded with different amounts because the different areas of the body do not grow in the same manner in the front and the back (Mullet *et al.,* 2009:9; Taylor & Shoben, 1984: 51-62). Three-dimensional grading systems are not commonly used in the apparel industry because they are not as straightforward as simplified two-dimensional grading systems; however, they are better able to maintain satisfactory fit throughout the size range (Mullet *et al*., 2009:7-8).

[11] Or a quarter of the total circumference change for a pattern that is cut on the fold or has a seam down centre front or centre back (Handford, 2003:5).

2.3.1.5 Communication of apparel sizing systems

With values of the secondary dimensions and the grade between the secondary dimensions calculated, the final step of developing an effective and efficient sizing system is to develop a size designation method for communicating the sizing system to consumers (Salusso *et al*., 2006:109). According to Petrova (2007:59), "even the perfect sizing system cannot be successful if it is not communicated properly to the consumer". Petrova (2007:59) further goes onto to say, if the consumer is not able to identify their correct size "dissatisfaction will result even if (a) garment that fits the customer perfectly is available".

A size is a specific combination of average body measurements and is communicated via arbitrary size designation symbols (Cooklin, 1990:43; Solinger, 1980:86). Size designation symbols indicate that a garment is suitable for anyone whose measurements fall within the tolerance limits of the size, and assist consumers in selecting properly fitted garments (Petrova, 2007:65; Marshall *et al*., 2004:312; Yu, 2004b:188; Beazley & Bond, 2003:8; Chun-Yoon & Jasper, 1996:89; Chun-Yoon & Jasper, 1993:31-32; Cooklin, 1990:43-44; Solinger, 1980:86). The size designation method along with the values of the key dimensions and the secondary dimensions of each size constitute the sizing system (Petrova, 2007:65). A sizing system for a skirt is shown in figure 2.8.

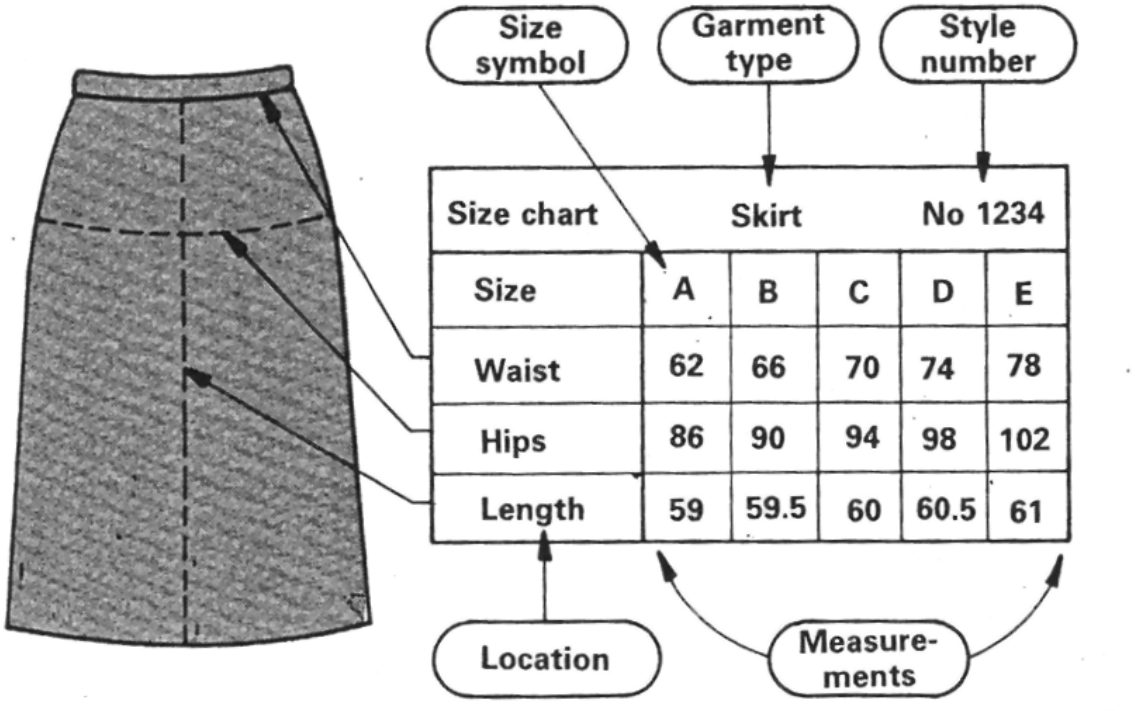
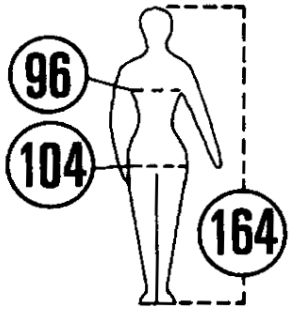


FIGURE 2.8: SIZING SYSTEM FOR A SKIRT (Cooklin, 1990:42)

Apparel sizing standards are voluntary and as a result, sizing varies from one manufacturer to the next in the apparel industry (Keiser & Garner, 2008:350; Pisut & Connell, 2007:368; Price & Zamkoff, 1996:2). With no standard sizing system used throughout the apparel industry, it has become standard practice for companies to develop their own size specifications and as a result sizing for women's apparel is highly unreliable (Flynn & Foster, 2009:243; Mullet *et al*., 2009:3; Keiser & Garner, 2008:350; Pisut & Connell, 2007:368; Salusso *et al*., 2006:98; Glock & Kunz, 2005:143; Loker et *al*., 2005:1). A significant departure from the sizing standards is with regard to size designation (Mullet *et al*., 2009:4). Size designation is not standardised in the apparel industry, varying from manufacturer to manufacturer, and has no relationship with any part of the female body (Keiser & Garner, 2008:357; Schofield, 2000:35; Mullet *et al*., 2009:4; Le Pechoux & Ghosh, 2002:10). With the abstract nature of size designation and the variations in the sizing of women's apparel, a size means whatever the apparel manufacturer wants it to mean (Zangrillo, 1990:169). The variations in size designation have led to consumers experiencing confusion when selecting a garment that matches their body dimensions (Cooklin, 1995:116).

The International Organization of Standardisation (ISO) proposed a standardised system of communicating garment sizing to reduce the confusion experienced in the communication of garment sizing (Yu, 2004b:183; Cooklin, 1995:116). The ISO suggests that garment sizing should be communicated by describing the key dimensions relevant to a particular garment either through a pictogram or a table, as shown in figure 2.9 (Cooklin, 1995:116). Research studies indicate that consumers prefer sizing nomenclature that makes use of a pictogram and key body dimensions for size selection (Marshall *et al*., 2004:322). Sizing nomenclature describing the basic body measurements for which the garment is intended to fit is the simplest and most effective form of sizing nomenclature (Cooklin, 1990:44).



BUST GIRTH	96
HIP GIRTH	104
HEIGHT	164

FIGURE 2.9: ISO SIZE LABEL FOR A LADIES JACKET (Aldrich, 2007:45)

2.3.2 Revision of apparel sizing systems

Apparel sizing standards are scheduled for update every five years, however, the schedule for the updating of sizing standards has no relationship to the anthropometric surveys that have been conducted (Lee *et al.,* 2007:377). The changes to apparel sizing standards have been based on industry practice and arbitrary calculations, rather than on representative anthropometric data (Lee *et al.,* 2007:377; Schofield, 2000:28-29). For instance, in the 1970 revision of the US apparel sizing standard one inch was added to the bust measurement for every size and body type covered by the sizing standard (Schofield, 2000:28).

Anthropometric measurements "will not change from year to year unless there is radical change in diet and/ or lifestyles" (Solinger, 1980:96). However, since the 1940s and the 1950s, when anthropometric data forming the basis of today's sizing was gathered (Connell *et al*., 2006:81; Schofield, 2000:30), "each successive generation has grown taller and wider in waist and hip girth" (Beazley & Bond, 2003:9). With the lack of current representative anthropometric data, the current sizing used in the apparel industry is not representative of the shape and the measurements of contemporary women (Salusso *et al.,* 2006:98). Consumers have come to accept that a normal body has the proportions reflected by current apparel sizing and often attribute the cause of apparel fit problems as related to their bodies, not the sizing of apparel, with resulting negative feelings about their bodies (Bye, 2010:159; Van Rooyen, 2007:67; Schofield & LaBat, 2005a:13; LaBat & DeLong, 1990:47). Salusso

(1995) is of the opinion that it is due time to seek validity in ready-to-wear apparel sizing rather than concluding that people's bodies are disproportioned (Schofield, 2000:39).

2.4 CONCLUSION

This chapter outlined the theoretical foundations of the study. In this chapter, literature on apparel fit and apparel sizing was reviewed within the context of the study. From the literature reviewed, accurate body dimensions of the target population emerged as a key factor in attaining good quality of fit in ready-to-wear apparel. With South African women of African descent having being acknowledged to predominately have a triangular body shape that differs from the ideal body shape that ready-to-wear apparel sizing is presently based on, sizing that reflects the proportions and body dimensions of the consumer needs to be developed in order to improve the quality of fit of ready-to-wear apparel. The purpose of this study was therefore, to develop experimental size specifications for the body measurements required for a basic sheath dress for South African female students of African descent with a triangular body shape. With accurate body dimensions available, improvements in the quality of fit of ready-to-wear apparel targeted at South African female students of African descent with a triangular body shape may thus be anticipated. Good quality of fit in ready-to-wear apparel, according to Chun (2007:220) begins with accurate body measurements of the target population.

The following chapter provides a brief overview of the research design. Detailed discussions of the methodology for phase one and phase two, as well as the findings for each phase are presented in chapter 4 and chapter 5 respectively.

CHAPTER 3

OVERVIEW OF THE RESEARCH DESIGN

3.1 RESEARCH DESIGN

In the study, experimental size specifications for female students with triangular body shapes were developed. Thereafter, the quality of fit attained from the experimental size specifications and the traditional size specifications was subsequently evaluated and analysed through quantitative evaluative experimental research using the one-group pretest-posttest pre-experimental design. Evaluative experimental research, according to Mouton (2001:160), aims to observe whether the effect of a given intervention is effective. In one-group pretest-posttest pre-experimental designs, a single group is evaluated prior to the implementation of the intervention (pretest), and evaluated after the implementation of the intervention (posttest) (Leedy & Ormrod, 2010:230). A panel of professionals with experience in apparel fit evaluation evaluated the quality of fit of the test garments

The study was exploratory in nature and served as a pilot study; further research will be required to provide conclusive findings (Zikmund & Babin, 2007:42). Furthermore, as this study was exploratory, a quantitative research design was the most suitable as it allows a researcher to obtain quantifiable data within a short period (Lebani, 2007:23). The study was cross-sectional since the observations were made at one point in time (Leedy & Ormrod, 2010:186).

3.2 RESEARCH OBJECTIVES

The objectives of the study were formulated as follows:

Objective 1: To develop experimental size specifications for the body measurements required for a basic sheath dress for South African female students of African descent with triangular body shapes in the size 6/30 to size 14/38 size range.

Objective 2: To evaluate the quality of fit attained from the experimental size specifications and the traditional size specifications to determine

whether the experimental size specifications offer South African female students of African descent with triangular body shapes with improved overall quality of fit.

3.3 METHODOLOGICAL OUTLINE

The study was divided into two phases. The objectives of the study and their relation to the two phases of the study are outlined in table 3.1.

TABLE 3.1: METHODOLOGICAL OUTLINE

PHASE ONE (CHAPTER 4)	PHASE TWO (CHAPTER 5)
Development of the experimental size specifications (objective 1)	Pretest: Evaluation of the quality of fit attained from the traditional size specifications (objective 2) Posttest: Evaluation of the quality of fit attained from the experimental size specifications (objective 2)

3.4 UNIT OF ANALYSIS

The experimental size specifications were developed for South African female students of African descent with triangular body shapes. The students were of medium height, in the size 6/30 to size 14/38 size range, aged between 18 and 25 years, and enrolled at the University of Pretoria. Female students of African descent were selected as the unit of analysis for this study because they are not currently adequately catered for by current ready-to-wear apparel sizing. Currently, ready-to-wear apparel is designed to fit women with an ideal body shape (Zwane & Magagula, 2007:283; Rasband, 1994:12); however, 59.26% of South African female students of African descent have a triangular body shape according to the preliminary findings of Makhanya's (2012) research.

3.5 METHODS AND PROCEDURES

Since the methods and procedures used in the study are extensive, they are presented in separate chapters. The methods and procedures for phase one and phase two are discussed and presented together with the findings of each phase in **chapter 4** and **chapter 5** respectively.

3.6 QUALITY OF THE DATA

For a study to produce precise and accurate data, the study has to be both valid and reliable (Delport, 2005:160). To enhance the quality of the data, the following measures discussed in terms of validity and reliability were implemented:

3.6.1 Validity

Validity in research refers to a measuring instrument that "measures what it is intended to measure" (Melville & Goddard, 1996:37), or a "research design that tests what it is supposed to test" (Graziano & Raulin, 2000:187). Validity can be described through a number of concepts such as, face validity, content validity, criterion validity, external validity, and internal validity (Delport, 2005:160; Leedy & Ormrod, 2010:97; Graziano & Raulin, 2000:186).

3.6.1.1 Face validity

Face validity, according to Delport (2005:161), refers to whether a measuring instrument or the research design appears to measure what it is supposed to measure. The author further goes on to say that face validity is not "a form of validation" since it refers to whether an instrument or the research design appears to measure what it is supposed to measure. Face validity, though not being a form of validation, is desirable in research as it reduces resistance on the part of the participants (Delport, 2005:161).

In the study, the experimental size specifications were developed by statistically analysing an anthropometric database of female students of the University of Pretoria using regression analysis. Thereafter, the quality of fit attained from the experimental size specifications and the traditional size specifications was comprehensively evaluated on a fit evaluation questionnaire. Thus, the design of the study and the associated instruments appear to have face validity since they appear relevant in terms of the objectives of the study.

3.6.1.2 Content validity

Closely related to face validity is content validity (Delport, 2005:161). Content validity, according to Delport (2005:161), is concerned with the ability of an instrument to measure what it is supposed to measure. To ensure content validity in the study, the research design and the research instruments were peer-reviewed to ensure that the research design tests

what it is supposed to test, and the measuring instruments measure what they are supposed to measure, as Delport (2005:161) suggested.

3.6.1.3 Criterion validity

Criterion validity refers to comparing the findings with external criterion that is known to be a valid measure of the concept under scrutiny in order to make valid interpretations (Delport, 2005:161). In the study, the principles of apparel fit such as line, grain, set, ease, and balance, and the standards of apparel fit were used as the criteria to measure the quality of fit of the test garments. The standards of apparel fit and the principles of apparel fit have been used in other studies (Song & Ashdown, 2010; Bye *et al*., 2008; Zwane & Magagula, 2007; Ashdown & O'Connell, 2006) as valid criteria to measure apparel fit. Additionally, the experience of the fit evaluators in pattern design, garment construction, and in altering garments to fit, facilitated the critical evaluation of the quality of fit of the test garments.

3.6.1.4 External validity

External validity is defined as the "degree to which we are able to generalize the results of the study (onto) other participants, conditions, times, and places" (Graziano & Raulin, 2000:187). The findings of this exploratory study cannot be projected onto the general South African population, due to the use of non-representative anthropometric data and the non-representative sample quality of fit was evaluated on.

3.6.1.5 Internal validity

Internal validity, in experimental research occurs when it can be determined confidently that an external factor is not responsible for the observations (Graziano & Raulin, 2000:188). To ensure internal validity in the study, the participants were selected according to the participant selection criterion to ensure similarity amongst the participants of the study. Furthermore, the test garments were constructed from the same fabric using the same construction techniques and by the researcher (with pattern design and sewing experience) to ensure similarity between the test garments (Murphey, 1993:65).

3.6.2 Reliability

Delport (2005:162) refers to reliability as consistency of measurement. A reliable measuring instrument or research design should generate the same results when used again under

identical conditions (Melville & Goddard, 1996:37). Due to the use of non-representative data, the same result will not be obtained if this study is replicated in the same population because the sample did not take into account the full variability found within the target population. Nevertheless, the following strategies were employed to enhance the reliability of the study:

- A thorough literature review of contemporary literature was conducted to understand the concepts and dimensions of the research problem. Furthermore, all concepts and dimensions of the study were clearly defined to eliminate any vagueness or ambiguity.
- The design of the study and the measuring instruments were peer-reviewed prior to commencing with the study to determine their validity and the absence of bias and ambiguity.
- The researcher, who is also a fashion designer, enrolled for a course in statistics at the University of Pretoria in which regression analysis was part of the curriculum.
- The measurements that were used to develop the experimental size specifications were obtained from three-dimensional body scan data gathered using a Textile/Clothing Technology Corporation ($[TC]^2$) body scanner. Three-dimensional body scanners rapidly and accurately measure three-dimensional objects such as the human body (Pandarum, 2009:4), and “are currently the latest and most objective method” of measuring the human body (Le Pechoux & Ghosh, 2002:13).
- The participant selection criteria ensured that the participants of the study were similar; replication of the results of the study might be possible if a replica study uses the same criteria to select the participants. The sampling criterion used in this study is discussed in **section 5.2.4**.
- The fit evaluation questionnaire consisted of several levels of measurement in order to measure accurately the variability of each concept and to increase the sensitivity of the instrument (Zikmund & Babin, 2007:211).
- Existing principles of apparel fit and standards of apparel fit were used as the criteria to evaluate the quality of fit of the test garments.
- The fit evaluators are academics, each with more than five years’ experience in teaching pattern design, pattern fitting, and garment construction.
- Since the concept of appropriate fit varies amongst people, the fit evaluators were given the criterion on which to evaluate the quality of fit of the test garments

to enhance interrater-reliability (Ashdown & O'Connell, 2006:137; Leedy & Ormrod, 2010:93; Schofield, 2000:16). The criterion on which to evaluate the quality of fit of the test garments was compiled after an in-depth review of literature on the standards of apparel fit and the principles of apparel fit.

- The captured data was compared with all the fit evaluation questionnaires to ensure that the data was correctly captured.
- The researcher has experience in pattern design, garment construction, and in altering garments to fit.

3.7 ETHICAL CONSIDERATIONS

In research studies where human beings are participants in the study, ethical considerations must be addressed prior to commencing with the study, during the study, and after the study, in order to protect the participants against deception, dangerous procedures, and invasion of privacy (Leedy & Ormrod, 2010:101; Graziano & Raulin, 2000:65).

According to Walliman (2005:346), all the participants should give informed consent; informed consent refers to consent which is given by the participants of a study based on the full understanding of the purpose and nature of the research, and their involvement in the study (Walliman, 2005:434). In this study, the participants were thoroughly informed of the purpose of the study and their role in the study, as suggested by Graziano and Raulin (2000:65). All participants were made aware that participation in the study is voluntary; furthermore, all participants were made aware that they have the right to terminate their participation in the study at any time, as Leedy and Ormrod (2010:101) recommend.

The participants that took part in the study were required to sign a participant consent form before they could take part in the study, following the suggestion of Creswell (2009:89). A participant information sheet and a participant consent form were compiled from guidelines for informed consent (Oxford Brookes University, 2011). The information sheet provided comprehensive information on the study to enable the participants to make an informed decision on whether to participate in the study. In the consent form, participants indicated their willingness to participate in the study based on the full understanding of the purpose of the study and their involvement in the study. The participant information sheet and participant consent forms were printed on the official letterhead of the University of Pretoria. Copies of the participant information sheet and the participant consent form are found in addendum A.

According to Leedy and Ormrod (2010:101), participants in a research study must be protected from undue physical harm and psychological discomfort. The participants were not exposed to any dangerous procedures; the participants were measured and expected to try-on the test garments. The study had the potential of creating psychological discomfort. To avoid psychological discomfort, the researcher did not make any comments about the anatomy of any participant when the body measurements were obtained from the participants. A female assistant was available to take the measurements of a participant that might have felt uncomfortable with the male researcher taking their body measurements. The participants were informed of the above prior to participating in the study, in heed of the recommendations made by Leedy and Ormrod (2010:101).

Prior to commencing with participant recruitment and data collection, the approval of the Ethics Committee of the Faculty of Natural and Agricultural Sciences at the University of Pretoria was sought.

All participants of the study were guaranteed of anonymity. The identities of the participants were kept confidential; their names were not disclosed and their faces were masked from the photographs taken during the fit evaluation sessions. Codes were used to identify the participants in order to protect their confidentiality as Graziano and Raulin (2000:67) suggest.

Ethical concerns that arose after data gathering were with regard to honesty. The findings of the study were reported without any misrepresentations of the findings, following the recommendations of Leedy and Ormrod (2005:103). Furthermore, the findings of the study were presented on as-is-basis despite some of the findings being contrary to the researcher's expectations. The work of other researchers and authors used in the dissertation was fully acknowledged as such to prevent plagiarism.

CHAPTER 4

PHASE ONE: THE DEVELOPMENT OF THE EXPERIMENTAL SIZE SPECIFICATIONS

4.1 INTRODUCTION

The experimental size specifications for the body measurements required for a basic sheath dress for South African female students of African descent with triangular body shapes were developed in phase one of the study. The general systems theory was selected to guide the development of the experimental size specifications. The general systems theory is a framework in which a system can be studied (Gregoire, 2010:2); a system according to Gregoire (2010:2), is defined as a collection of independent parts that are designed to work together as a coherent entity to achieve one or more objectives. The process of developing experimental size specifications reflects a system, as various parts work together as a unit to develop the experimental size specifications. The conceptual framework presented in figure 4.1 was compiled within the general systems theory to explain the methodology that was used in the study to develop the experimental size specifications for South African female students with triangular body shapes.

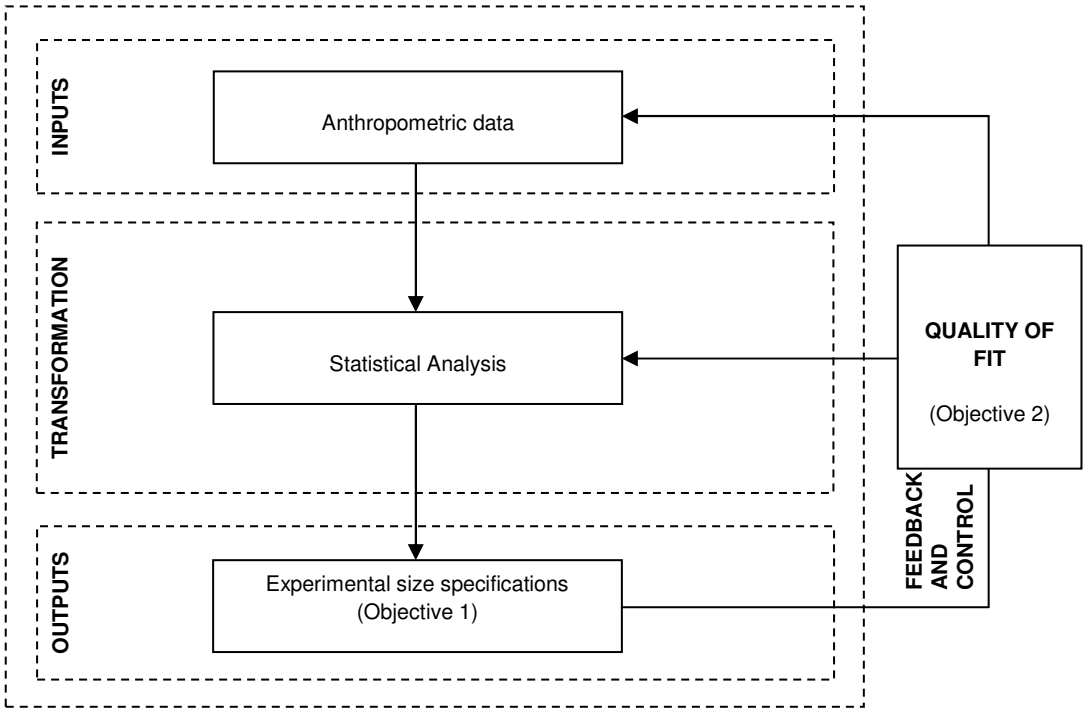


FIGURE 4.1: SCHEMATIC CONCEPTUAL FRAMEWORK

According to the general systems theory, a system consists of three major parts that operate together to achieve the objectives of the system (Gregoire, 2010:2). The three major parts of the system are the inputs, the transformation, and the outputs (Gregoire, 2010:2). The inputs of a system are the resources required to achieve the objectives of the system (Gregoire, 2010:2). In the context of this study, anthropometric data was the input into the system of developing the experimental size specifications. The transformation is the process of changing the inputs into the outputs, with the output representing the achievement of the objectives of the system (Gregoire, 2010:2). The experimental size specifications are the output of the system depicted in figure 4.1.

Systems that operate in an open environment can be expanded to include a feedback and control mechanism. The feedback and control mechanism receives information from the environment that the system operates in and is important in ensuring that the system keeps operating towards its objectives (Gregoire, 2010:3; Whitchurch & Constantine, 1993:334; Kast & Rosenzweig, 1972:450). The quality of fit, in terms of the study, acts as the feedback and control mechanism since the objective of the experimental size specifications is to provide consumers with ready-to-wear apparel with acceptable quality of fit. If consumers experience dissatisfaction with the quality of fit, if external factors are not the cause of the dissatisfaction, the inputs and the transformation process should be reviewed to ensure that the output produces ready-to-wear apparel with acceptable quality of fit.

Equifinality is a concept of the general systems theory, which suggests that a system has the ability to achieve the same output through different inputs and transformation processes (Gregoire, 2010:4; Kast & Rosenzweig, 1972:450). In terms of the equifinality concept, there are different methods of developing size specifications; the approach presented in the conceptual framework is one of the alternatives that can be used to develop the experimental size specifications.

4.2 METHODS AND PROCEDURES

The process of developing size specifications involves the division of the anthropometric data of the population in question into different sizes (Gupta & Gangadhar, 2004:458; Le Pechoux & Ghosh, 2002:16). In the study, the methodology that was used to transform the anthropometric data of South African female students of African descent with triangular body shapes into the experimental size specifications was as follows:

- Selection of appropriate anthropometric data for statistical analysis

- Selection of the key dimensions
- Determining the size range
- Calculation of the secondary dimensions and the grade between sizes
- Compiling the experimental size specifications from the results of the preceding steps

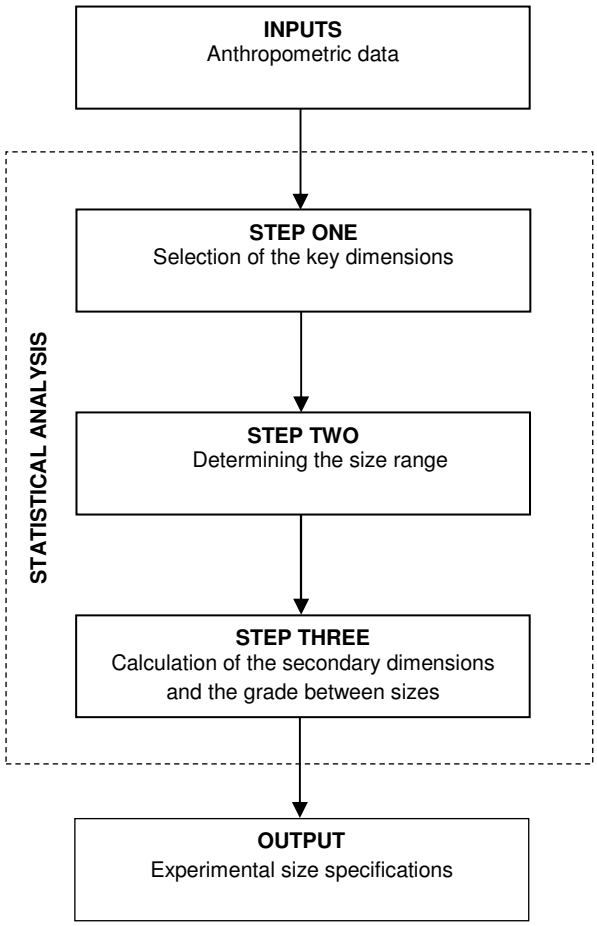


FIGURE 4.2: METHODOLOGICAL FRAMEWORK (Adapted from Mpampa *et al.*, 2010:52)

4.3 THE INPUTS: THE ANTHROPOMETRIC DATA

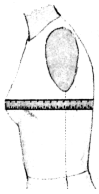
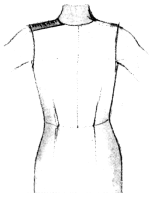
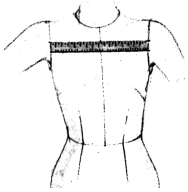
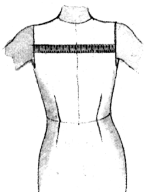
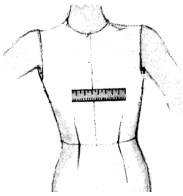
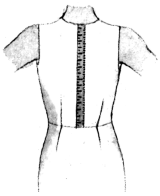
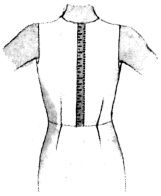
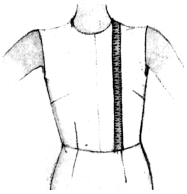
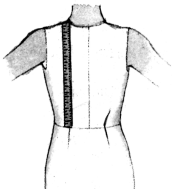
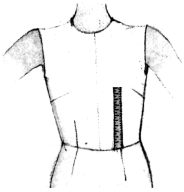
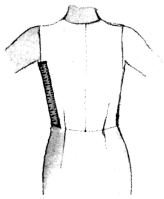
The development of a sizing system, in this case experimental size specifications, begins with the collection of the anthropometric data of the population in question (Petrova, 2007:65). With the lack of anthropometric data of the general South African population, the anthropometric data that was used in the study was obtained from a subset of the anthropometric data gathered as part of Makhanya's (2012) doctoral research at the University of Pretoria. The anthropometric database consists of data gathered using a $[TC]^2$

three-dimensional (3D) body scanner in 2009. The database consists of 233 3D body scans of female students of various ethnicities aged between 18 and 25 years at the University of Pretoria, of which a 108 3D body scans were of female students of African descent. The anthropometric database was analysed as part of Makhanya's (2012) research on the body shapes of South African women. Comprehensive details on the anthropometric database are described in detail in Makhanya (2012).

With the anthropometric data on hand, the first step of creating a sizing system, in this case experimental size specifications, is to divide the population into different body shape subgroups. In this study, it was not necessary to divide the database into different body shape subgroups as Makhanya (2012) had already done so in her study. According to the preliminary findings of Makhanya's (2012) study, 64 female students of African descent out of a sample of a 108 female students of African descent were classified to have a triangular body shape (i.e. 59.26%). A subset of the anthropometric database representing the unit of analysis, in terms of body shape and ethnicity, was selected for use in the study. All 3D body scans of South African female students of African descent classified as having a triangular body shape in Makhanya's (2012) study were selected for use in the development of the experimental size specifications; 64 3D body scans of South African female students of African descent with a triangular body shape were selected for use in the study.

A measurement extraction parameter file for the extraction of the measurements relevant to this study was created using the NX16 3D Body Measurement System developed by $[TC]^2$. A measurement extraction parameter file, according to the NX16 3D Body Measurement System help file, "is a set of instructions to the Measurement Extraction program to tell it which measurements to extract (from a 3D body scan) and in what order. It also has the parameters the program uses to extract the measurements". With the measurement extraction parameters defined, measurements were then extracted from the 64 3D body scans selected for use in the study.

Since the purpose of this study was to develop experimental size specifications for the body measurements required for a basic sheath dress, the body measurements extracted from the 3D body scans were those required to draft a basic sheath dress in the patternmaking text *Make your own patterns* by Bergh (1995). The body measurements extracted from the 64 3D body scans were entered into Microsoft Excel 2007 for statistical analysis. Figure 4.3 shows the body measurements that were extracted from the 3D body scans.

BODY MEASUREMENTS		
Bust (H*) 	**Waist (H*)** 	**Hips (H*)** 
Shoulder (H*) 	**Across chest (H*)** 	**Across back (H*)** 
Bust span (H*) 	**Centre front (V*)** 	**Centre back (V*)** 
Front shoulder height (V*) 	**Back shoulder height (V*)** 	**Bust-to-waist (V*)** 
Side seam (V*) 	**Waist-to-hip (V*)** 	**Waist-to-knee (V*)** 

*"H" denotes horizontal measurements while "V" denotes vertical measurements.

FIGURE 4.3: BODY MEASUREMENTS EXTRACTED FROM THE 3D BODY SCANS (Adapted from Bergh, 1995:12-13)

4.4 THE TRANSFORMATION OF THE ANTHROPOMETRIC DATA INTO THE EXPERIMENTAL SIZE SPECIFICATIONS

The anthropometric data was transformed into experimental size specifications through statistical analysis. The statistical analysis consisted of three steps, namely, selection of the key dimensions, determining the size range, and the calculation of the secondary dimensions and the grade between sizes, as shown in figure 4.2.

4.4.1 Selection of the key dimensions

Prior to the transformation of the anthropometric data into experimental size specifications, key dimensions for the experimental size specifications had to be selected. In the study, two key dimensions were required, one for horizontal measurements and another for vertical measurements, as findings of anthropometric studies indicate that there is no key dimension related to both horizontal and vertical measurements (Faust & Carrier, 2010:93; Mpampa *et al.*, 2010:57; Petrova, 2007:67; Schofield & LaBat, 2005a:17; Gupta & Gangadhar, 2004:463; Le Pechoux & Ghosh, 2002:20; Schofield, 2000:82; Beazley, 1998:268; Chun-Yoon & Jasper, 1996:90; Taylor & Shoben, 1984:16; O'Brien & Shelton, 1941:1).

4.4.1.1 Horizontal key dimension

The bust girth is considered as a key dimension for the sizing of apparel, as the bust girth is generally used as the primary size designator (Schofield, 2000:83; O'Brien & Shelton, 1941:1). However, the British sizing system unlike other sizing systems uses the hip girth as the primary size designator (Schofield, 2000:83). According to analysis of anthropometric data, the bust girth is a good predictor of the horizontal measurements of the upper torso while the hip girth is a good predictor of the horizontal measurements of the lower torso (Petrova, 2007:70; Gupta & Gangadhar, 2004:463; Le Pechoux & Ghosh, 2002:20; Chun-Yoon & Jasper, 1996:94). In view of this study's objective of developing experimental size specifications for both the upper torso and the lower torso, bivariate correlation analysis was performed to determine whether to use the hip girth or the bust girth as the key dimension for the horizontal measurements in this study.

Bivariate correlation analysis, according to Levin and Rubin (1991:505), "describe(s) the degree to which one variable is linearly related to another" variable, and may thus be used to select a key dimension that has a high correlation with other measurements (Le Pechoux & Ghosh, 2002:20; Beazley, 1998:268; Chun-Yoon & Jasper, 1996:90). Both the bust girth and

the hip girth were tested for correlation with the other measurements of the upper and lower torso by computing Pearson's correlation coefficient (r_{xy}) in Microsoft Excel 2007.

Pearson's correlation coefficient (r_{xy}) measures the strength of the linear relationship between two variables, x and y (Anderson *et al.,* 2003:584; Croney, 1980:77). Pearson's correlation coefficient takes on values between -1 and +1 (Anderson *et al.,* 2003:584). According to Croney (1980:77), any value of Pearson's correlation coefficient "above (or below) zero indicates some degree of functional relationship" between the two variables and as the value of Pearson's correlation coefficient approaches ±1.0 a perfect positive or negative relationship would exist between the two variables.

In interpreting Pearson's correlation coefficient, the 1990 British Standard (BS 7231) for the sizing of children's apparel provides additional guidelines for interpreting Pearson's correlation coefficient; according to the British Standard, if Pearson's correlation coefficient is less than 0.5 there is no relationship between the two variables (BS 7231 as quoted in Mpampa *et al*., 2010:53). For values of Pearson's correlation coefficient between 0.5 and 0.75 there is a mild relationship between the two variables, and if Pearson's correlation coefficient is above 0.76 a strong relationship exists between the two variables (BS 7231 as quoted in Mpampa *et al*., 2010:53).

In this study, Pearson's correlation coefficient was interpreted in terms of the guidelines provided by the British Standard. However, values of Pearson's correlation coefficient less than 0.5 were considered to suggest a weak relationship between two variables, as Croney (1980:77) considers any value of Pearson's correlation coefficient above (or below) zero to indicate "some degree of functional relationship" between the two variables. The criterion used in this study to interpret Pearson's correlation coefficient is tabulated in table 4.1. The values of the correlation coefficients computed in the study are shown in table 4.2.

TABLE 4.1: CRITERIA FOR INTERPRETING PEARSON'S CORRELATION COEFFICIENT (r_{xy})

VALUE OF PEARSON'S CORRELATION COEFFICIENT (r_{xy})	RELATIONSHIP BETWEEN x AND y
$r_{xy} \leq 0.5$	Weak relationship between x and y
$0.5 \leq r_{xy} \leq 0.75$	Mild relationship between x and y
$r_{xy} \geq 0.76$	Strong relationship between x and y

As it can be seen in table 4.2 and in figure 4.4, both the bust girth and the hip girth have positive correlation with other horizontal measurements. Both the bust girth and the hip girth have a weak positive relationship with the horizontal measurements above the bust girth, whereas below the bust girth, both the bust girth and the hip girth have a positive mild-to-strong relationship with the horizontal measurements. The bust girth generally had better correlation with most of the horizontal measurements, compared to the correlation between the hip girth and most of the horizontal measurements. From the bivariate correlation analysis, it may be concluded that horizontal measurements correlate well with other horizontal measurements since both the bust girth and the hip girth have positive correlation with other horizontal measurements.

TABLE 4.2: BIVARIATE CORRELATION ANALYSIS (n = 64)

HORIZONTAL MEASUREMENTS	BUST (r_{xy})	HIP (r_{xy})
Bust	1.00#	0.75*
Waist	0.81	0.71
Hips	0.75*	1.00#
Shoulder	0.17	0.15
Across chest	0.37	0.24
Across back	0.33	0.22
Bust span	0.18	0.17
VERTICAL MEASUREMENTS	**BUST (r_{xy})**	**HIP (r_{xy})**
Centre front	0.01	0.22
Centre back	-0.25	-0.01
Front shoulder height	0.17	0.32
Back shoulder height	-0.30	-0.06
Bust-to-waist	-0.45	-0.24
Side seam	-0.48	-0.24
Waist-to-hip	0.21	0.65
Waist-to-knee	0.18	0.38

#Perfect correlation: bust vs. bust and hip vs. hip

*Inverse relationship: bust vs. hip and hip vs. bust

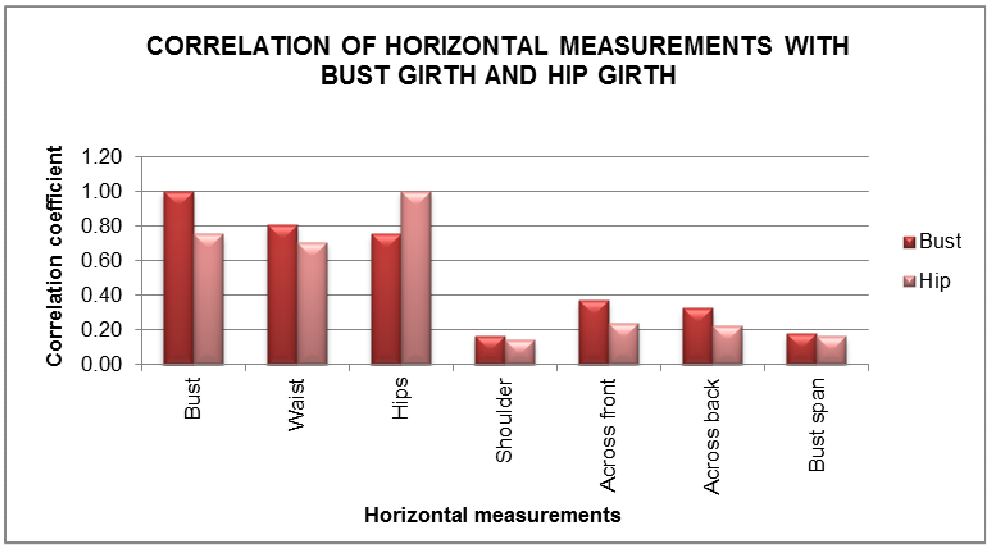


FIGURE 4.4: CORRELATION OF THE HORIZONTAL MEASUREMENTS WITH THE BUST GIRTH AND THE HIP GIRTH (n = 64)

With regard to the correlation of the vertical measurements with the bust girth and the hip girth, there is an inconclusive trend as it can be seen in figure 4.5. Both the bust girth and the hip girth have weak correlation with most of the vertical measurements. Some of the vertical measurements were found to have negative correlation with both the bust girth and the hip girth. From the bivariate correlation analysis, it may be concluded that there is a poor relationship between the horizontal measurements and the vertical measurements, since not all vertical measurements increase as the horizontal measurements increase.

In view of the findings of the correlation analysis, the bust girth was selected as the horizontal key dimension for the study as it showed better correlation with most of the horizontal measurements despite having a poor correlation with most of the vertical measurements. In Schofield (2000:168,189), the bust girth was also used as the key dimension despite the bust girth being found to have negative correlation with some of the vertical measurements.

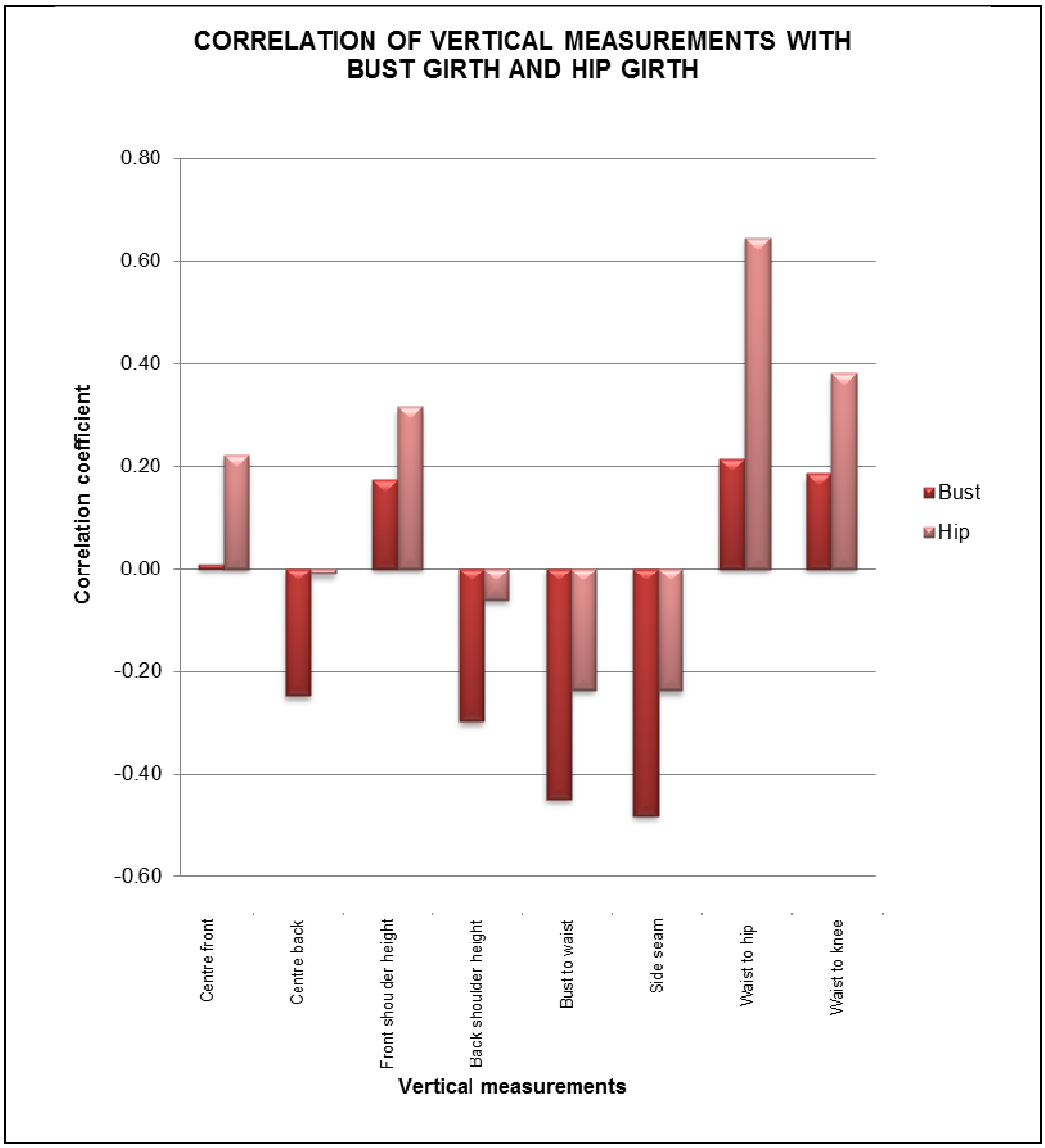


FIGURE 4.5: CORRELATION OF THE VERTICAL MEASUREMENTS WITH THE BUST GIRTH AND THE HIP GIRTH (n = 64)

4.4.1.2 Vertical key dimension

For vertical measurements, height is generally considered as the key dimension since height strongly correlates with most vertical measurements (Mullet *et al.*, 2009:5; Le Pechoux & Ghosh, 2002:20; Beazley, 1998:268; Chun-Yoon & Jasper, 1993:34; O'Brien & Shelton, 1941:1). However, in this study it was not possible to use height as a vertical key dimension because height was not extractable from the 3D body scans[12]. Therefore, in the study there was no key dimension selected for the vertical measurements. Details on how the vertical

[12] Height was not extractable from the 3D body scans due to the missing regions on the human head, as it can be seen in figure 6.1.

measurements for the experimental size specifications were calculated in the absence of a key dimension for the vertical measurements are provided in **section 4.4.3.2**.

4.4.2 Determining the size range

With the bust girth selected as the key dimension, the next step of the development of the experimental size specifications was to determine the size range and the measurement values for the bust girth. In determining the size range and the measurement values of the bust girth, the accommodation range of the sizing system needs to be first determined by establishing the minimum and maximum measurement values for the bust girth as well as the size interval (Petrova, 2007:64).

As previously mentioned, in the study the British sizing system is used as a reference because South Africa's sizing for women's apparel is adapted from British sizing (Zwane & Magagula, 2007:283; Strydom, 2006:217). In this study, a 4 cm size interval for the bust girth was selected following the guidelines of the current British sizing standard (Aldrich, 2008:12-13; Schofield, 2000:104). The current British standard prescribes a 4 cm circumference grade for the bust girth for the size 6 to size 20 size range, equivalent to the South African size 4/28 to size 18/42 size range.

With the size interval for the bust girth selected, the next step was to determine the range of measurements for the bust girth that the experimental size specifications will cover. In order to select the range of measurements for the bust girth, the 3D body scans were distributed into different sizes according to current industry practice.

With the absence of South African sizing guidelines for women's ready-to-wear apparel, the bust measurements for the size 4/28 to size 16/42[13] size range were calculated from the bust measurement of the size 10/34 *Figure Forms* dress form. A woman wearing size 10/34 is generally considered to have a bust measurement of 89 cm in the South African apparel industry, since the *Figure Forms* dress form that is used extensively in the apparel industry has an 89 cm bust measurement. From the bust measurement of the size 10/34, the bust measurements for the size 4/28 to size 16/42 size range were then calculated by adding and subtracting 4 cm (the size interval) from the bust measurement of the size 10/34.

[13] Only the bust measurements of the size 4/28 to size 16/42 size range were calculated because the bust girths of the 3D body scans fell into this size range.

With the bust measurements for the size 4/28 to size 16/42 size range determined, the range of body measurements that can be accommodated by a particular size were then calculated since very few 3D body scans had bust measurements that matched those shown in table 4.3. According to literature, a person's body dimensions should fall within the grade interval of a specific size in order to obtain acceptable quality of fit from that size (LaBat 1987 in Schofield, 2000:36; Cooklin, 1995:5). The range of bust measurements that can be accommodated by a particular size were calculated by adding 2 cm to the bust measurement of a particular size to determine the upper limit of the size, and by subtracting 2 cm from the bust measurement of a particular size to determine the lower limit of the size. The range of bust measurements that can be accommodated by size 10/34 are shown in figure 4.6.

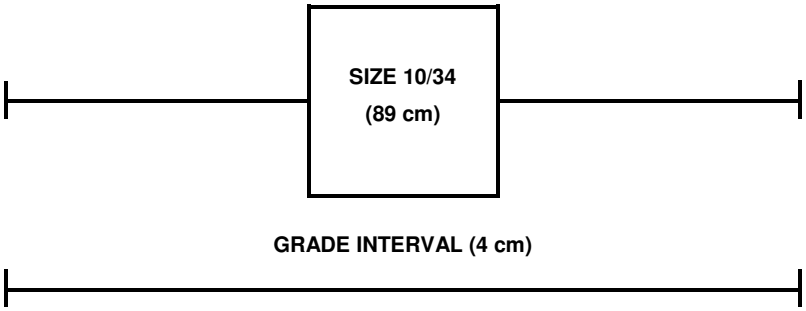


FIGURE 4.6: PARAMETERS OF A SIZE (Adapted from Cooklin, 1995:5)

Table 4.3 shows the bust measurements of the various sizes and the range of bust measurements that can be accommodated by each size. The 3D body scans, were distributed into different sizes based on the range of bust measurements (as shown in table 4.3 and in figure 4.7).

TABLE 4.3: DISTRIBUTION OF THE 3D BODY SCANS INTO DIFFERENT SIZES (n = 64)

SIZE	4/28	6/30	8/32	10/34	12/36	14/38	16/40	18/42
Bust measurement	77 cm	81 cm	85 cm	89 cm	93 cm	97 cm	101 cm	105 cm
Range of bust measurements	>75.1 cm to 79 cm	> 79.1 cm to 83 cm	> 83.1 cm to 87 cm	> 87.1 cm to 91 cm	> 91.1 cm to 95 cm	> 95.1 cm to 99 cm	> 99.1 cm to 103 cm	> 103.1 cm to 107 cm
Number of 3D body scans	4	11	19	10	8	7	3	2

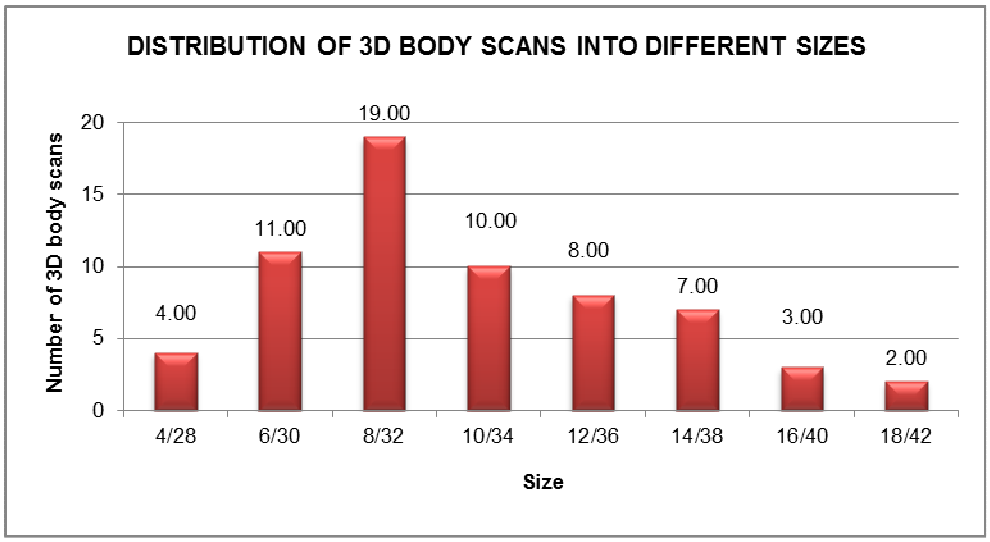


FIGURE 4.7: DISTRIBUTION OF THE 3D BODY SCANS INTO DIFFERENT SIZES (n = 64)

Out of the sample of 64 3D body scans, 55 3D body scans (i.e. 85.94%) had a bust girth measurement falling into the size 6/30 to size 14/38 size range. In view of the large portion of the 3D body scans in the size 6/30 to size 14/38 size range, it was decided to limit the size range of the experimental size specifications to these sizes. The sizes selected for the experimental size specifications are highlighted in table 4.3. The accommodation rate of a sizing system, the portion of the population that is accommodated by the sizing system, typically falls between 65% and 85% (Petrova, 2007:64); the 85.94% accommodation rate achieved in this study marginally falls above the acceptable range.

4.4.3 Calculation of the secondary dimensions and the grade between the secondary dimensions

With the key dimensions for the experimental size specifications determined, the next step was to calculate the secondary dimensions for the different sizes and the grade between the secondary dimensions.

In the sizing of apparel, various statistical methods “ranging from simple percentiles to complex combinations of multivariate and regression analyses” have been employed (Le Pechoux & Ghosh, 2002:16). Gupta and Gangadhar (2004:458) are of the opinion that most statistical techniques used thus far are “rather complicated and based on complex mathematical calculations”. Developing size specifications based on the findings of a small-scale anthropometric survey, as is the case in this study, requires simple statistical analysis

because complex statistical techniques require a large sample of anthropometric data to produce worthwhile results (Beazley, 1998:262-263).

The calculation of the secondary dimensions and the grades between the secondary dimensions was executed in separate steps as the bivariate correlation analysis indicated a poor correlation between the horizontal measurements and the vertical measurements, hence different statistical techniques were required to calculate the horizontal secondary dimensions and the vertical secondary dimensions for the experimental size specifications.

4.4.3.1 Calculation of the secondary horizontal dimensions and the grade between the secondary horizontal dimensions

In this study, the statistical technique, least-squares regression analysis was selected to calculate the secondary horizontal dimensions. Regression analysis[14], in terms of apparel sizing, may be defined as a statistical technique in which the values of secondary dimensions may be predicted from known values of the key dimension (Field, 2009:198; Le Pechoux & Ghosh, 2002:18). Regression analysis, as previously mentioned, is commonly used to estimate the dimensions of the body from size-to-size (Shin & Istook, 2007:136; Le Pechoux & Ghosh, 2002:18,20; McCulloch *et al.*, 1998:492).

In linear regression, and in terms of apparel sizing, the key dimension is considered as the independent variable (x-variable) as it explains the change that occurs in the secondary dimensions (y-variables/ dependent variables) (Anderson *et al.,* 2003:631). The bust girth was previously selected as the key dimension for the horizontal measurements based on the findings of the bivariate correlation analysis, and was used as the independent variable for the regression analysis as its correlation with the secondary horizontal dimensions may enable it to predict the secondary horizontal dimensions accurately (Kranzler, 2007:108-109). In Schofield (2000:168), the bust girth was also used as the independent variable for the regression analysis.

With the bust girth used as the independent variable, estimated regression equations for the secondary horizontal dimensions were then calculated using the least squares regression analysis technique. A regression equation shows "how the dependent variable y is related to the independent variable x" (Anderson *et al.,* 2003:566), and may be used to predict new

[14]"Regression analysis is a way of predicting an outcome variable from one predictor variable…" according to Field (2009:198).

values of the dependent variable y for new values of the independent variable x (Williams, 2004:305; Croney, 1980:84). The regression equation is given as:

$$\hat{y} = b_0 + b_1 x$$

where $\hat{y}$ is the mean value for a known or estimated value of the independent variable x, b_0 is the y-intercept of the regression line, and b_1 is the slope of the regression line (Anderson *et al.,* 2003:567). The $\hat{y}$-intercept is "a constant for any given straight line ... (and) represents the value of the y variable when the x variable has a value of 0" (Levin & Rubin, 1991:521). The slope of the regression equation, represents the estimated rate of change for the dependent variable y for each unit change in the independent variable x (Swanepoel, Vivier, Millard & Ehlers, 2009:20; Williams, 2004:304). The estimated regression equations for the secondary horizontal dimensions (with the bust girth used as the independent variable) are shown in table 4.4.

TABLE 4.4: ESTIMATED REGRESSION EQUATIONS FOR THE SECONDARY HORIZONTAL DIMENSIONS

SECONDARY HORIZONTAL DIMENSIONS	INTERCEPT ($\hat{y}$)	SLOPE (b_1)	REGRESSION EQUATION
Waist	3.67	0.82	$\hat{y} = 3.67 + 0.82x$
Hips	14.44	1.01	$\hat{y} = 14.44 + 1.01x$
Shoulder	6.08	0.06	$\hat{y} = 6.08 + 0.06x$
Across chest	4.51	0.30	$\hat{y} = 4.51 + 0.30x$
Across back	16.49	0.18	$\hat{y} = 16.49 + 0.18x$
Bust span	10.61	0.09	$\hat{y} = 10.61 + 0.09x$

With the estimated regression equations computed, the estimated values of the secondary horizontal dimensions for female students with the triangular body shape falling into the size 6/30 to size 14/38 size range were then calculated. To calculate the estimated values of the secondary horizontal dimensions, the bust measurements in table 4.3 for the size 6/30 to size 14/38 size range were substituted into each of the estimated regression equations for the secondary horizontal dimensions[15]; the estimated secondary horizontal dimensions are shown in table 4.5.

[15] For instance to calculate the across back measurement for size 12/36, the bust girth for size 12/36 (93 cm) was substituted for x into the regression equation for the across back measurement as follows $\hat{y}$ =20.67+0.12(93). Twenty-four calculations were computed to estimate the horizontal secondary dimensions for the experimental size specifications.

TABLE 4.5: ESTIMATED HORIZONTAL MEASUREMENTS FOR THE SIZE 6/30 TO SIZE 14/38 SIZE RANGE

KEY DIMENSION	SIZE				
	6/30	8/32	10/34	12/36	14/38
Bust	81.00 cm	85.00 cm	89.00 cm	93.00 cm	97.00 cm
SECONDARY DIMENSIONS	**6/30**	**8/32**	**10/34**	**12/36**	**14/38**
Waist	70.08 cm	73.36 cm	76.64 cm	79.92 cm	83.20 cm
Hips	96.37 cm	100.42 cm	104.47 cm	108.51 cm	112.56 cm
Shoulder	11.05 cm	11.29 cm	11.54 cm	11.78 cm	12.03 cm
Across chest	29.05 cm	30.27 cm	31.48 cm	32.69 cm	33.90 cm
Across back	31.05 cm	31.77 cm	32.49 cm	33.21 cm	33.93 cm
Bust span	17.66 cm	18.01 cm	18.36 cm	18.70 cm	19.05 cm

With the values of the secondary horizontal dimensions for the different sizes estimated, the next step was to calculate the grades between the secondary horizontal dimensions. The bust was used as the basis for all comparative calculations (Gupta & Gangadhar, 2004:466; Cooklin, 1990:20), since the bust was used as the independent variable in the regression analysis. The grades for all secondary horizontal dimensions are stated in relation to the bust girth grade (Cooklin, 1990:20).

The slope of the regression equation, as previously mentioned, represents the estimated rate of change for the dependent variable y for each unit change in the independent variable x (Swanepoel *et al.*, 2004:20). In terms of this study, the slope of the regression equation represents the estimated change that occurs in the secondary horizontal dimensions for each unit change in the bust girth, and may be viewed as the estimated grade required for each secondary horizontal dimension for each unit increase/decrease in the size of the bust (Schofield, 2000:166-168).

As the results of the bivariate correlation analysis had indicated, the slopes of the regression equations computed in this study were all positive indicating a positive relationship between the bust girth and all other secondary horizontal dimensions. When the slope is positive, the dependent variable y increases by an estimated b_1 units when the independent variable x changes by one unit (Swanepoel *et al.*, 2009:19), and in terms of the study indicates that for every one centimetre change in the bust girth each secondary horizontal dimension increased by an estimated b_1 centimetres (Schofield, 2000:168).

The slopes from the estimated regression equations indicate the estimated grade for the secondary horizontal dimensions for every centimetre change in the bust. However, in the

study, a 4 cm grade is used for the bust girth. Hence, additional estimated grades for the secondary horizontal dimensions for a 4 cm bust grade had to be calculated for the experimental size specifications. The estimated grades for a 4 cm bust grade were calculated by subtracting the estimated secondary horizontal dimensions of two adjacent sizes; both the up and down grades were equal for each size in the size range. The estimated grades for a 4 cm bust grade that were calculated from the estimated secondary horizontal dimensions were also equal to the product of the slope multiplied by four.

Scatter diagrams were plotted to illustrate the estimated change in each secondary horizontal dimension for each unit increase in bust girth graphically. A scatter diagram, according to Anderson *et al.* (2003:60), "is a graphical presentation of the relationship between two quantitative variables". Scatter diagrams with the bust plotted on the x-axis against each secondary horizontal measurement on the y-axis are shown in figure 4.8 to figure 4.13.

- **The estimated grade for the waist girth**

There is a strong relationship (r_{xy} = 0.81) between the bust girth and the waist girth as shown in figure 4.8. The slope for the waist girth (b_1 = 0.82) suggests that for each centimetre increase in bust girth the waist girth increases by an estimated 0.82 cm (or by an estimated 3.28 cm for a 4 cm bust grade).

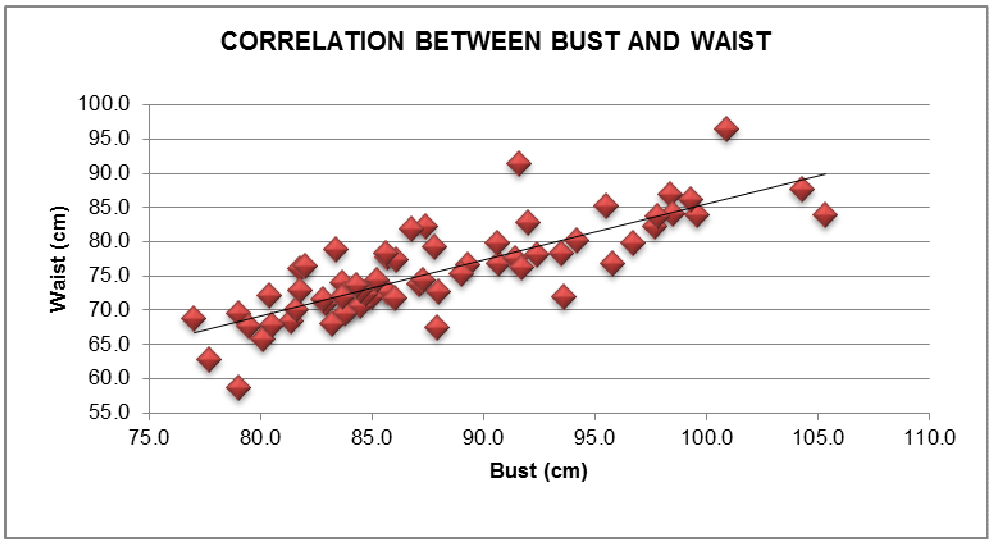


FIGURE 4.8: CORRELATION BETWEEN THE BUST GIRTH AND THE WAIST GIRTH

- **The estimated grade for the hip girth**

The hip girth has a mild relationship (r_{xy} = 0.75) with the bust girth as shown in figure 4.9. The slope for the hip girth (b_1 = 1.01) suggests that for each centimetre increase in bust girth the hip girth increases by an estimated 1.01 cm (or by an estimated 4.05 cm for a 4 cm bust grade).

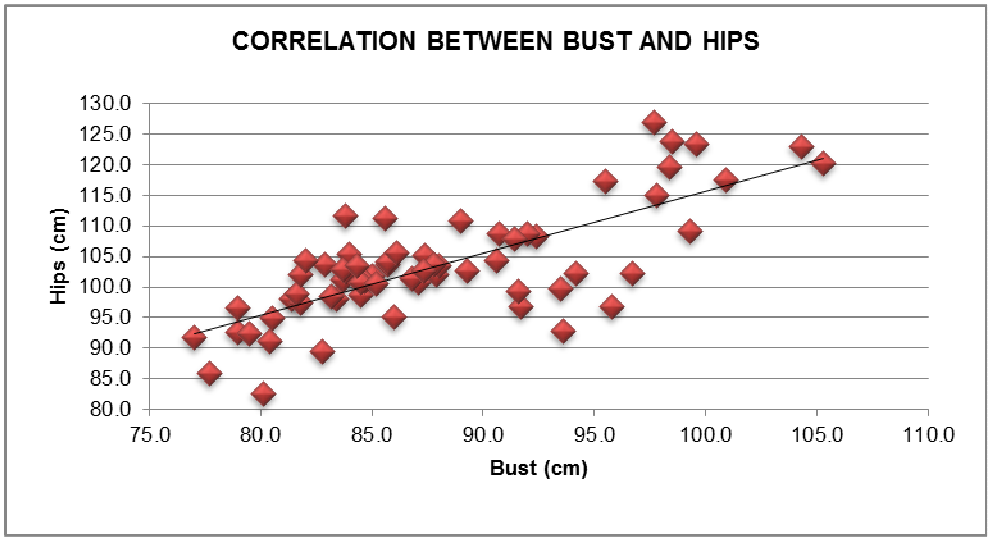


FIGURE 4.9: CORRELATION BETWEEN THE BUST GIRTH AND THE HIP GIRTH

- **The estimated grade for the shoulder**

The shoulder has a weak relationship (r_{xy} = 0.17) with the bust girth as shown in figure 4.10. The slope for the shoulder (b_1 = 0.06) suggests that for each centimetre increase in bust girth the shoulder increases by an estimated 0.06 cm (or by an estimated 0.25 cm for a 4 cm bust grade).

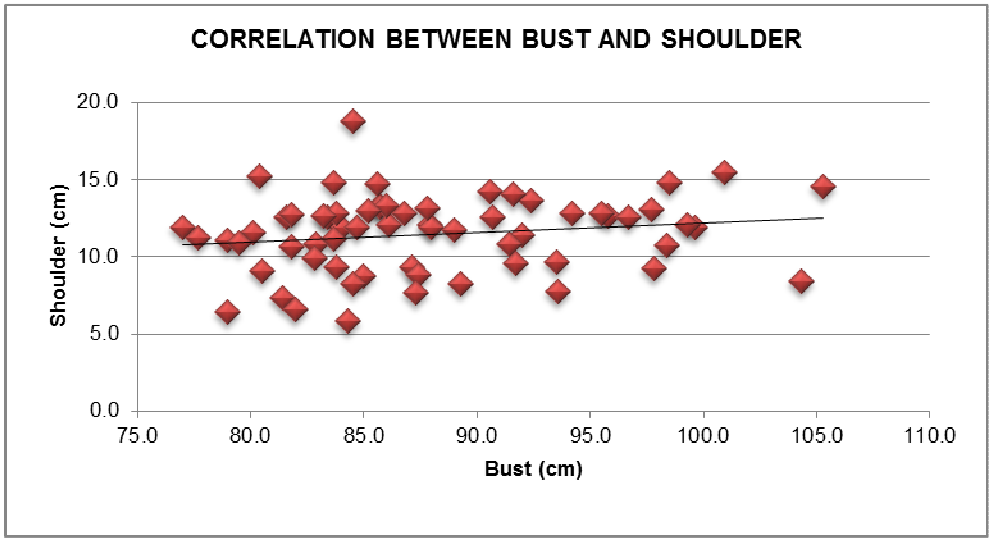


FIGURE 4.10: CORRELATION BETWEEN THE BUST GIRTH AND THE SHOULDER

- **The estimated grade for across chest**

Across chest has a weak relationship (r_{xy} = 0.37) with the bust girth as shown in figure 4.11. The slope for across chest (b_1 = 0.30) suggests that for each centimetre increase in bust girth across chest increases by an estimated 0.30 cm (or by an estimated 1.21 cm for a 4 cm bust grade).

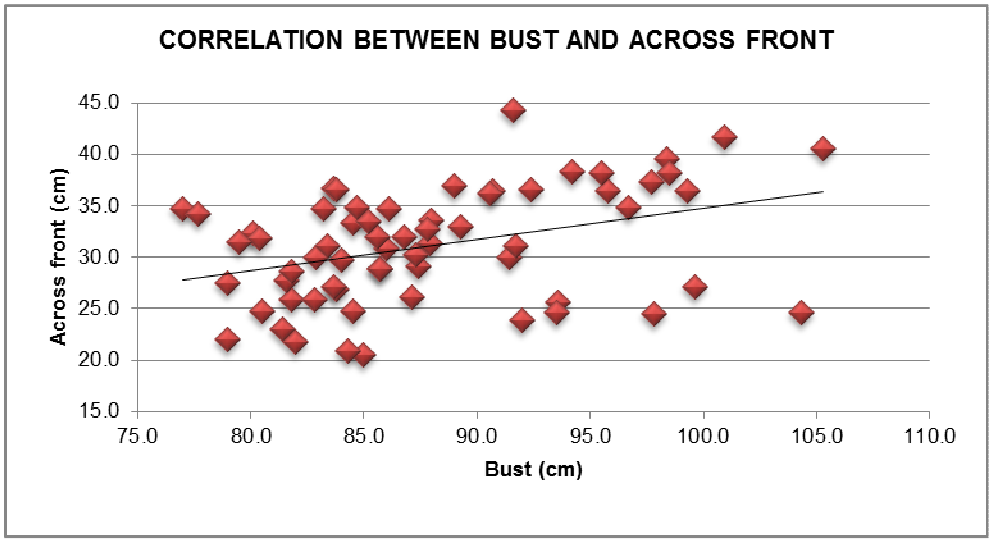


FIGURE 4.11: CORRELATION BETWEEN THE BUST GIRTH AND ACROSS CHEST

- **The estimated grade for across back**

Across back has a weak relationship (r_{xy} = 0.33) with the bust girth as shown in figure 4.12. The slope for across back (b_1 = 0.18) suggests that for each centimetre increase in bust girth across back increases by an estimated 0.18 cm (or by an estimated 0.72 cm for a 4 cm bust grade).

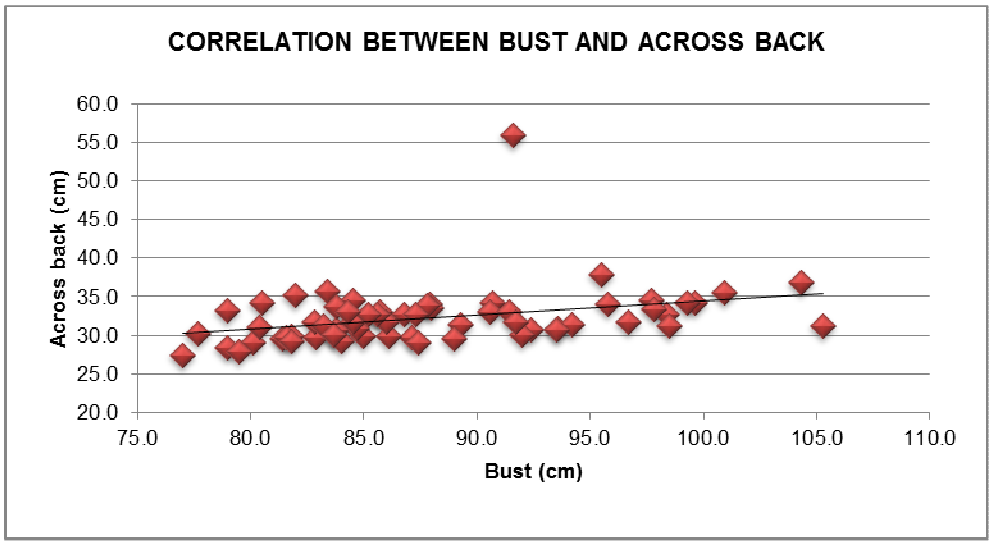


FIGURE 4.12: CORRELATION BETWEEN THE BUST GIRTH AND ACROSS BACK

- **The estimated grade for the bust span**

The bust span has a weak relationship (r_{xy} = 0.18) with the bust girth as shown in figure 4.13. The slope for the bust span (b_1 = 0.09) suggests that for each centimetre increase in bust girth the bust span increases by an estimated 0.09 cm (or by an estimated 0.35 cm for a 4 cm bust grade).

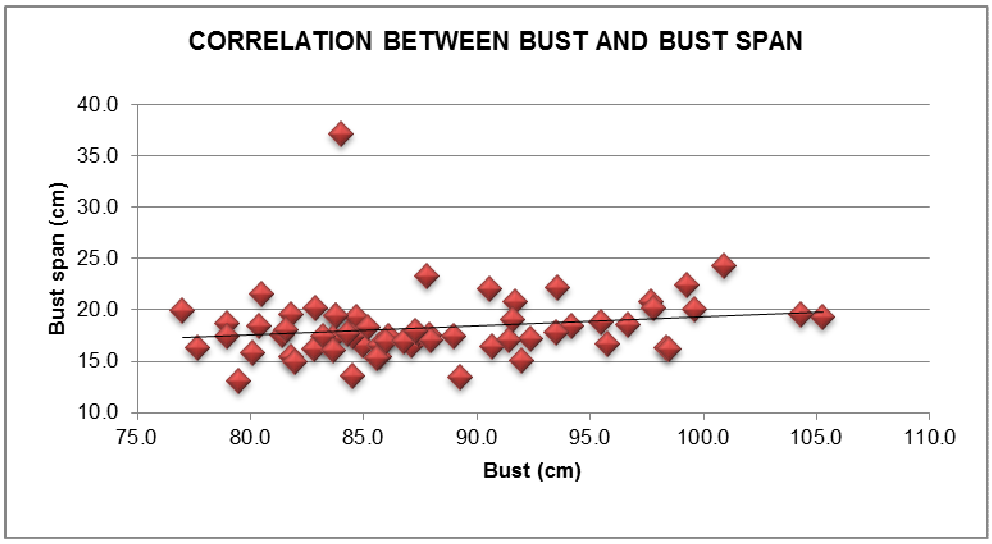


FIGURE 4.13: CORRELATION BETWEEN THE BUST GIRTH AND BUST SPAN

4.4.3.2 Calculation of the secondary vertical dimensions

Since the aim of the study was to develop experimental size specifications for female students of medium height, the vertical measurements of the 3D body scans had to be grouped into different height groups. Gupta and Gangadhar (2004:461), in their development of sizing for Indian women used height to group the vertical measurements into different height groups. However, in this study it was not possible to use height since height was not extractable from the 3D body scans. Instead, the vertical measurements extracted from the 3D body scans were used to group the vertical measurements of the 3D body scans into different height groups since all vertical measurements including height have good correlation with each other (Mpampa *et al.*, 2010:57; Gupta & Gangadhar, 2004:463; Beazley, 1998:268; O'Brien & Shelton, 1941:31).

In Gupta and Gangadhar (2004:461), the vertical measurements of Indian women were grouped into three height groups based on the mean and the standard deviation (σ) of height, as shown in table 4.6. In this study, in order to group the vertical measurements into

different height groups, the mean and the standard deviation (σ) for each vertical measurement was calculated in Microsoft Excel 2007 (refer to table 4.7). Each vertical measurement was then grouped into different height groups following the guidelines of Gupta and Gangadhar (2004:461). The distribution of the vertical measurements into different height groups is shown in table 4.8, table 4.9, and in figure 4.14.

TABLE 4.6: HEIGHT GROUPS (Gupta & Gangadhar, 2004:461)

HEIGHT GROUP	CRITERIA
Short height group	≤ Mean - 1 σ
Medium height group	= Mean ± 1 σ
Tall height group	≥ Mean + 1 σ

TABLE 4.7: UNIVARIATE ANALYSIS OF VERTICAL MEASUREMENTS (n = 64)

VERTICAL MEASUREMENTS	MEAN	STANDARD DEVIATION (σ)	MINIMUM	MAXIMUM	RANGE
Centre front	35.90 cm	2.80 cm	27.00 cm	43.60 cm	16.60 cm
Centre back	40.81 cm	3.16 cm	33.00 cm	47.90 cm	14.90 cm
Front shoulder height	42.68 cm	2.81 cm	34.70 cm	50.40 cm	15.70 cm
Back shoulder height	42.93 cm	3.48 cm	35.60 cm	55.80 cm	20.20 cm
Bust-to-waist	17.53 cm	2.78 cm	10.70 cm	24.50 cm	13.80 cm
Side seam	24.66 cm	3.92 cm	19.00 cm	37.90 cm	18.90 cm
Waist-to-hip	20.10 cm	4.53 cm	9.30 cm	29.80 cm	20.50 cm
Waist-to-knee	52.50 cm	4.94 cm	39.00 cm	63.00 cm	24.00 cm

TABLE 4.8: DISTRIBUTION OF THE VERTICAL MEASUREMENTS INTO DIFFERENT HEIGHT GROUPS (n = 64)

VERTICAL MEASUREMENTS	HEIGHT GROUP		
	SHORT (≤ Mean - 1 σ)	MEDIUM (= Mean ± 1 σ)	TALL (≥ Mean + 1 σ)
Centre front	27.00 cm* to 33.09 cm	33.10 cm to 38.70 cm	38.71 cm to 43.60 cm*
Centre back	33.00 cm* to 37.64 cm	37.65 cm to 43.97 cm	43.98 cm to 47.90 cm*
Front shoulder height	34.70 cm* to 39.85 cm	39.86 cm to 45.49 cm	45.50 cm to 50.40 cm*
Back shoulder height	35.60 cm* to 39.44 cm	39.45 cm to 46.41 cm	46.42 cm to 55.80 cm*
Bust-to-waist	10.70 cm* to 14.74 cm	14.75 cm to 20.31 cm	20.32 cm to 24.50 cm*
Side seam	19.00 cm* to 20.73 cm	20.74 cm to 28.58 cm	28.59 cm to 37.90 cm*
Waist-to-hip	9.30 cm* to 15.56 cm	15.57 cm to 24.63 cm	24.64 cm to 29.80 cm*
Waist-to-knee	39.00 cm* to 47.55 cm	47.56 cm to 57.44 cm	57.45 cm to 63.00 cm*

* Minimum and maximum values.

TABLE 4.9: DISTRIBUTION OF THE 3D BODY SCANS INTO DIFFERENT HEIGHT GROUPS (n = 64)

VERTICAL MEASUREMENT	SHORT		MEDIUM		TALL	
Centre front	7.00	10.94%	49.00	76.56%	8.00	12.50%
Centre back	10.00	15.63%	42.00	65.63%	12.00	18.75%
Front shoulder height	11.00	17.19%	43.00	67.19%	10.00	15.63%
Back shoulder height	8.00	12.50%	45.00	70.31%	11.00	17.19%
Bust-to-waist	10.00	15.63%	45.00	70.31%	9.00	14.06%
Side seam	9.00	14.06%	43.00	67.19%	12.00	18.75%
Waist-to-hip	15.00	23.44%	41.00	64.06%	8.00	12.50%
Waist-to-knee	11.00	17.19%	41.00	64.06%	12.00	18.75%
Average	10.13	15.82%	43.63	68.16%	10.25	16.02%

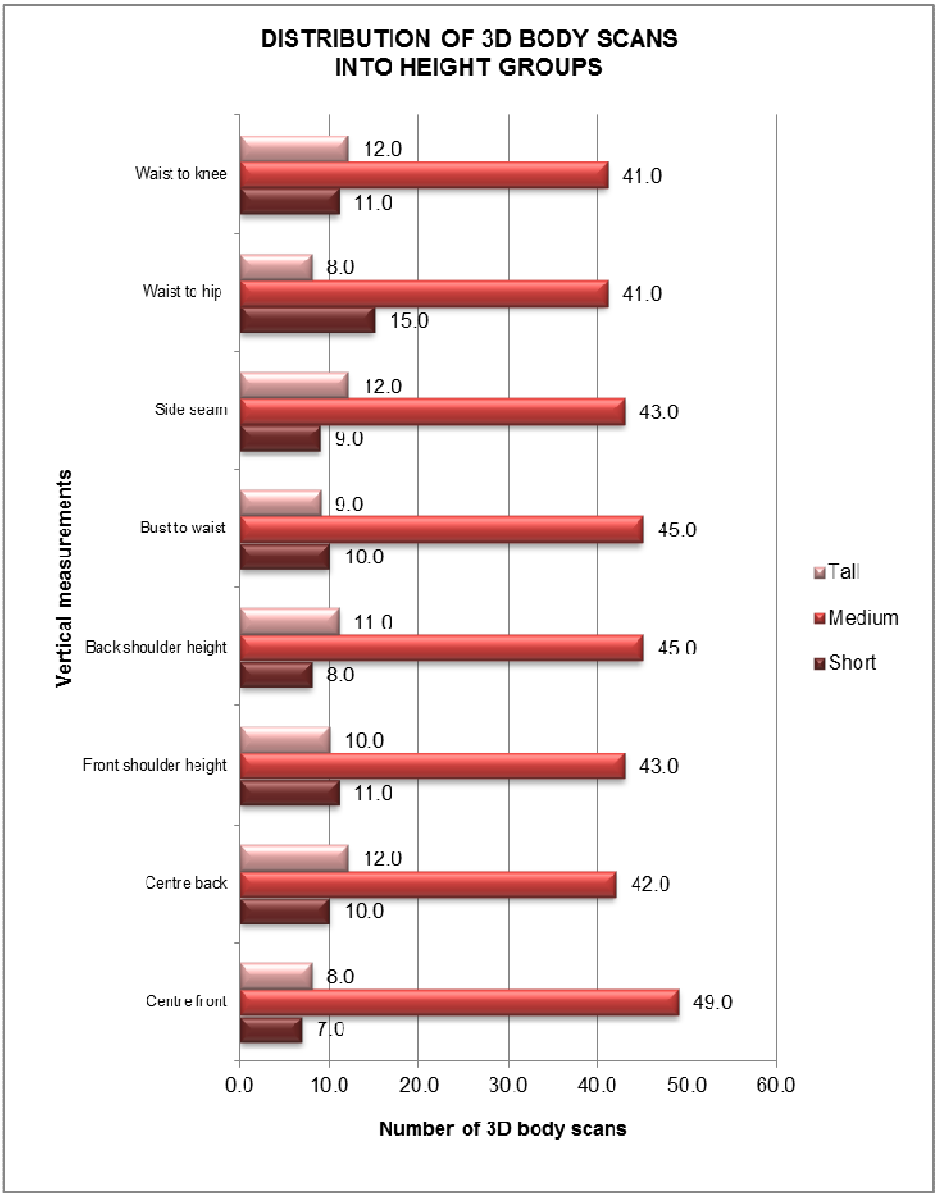


FIGURE 4.14: DISTRIBUTION OF THE 3D BODY SCANS INTO HEIGHT GROUPS (n = 64)

Since the correlation analysis indicated a poor relationship between the horizontal measurements and the vertical measurements, regression analysis was not used to calculate the vertical measurements for the experimental size specifications. With the vertical measurements grouped into different height groups, the mean for each vertical measurement was then calculated in Microsoft Excel 2007. The mean vertical measurements of the medium height group are shown in table 4.10. The vertical measurements were kept constant throughout the size range, i.e. the vertical measurements did not increase with an increase in the horizontal measurements, as the findings of the bivariate correlation analysis indicated a poor relationship between the horizontal measurements and the vertical measurements.

TABLE 4.10: THE MEAN VERTICAL MEASUREMENTS OF THE MEDIUM HEIGHT GROUP

VERTICAL MEASUREMENT	MEAN VERTICAL MEASUREMENTS FOR MEDIUM HEIGHT GROUP	NUMBER OF BODY SCANS IN MEDIUM GROUP (n)*
Centre front	35.80 cm	49.00 (76.56%)
Centre back	40.38 cm	42.00 (65.63%)
Front shoulder height	42.59 cm	43.00 (67.19%)
Back shoulder height	42.29 cm	45.00 (70.31%)
Bust-to-waist	17.40 cm	45.00 (70.31%)
Side seam	23.92 cm	43.00 (67.19%)
Waist-to-hip	21.26 cm	41.00 (64.06%)
Waist-to-knee	52.91 cm	41.00 (64.06%)

*The mean number of 3D body scans falling into medium height group was 43.63 or 68.16% for all vertical measurements.

4.5 THE OUTPUT: THE EXPERIMENTAL SIZE SPECIFICATIONS

Having completed the statistical analysis, the values of the key dimensions, secondary dimensions, and the grade between sizes were tabulated together to create the experimental size specifications for the body measurements required for a basic sheath dress for South African female students of African descent with triangular body shapes in the size 6/30 to size 14/38 size range. If the experimental size specifications were to be used to construct garments for the students in the subset of the anthropometric database used in the study, the experimental size specifications would accommodate 85.94% of the sample in terms of horizontal measurements and 68.16% of the sample in terms of vertical measurements (Beazley, 1998:277). The experimental size specifications, the output of the system depicted in figure 4.1, are shown in table 4.11.

It must be noted that the experimental size specifications developed in the study are not representative of the South African population due to the exploratory nature of this study and the unrepresentative anthropometric data that was used in the study. For any sizing system to be successful in producing garments with acceptable quality of fit, the sizing system has to be based on representative anthropometric data as previously mentioned (Mastamet-Mason *et al.*, 2008:10; Strydom & De Klerk, 2006:80; Le Pechoux & Ghosh, 2002:11).

TABLE 4.11: THE EXPERIMENTAL SIZE SPECIFICATIONS

EXPERIMENTAL SIZE SPECIFICATIONS (BODY MEASUREMENTS)									
Size range:	6/30 – 14/38								
Age group:	18 to 25 years								
Garment:	Sleeveless basic sheath dress								
Body shape:	Triangular								
Height group:	Medium								
Population group:	South African female students African descent at the University of Pretoria								
	SIZE								
Horizontal Measurements	**6/30**	**Grade**	**8/32**	**Grade**	**10/34**	**Grade**	**12/36**	**Grade**	**14/38**
Bust	81.00	-4.00	85.00	-4.00	89.00	4.00	93.00	4.00	97.00
Waist	70.08	-3.28	73.36	-3.28	76.64	3.28	79.92	3.28	83.20
Hips	96.37	-4.05	100.42	-4.05	104.47	4.05	108.51	4.05	112.56
Shoulder	11.05	-0.25	11.29	-0.25	11.54	0.25	11.78	0.25	12.03
Across chest	29.05	-1.21	30.27	-1.21	31.48	1.21	32.69	1.21	33.90
Across back	31.05	-0.72	31.77	-0.72	32.49	0.72	33.21	0.72	33.93
Bust span	17.66	-0.35	18.01	-0.35	18.36	0.35	18.70	0.35	19.05
Vertical Measurements	**6/30**	**Grade**	**8/32**	**Grade**	**10/34**	**Grade**	**12/36**	**Grade**	**14/38**
Centre front	35.80	0.00	35.80	0.00	35.80	0.00	35.80	0.00	35.80
Centre back	40.38	0.00	40.38	0.00	40.38	0.00	40.38	0.00	40.38
Front shoulder height	42.59	0.00	42.59	0.00	42.59	0.00	42.59	0.00	42.59
Back shoulder height	42.29	0.00	42.29	0.00	42.29	0.00	42.29	0.00	42.29
Bust-to-waist	17.40	0.00	17.40	0.00	17.40	0.00	17.40	0.00	17.40
Side seam	23.92	0.00	23.92	0.00	23.92	0.00	23.92	0.00	23.92
Waist-to-hip	21.26	0.00	21.26	0.00	21.26	0.00	21.26	0.00	21.26
Waist-to-knee	52.91	0.00	52.91	0.00	52.91	0.00	52.91	0.00	52.91

*All measurements are in centimetres

4.6 CONCLUSION

In this chapter, the experimental size specifications for South African female students of African descent with triangular body shapes were developed within the general systems theory. The experimental size specifications were developed by statistically analysing an anthropometric database of female students of African descent with a triangular body shape.

Statistical techniques, such as bivariate correlation analysis and least-squares regression analysis, were used in the development of the experimental size specifications. The chapter concluded by presenting the proposed experimental size specifications for South African female students of African descent with triangular body shapes.

With the experimental size specifications developed, the quality of fit attained from the experimental size specifications and the traditional size specifications will be evaluated in the next chapter to determine whether the experimental size specifications offer improved overall quality of fit for South African female students of African descent with a triangular body shape.

CHAPTER 5

PHASE TWO: FIT EVALUATION

5.1 INTRODUCTION

In phase two of the study, the quality of fit attained from the experimental size specifications and the traditional size specifications was evaluated through quantitative evaluative experimental research using the one-group pretest-posttest pre-experimental design. In one-group pretest-posttest pre-experimental designs, a single group is evaluated prior to the implementation of the intervention (pretest), and evaluated after the implementation of the intervention (posttest) (Leedy & Ormrod, 2010:230). The quality of fit attained from the traditional size specifications was evaluated in the pretest, and compared to the quality of fit attained from the experimental size specifications in the posttest.

5.2 METHODS AND PROCEDURES

5.2.1 Experimental design

Experimental research designs, allow the researcher to observe what would happen if something is changed by manipulating one or more variables (Flynn & Foster, 2009:136; Melville & Goddard, 1996:3). In experimental research, one or more independent variables are manipulated by the researcher and lead to a change in the dependent variable (Flynn & Foster, 2009:139; Melville & Goddard, 1996:3). The independent variable is the variable that is deliberately manipulated (to determine the effect of the change), while the dependent variable is the effect that is observed from the manipulation of the independent variable (Flynn & Foster, 2009:139; Melville & Goddard, 1996:27). In the context of this study, the traditional size specifications and the experimental size specifications were the two independent variables, with the quality of fit attained from both sets of size specifications being the dependent variables. The independent variables and dependent variables are shown in table 5.1.

TABLE 5.1: THE INDEPENDENT VARIABLES AND DEPENDENT VARIABLES

SAMPLE GROUP	INDEPENDENT VARIABLE	DEPENDENT VARIABLE
Pretest	Traditional size specifications	Quality of fit
Posttest	Experimental size specifications	Quality of fit

According to Zikmund and Babin (2007:177), in experimental research "an independent variable is manipulated over two treatment levels resulting in two groups, an experimental group and a control group". The experimental group is the group that the experimental treatment is administered to, while the control group is the comparison group that receives no experimental treatment (Zikmund & Babin, 2007:177; Trochim, 2001:192; Melville & Goddard, 1996:29). In the study, the test garments developed from the experimental size specifications represented the experimental group as the experimental size specifications were specially developed for the unit of analysis. The test garments developed from the traditional size specifications were considered as the control group since they were developed from sizing currently (i.e. traditional) used in the apparel industry.

The experimental design is summarized as follows:

FIGURE 5.1: THE EXPERIMENTAL DESIGN

5.2.2 The development of the test garments

5.2.2.1 The development of the test garments sized according to the traditional size specifications

To develop the test garments sized according to the traditional size specifications (i.e. current sizing used in the apparel industry), a basic sheath dress was first drafted to fit the *Figure Forms* size 10/34 dress form used widely in the South African apparel industry and then graded into different sizes using a commonly used grading system. The shape of the dress form used in the study closely resembles the ideal body shape on which current apparel sizing is predominantly based on, and is widely used in the South African apparel industry.

The basic sheath dress was drafted according to the method set out in the patternmaking text *Make your own patterns* by Bergh (1995), using free2Design[16] software (version 2007.1.106.3). The researcher has previously used the method of drafting a basic sheath dress in Bergh (1995) and found Bergh's method to produce satisfactory quality of fit. The amount of ease included in the major circumferences of the basic sheath dress is shown in table 5.2. Due to the close fit required for this study, the ease allowances given in table 5.2 were considered appropriate.

TABLE 5.2: EASE INCLUDED IN THE BASIC SHEATH DRESS

LOCATION	EASE
Bust	4 cm
Waist	2 cm
Hip	4 cm

The size 10/34 basic sheath dress was then graded into different sizes using free2Design. It would have been ideal to use a grading system from the apparel industry to grade the size 10/34 basic sheath dress; however, it was difficult to do so since grading systems are priority information and are closely guarded in the apparel industry (Burns, & Bryant, 1997:256). The 1 ½ inch (3.81 cm) simplified two-dimensional grading system set out in the academic text used in pattern grading instruction at the University of Pretoria, *Professional pattern grading for women's, men's, and children's apparel* by Handford (2003), was selected to grade the patterns. The grading system in Handford's text is a simplified two-dimensional grading system. Simplified two-dimensional grading systems are commonly used in the apparel industry and in most academic pattern grading texts because of the ease of learning and the ease of use (Mullet *et al*., 2009:7-8). The nests of traditionally graded patterns, shown in figure 5.2, were plotted in full-scale and were used to cut the traditional test garments.

5.2.2.2 The development of the test garments sized according to the experimental size specifications

To develop the experimental test garments, a basic sheath dress was drafted to fit the measurements of the smallest size (size 6/30) and the largest size (size 14/38) included in the experimental size specifications according to the method set out in Bergh (1995) using free2Design. The amount of ease added to the patterns drafted for the experimental test garments, was the same amount of ease that was added to the patterns drafted for the traditional test garments. Patterns for the full size range were obtained from the patterns of

[16] free2Design is an open source technical drawing computer program similar in functionality to AutoCAD.

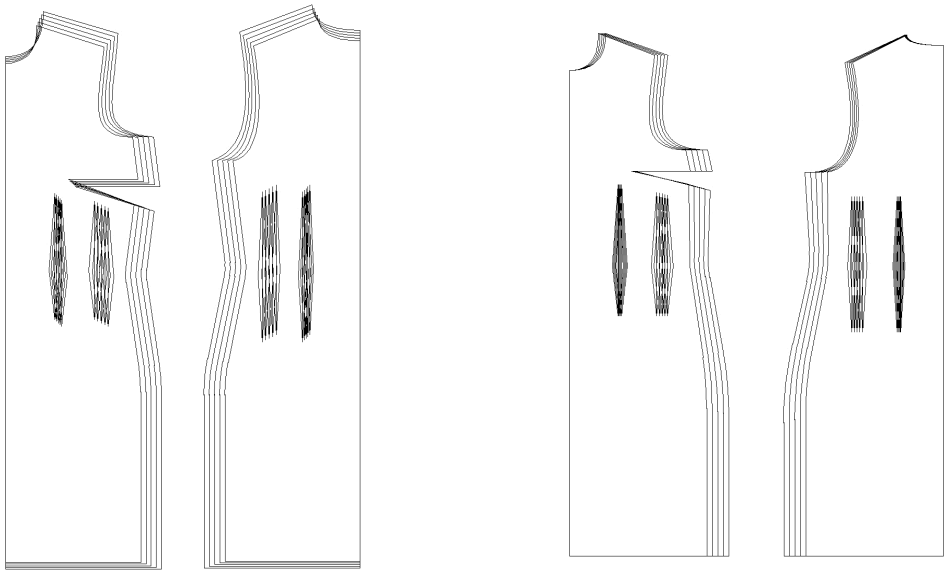
the smallest size and the patterns of the largest size through the superimposed method of grading.

The superimposed method of grading, also referred to as two-pattern grading or proportional grading, requires two sets of master patterns (Schofield, 2007:167; Defty, 1984:3). The two patterns are made in two different sizes, usually the largest size in the size range and the smallest size in the size range (Aldrich, 2008:172; Defty, 1984:3). The two sets of patterns are then superimposed onto each other with a common zero point (Bond, Liao & Turner, 2000:108; Taylor & Shoben, 1984:63). Patterns for intermediate sizes are obtained by drawing vectors to connect the cardinal points of the smallest and the largest size; equidistant points corresponding to the number of sizes between the two cardinal points are then added along the vector (Cooklin, 1992:36). The perimeter of the pattern for each size is completed by connecting the points (for each size) along the vectors with straight lines and curved lines. The superimposed method of grading is the most accurate grading method since it eliminates any possibility of style distortion that may arise from other methods of grading (Aldrich, 2008:172; Defty, 1984:3).

The nests of experimentally graded patterns, shown in figure 5.2, were plotted in full-scale and were used to cut the experimental test garments. The nests of experimentally graded patterns in figure 5.2 despite being graded using the superimposed method of grading, resemble a nest of patterns graded according to a traditional two-dimensional grading system, since the circumference measurements were divided equally between the front and the back patterns when the patterns were drafted.

5.2.2.3 Construction of the test garments

All test garments were constructed by the researcher from gingham using the same construction techniques, to ensure uniformity in the appearance of the test garments and to avoid creating bias during fit evaluation (Murphey, 1993:65). Gingham was selected for the construction of the test garments because the lengthwise grain and crosswise grain are clearly visible, and will make fit evaluation easier. The sheath dress had a centre back zipper opening. Closed seams, finished with an overlocker, were used throughout the dress, with the exception of the open seam at centre back on which the zipper was inserted. The neckline and armholes were finished with bias binding. The hem was folded and topstitched by machine.



TRADITIONAL PATTERNS EXPERIMENTAL PATTERNS

FIGURE 5.2: NESTS OF GRADED PATTERNS

5.2.3 Sample size

Considering the exploratory nature of the study and the time-consuming nature of fit evaluation (Petrova & Ashdown, 2008:234), quality of fit was evaluated on a non-representative sample of one participant per size. However, the quality of fit attained from the traditional size specifications and the experimental size specifications was only evaluated up to size 12/36 as there were no individuals wearing size 14/38 willing to participate in the study.

5.2.4 Sampling criteria

Non-probability purposive sampling was used to select the participants for the fit quality evaluation. Non-probability purposive sampling techniques do not represent all members of the population in the sample because the researcher selects participants that have a particular characteristic (Leedy & Ormrod, 2010:212; Strydom, 2005:202). To address the research problem and to enhance the validity and the reliability of the findings, the participants of the study had to comply with the following criteria to qualify for participation in the study:

5.2.4.1 Geographic location

The population from which the sample was drawn was limited to the students of the University of Pretoria; the anthropometric database used in the study does not represent the general South African population since it consists of data gathered from the students of the University of Pretoria. Furthermore, the shapes and sizes of people vary according to geographic location (Yu, 2004b:183; Taylor, 1990:54).

5.2.4.2 Population group

The participants of the study had to be of African descent. Women of African descent are not currently adequately catered for by current apparel sizing systems since they have been predominantly found to have triangular body shapes as it was stated in the introduction of the study.

5.2.4.3 Age group

The participants of the study had to be aged between 18 and 25 years because the anthropometric database used in the study consisted of 3D body scans of female students aged between 18 and 25 years. Furthermore, according to Taylor (1990:51), it is “advisable to break up the population into (different) age groups … starting from the point growth stops”, since size and shape change throughout a person’s lifetime and through different generations (Hsu, 2009:200; Le Pechoux & Ghosh, 2002:2).

5.2.4.4 Vertical measurements

As previously mentioned, the experimental size specifications were developed for female students of medium height. Since it was not possible to extract height from the 3D body scans, the centre back length was used as a substitute vertical measurement to select the participants for the fit evaluation. All vertical measurements including height, according to Gupta and Gangadhar (2004:463), have good correlation with each other. Therefore, the participants to be considered for participation had to have centre back lengths that fell into the range of 37.65 cm to 43.97 cm, the minimum and maximum values for the medium height group as shown in table 4.8.

5.2.4.5 Key body dimensions

The participants, to be considered for selection in the study had to have bust, waist, and hip dimensions that were similar to those included in the experimental size specifications developed in the study. The key dimensions for the different sizes are shown in table 5.3, with the actual dimensions of the participants shown in table 5.4. The participants selected for the study, despite not having the exact measurements required for participation in the study, were selected because most of their measurements were close to the required body measurements.

TABLE 5.3: KEY BODY DIMENSIONS FOR PARTICIPANT SELECTION

PARTICIPANT	A	B	C	D	E
SIZE	6/30	8/32	10/34	12/36	14/38
Bust	81.00 cm	85.00 cm	89.00 cm	93.00 cm	97.00 cm
Waist	70.08 cm	73.36 cm	76.64 cm	79.92 cm	83.20 cm
Hip	96.37 cm	100.42 cm	104.47 cm	108.51 cm	112.56 cm

TABLE 5.4: ACTUAL BODY DIMENSIONS OF THE PARTICIPANTS

PARTICIPANT	A	B	C	D	E*
SIZE	6/30	8/32	10/34	12/36	14/38
Bust	80.00 cm	89.00 cm	90.00 cm	92.00 cm	-
Waist	73.00 cm	71.00 cm	74.50 cm	77.00 cm	-
Hip	98.00 cm	100.00 cm	103.50 cm	110.50 cm	-
Centre back	40.00 cm	38.00 cm	42.00 cm	39.00 cm	-

* There were no individuals wearing size 14/38 willing to participate in the study.

5.2.5 Sampling procedure

The participants of the study were recruited through word of mouth and snowball sampling. Interested participants were screened against the participant selection criteria. The participants that met the selection criteria were informed of the following:

- The objectives of the study
- What is expected of them during the data gathering process
- The time required to participate in the study
- How the data gathered will be processed
- That participation in the study is voluntary
- Their right of terminating their participation in the study at anytime

Once a participant had given their consent to participate in the study, participants were required to sign a participant consent form prior to taking part in the study. To thank the participants for their time, each participant was compensated with R 150.

5.2.6 Data collection

The participants for the fit evaluation were recruited through the procedure outlined in section 5.2.4 and section 5.2.5. Private fit sessions were scheduled with each participant. Prior to the start of each fit session the participants were once again informed of the purpose of the study, what is expected from them, and their rights, as described in section 5.2.5. Participants were required to sign a participant consent form before taking part in the study.

A panel of three professionals with experience in apparel fit evaluation evaluated the quality of fit of the test garments. The professionals were not involved in the study in order to increase the objectivity of the fit evaluation. The professionals were given the standards on which to evaluate the quality of fit of the test garments in order to enhance interrater reliability since the concept of appropriate fit varies amongst people (Ashdown & O'Connell, 2006:137; Leedy & Ormrod, 2010:93; Schofield, 2000:16). The standards that were used evaluate the quality of fit of the test garments are presented in table 5.6. Each member of the panel independently evaluated the quality of fit of the test garments during the fit evaluation sessions. The test garments were labelled A to H to avoid creating size perception bias (Campbell & Horne, 2001:188).

5.2.7 Measuring instrument

A comprehensive questionnaire was compiled to evaluate the quality of fit of the test garments. The questionnaire, adapted from Yu's fit evaluation scale (Yu, 2004a:39), was used to address objective two. The questionnaire was a systematic and structured method of evaluating the quality of fit of the test garments in a precise and easily quantifiable manner (Mothibi, 2007:14). The questionnaire evaluated several areas of a test garment, such as the neckline, the shoulders, the bust, and the waist amongst others, in order to determine the quality of fit of the test garments. The questionnaire utilised modified versions of semantic differential scales to measure the quality of fit of a particular area of a test garment. Semantic differential scales measure concepts "using a series of … bipolar rating scales" (Zikmund & Babin, 2007:216). The modified semantic differential scales consisted of nine categories that ranged from one extreme to the other, with bipolar statements describing the extreme ends of each scale (Delport, 2005:184). The bipolar statements explained the fitting problems that

are observable at a particular area of a test garment in order to measure the quality of fit of the test garment in that area. For instance, to measure the quality of fit of the test garment over the bust, two bipolar statements such as "*the bodice is too tight over the bust*" and "*the bodice is too loose over the bust*" were formulated. The middle position of each scale indicated good quality of fit (Yu, 2004a:38).

The bipolar statements were accompanied by graphics to explain the bipolar statements visually. The graphics were obtained from Liechty, Rasband, and Pottberg (2010), Myers-McDevitt (2009), Rasband (1994), and Kirshon (1985). The bipolar statements used in the questionnaire to measure the quality of fit of the test garments were based on the standards of apparel fit and the principles of apparel fit. The semantic differential scales were supplemented with a few open-ended questions to measure aspects of apparel fit that could not be measured accurately using the semantic differential scales. A self-anchored rating scale measuring the overall quality of fit of a test garment on a scale of one to nine was included at the end of the questionnaire, with a rating of 1 representing poor quality of fit and a rating of 9 representing good quality of fit. The structure of the questionnaire is shown in table 5.5, with a copy of the actual questionnaire included in addendum B.

The questionnaire was compiled after an in-depth review of literature on the standards of apparel fit and the principles of apparel fit in order to attain criterion validity. The standards of apparel fit relevant to the test garments were compiled from the literature reviewed. The principles of apparel fit that each standard of apparel fit correlates with were also identified. Questions were then compiled to evaluate the quality of fit of the test garments based on the standards of apparel fit and the principles of apparel fit that were identified as relevant to the test garments. The standards of apparel fit that were applicable to the test garments were given to the professionals as the criteria on which to evaluate the quality of fit of the test garments. Table 5.6 presents the standards of apparel fit, which were identified as applicable to the test garments, along with the principles of apparel fit that correlate with each standard. The corresponding question numbers in the questionnaire that measure each standard are also presented on the table.

The initial questionnaire was scrutinised by the two supervisors; the wording, content, and use of concepts in the questionnaire was checked. Suggestions were made to swap the sequence of two questions and to split one double-barrelled question; the suggestions were attended to in the final version of the questionnaire. The questionnaire contained instructions on how to complete each question correctly.

TABLE 5.5: THE STRUCTURE OF THE QUESTIONNAIRE

QUESTION	ASPECT MEASURED	QUESTION TYPE	SCALES OF MEASUREMENT
1	The fit of the test garment around the neckline	Nine-point semantic differential graphic scale	Ordinal
2	The fit of the test garment across the shoulders	Nine-point semantic differential graphic scale	Ordinal
3	The alignment of the shoulders of the test garment with the shoulders of the participant	Nine-point semantic differential graphic scale	Ordinal
4	The fit of the test garment across the chest	Nine-point semantic differential graphic scale	Ordinal
5	The fit of the test garment across the upper back	Nine-point semantic differential graphic scale	Ordinal
6	The fit of the test garment around the armhole	Nine-point semantic differential graphic scale	Ordinal
7	The fit of the test garment around the bust	Nine-point semantic differential graphic scale	Ordinal
8	The position of the bust on the test garment	Nine-point semantic differential graphic scale	Ordinal
9	The fit of the test garment around the midriff	Nine-point semantic differential graphic scale	Ordinal
10	The position of the waist on the test garment	Nine-point semantic differential graphic scale	Ordinal
11	The fit of the test garment around the waist	Nine-point semantic differential graphic scale	Ordinal
12	The fit of the test garment over the abdomen	Nine-point semantic differential graphic scale	Ordinal
13	The position of the hips on the test garment	Nine-point semantic differential graphic scale	Ordinal
14	The fit of the test garment around the upper hips	Nine-point semantic differential graphic scale	Ordinal
15	The fit of the test garment around the hips	Nine-point semantic differential graphic scale	Ordinal
16	The set of the hem at the front of the test garment	Nine-point semantic differential graphic scale	Ordinal
17	The set of the hem at the back of the test garment	Nine-point semantic differential graphic scale	Ordinal
18	The alignment of centre front and centre back	Open-ended question	Nominal
19	The alignment of the crosswise grain throughout the test garment	Open-ended question	Nominal
20	The alignment of the lengthwise grain throughout the test garment	Open-ended question	Nominal
21	The overall fit of the test garment	Self-anchored rating scale	Ordinal

TABLE 5.6: FIT STANDARDS

	FIT STANDARD	FIT PRINCIPLES	QUESTION NUMBER	REFERENCE
1	The shoulder seam rests centred on top of the shoulder, pointing towards and ending at the shoulder joint.	Line	1;2	Liechty, Rasband & Pottberg, 2010:60; Myers-McDevitt, 2009:243; Bye *et al.*, 2008:82; Brown & Rice, 2001:160; Rasband, 1994:34; Kirshon, 1985:196; Colton, 1976:97.
2	The garment fits smoothly across the shoulders without excess ease or strain.	Set; ease	2; 3	Brown & Rice, 2001:160.
3	The neckline fits smoothly around the base of the neck with no strain or gaping.	Line; set; ease	1	Liechty e*t al.*, 2010:60; Myers-McDevitt, 2009:242; Bye e*t al.*, 2008:82; Brown & Rice, 2001:161; Brown & Rice, 2001:158; Rasband, 1994:34; Kirshon, 1985:196.
4	The armscye is a smooth curve that follows the crease of the arm, fitting smoothly without gaping or cutting into the arm, and rests 1/2 inch below the armpit.	Line; set; ease	2; 3; 4; 5;6	Liechty e*t al.*, 2010:60; Liechty *et al.*, 2010:54; Myers-McDevitt, 2009:243; Bye e*t al.*, 2008:82; Joseph-Armstrong, 2006:39; Brown & Rice, 2001:162; Brown & Rice, 2001:158; Rasband, 1994:34; Kirshon, 1985:196.
5	The garment fits smoothly over the chest and the bust without excess ease or strain.	Set; ease	4; 7; 8	Liechty e*t al.*, 2010:54; Myers-McDevitt, 2009:244; Bye e*t al.*, 2008:83; Brown & Rice, 2001:161; Kirshon, 1985:196.
6	The garment fits smoothly over the upper back without excess ease or strain.	Set; ease	5	Liechty e*t al.*, 2010:60; Myers-McDevitt, 2009:244; Rasband, 1994:34.
7	The waistline of the garment rests on the body's natural waistline, fitting the body closely without strain or excess ease.	Line; set; ease	10; 11	Myers-McDevitt, 2009:245; Bye e*t al.*, 2008:82-93; Brown & Rice, 2001:162; Rasband, 1994:35; Kirshon, 1985:196; Colton, 1976:97.
8	The garment fits smoothly over the abdomen without excess ease or strain.	Set; ease	12	Brown & Rice, 2001:163; Kirshon, 1985:196.
9	The garment fits smoothly over the hips without excess ease or strain.	Line; set; ease	13; 14; 15	Liechty e*t al.*, 2010:54; Myers-McDevitt, 2009:245; Bye e*t al.*, 2008:83; Brown & Rice, 2001:163; Kirshon, 1985:196.
10	The side seams appear to hang vertically centred on the body and perpendicular to the waist and the floor, without pulling to the front or back of the body.	Line; balance; grain; set	7; 12; 14; 15	Liechty e*t al.*, 2010:61; Myers-McDevitt, 2009:244; Bye e*t al.*, 2008:82; Brown & Rice, 2001:158.
11	The skirt falls smoothly (straight down) from below the abdomen/hip to the hem.	Line; balance; grain; set	12; 14; 15	Liechty e*t al.*, 2010:62; Myers-McDevitt, 2009:245; Bye e*t al.*, 2008:83; Joseph-Armstrong, 2006:45; Rasband, 1994:36.
12	The hem hangs evenly, parallel to the floor all around.	Line	16; 17	Liechty e*t al.*, 2010:62; Myers-McDevitt, 2009:245; Joseph-Armstrong, 2006:45; Kirshon, 1985:196; Colton, 1976:97.
13	Centre back and centre front are straight lines aligned with the centre of the body, falling straight down and perpendicular to the floor.	Line; balance; grain; set	18	Liechty e*t al.*, 2010:60; Liechty e*t al.*, 2010:54; Myers-McDevitt, 2009:243; Bye e*t al.*, 2008:82; Brown & Rice, 2001:158; Rasband, 1994:35.
14	The crosswise grain should run parallel to the floor at the hem, hip, bust, chest, and upper back.	Grain; line; balance	16; 17; 19	Liechty e*t al.*, 2010:61; Liechty e*t al.*, 2010:54; Myers-McDevitt, 2009:244; Brown & Rice, 2001:156; Rasband, 1994:35.
15	The lengthwise grain is parallel to centre front and centre back, and perpendicular to the floor.	Line; balance; grain; set	20	Liechty e*t al.*, 2010:61; Myers-McDevitt, 2009:244; Brown & Rice, 2001:156; Rasband, 1994:35.
16	Darts point toward and end short of the fullest part of the body curve they shape, and have smooth dart points.	Line; set	8; 13	Liechty e*t al.*, 2010:60; Liechty e*t al.*, 2010:54; Myers-McDevitt, 2009:244; Brown & Rice, 2001:161; Rasband, 1994:34; Colton, 1976:97.

5.2.8 Analysis of data

Descriptive statistical techniques (i.e. means) were used to determine whether the experimental size specifications offer South African female students of African descent with triangular body shapes with improved quality of fit. Considering the exploratory nature of this study and in view of the small non-representative sample quality of fit was evaluated on, descriptive statistics were considered appropriate for the analysis of the quality of fit of the test garments. The study was not large enough to generate data that could be analysed using inferential statistics. Descriptive statistics were also used in other studies (Zwane & Magagula, 2007; Giddings & Boles, 1990) to analyse the quality of fit of the test garments.

TABLE 5.7: OPERATIONALISATION OF PHASE TWO IN TERMS OF OBJECTIVES AND STATISTICAL METHODS

	OBJECTIVE	STATISTICAL ANALYSIS
2	To evaluate the quality of fit attained from the experimental size specifications and the traditional size specifications to determine whether the experimental size specifications offer South African female students of African descent with triangular body shapes with improved overall quality of fit.	Descriptive statistics (frequencies and means)

In question 1 to question 17 of the fit evaluation questionnaire, the quality of fit of the different areas of the test garments was evaluated. The quality of fit of the different areas of the test garments was evaluated on nine-point semantic differential scales. Prior to calculating the means, the nine categories of the semantic differential scales were reduced to three categories and assigned scores of one to three, with a score of one representing the category of poor quality of fit and a score of three representing the category of good quality of fit as shown in table 5.8. With the quality of fit measured on a scale of -4 to +4, means were not calculated from the raw data since the raw data has the potential of distorting the mean due to the addition of positive and negative numbers[17]. In Schofield *et al.* (2006:158) the fit evaluation data was also summarised into three categories of “good fit”, “moderate fit”, and “poor fit”[18]. The raw data gathered from the professionals is presented in addendum C.

[17] As it was previously mentioned, zero (the middle point of each semantic differential scale) was considered to represent good quality of fit. Thus, if two of the four test garments were each assigned scores of -2 and the other two test garments were each assigned scores of +2, the mean for that particular area would be zero despite none of the test garments having being considered to have good quality of fit.

[18] In Schofield *et al.* (2006:158) five-point measurement scales were used to evaluate the quality of fit of the test garments.

TABLE 5.8: SUMMARISED CATEGORIES FOR QUESTION 1 to 17

NINE-POINT SEMANTIC DIFFERENTIAL SCALE CATEGORY	- 4	- 3	- 2	- 1	0	1	2	3	4
SUMMARISED CATEGORY	Poor quality of fit		Moderate quality of fit		Good quality of fit	Moderate quality of fit		Poor quality of fit	
SUMMARISED SCORE	1		2		3	2		1	

The overall quality of fit of the test garments was measured on a nine-point self-anchored rating scale in question 21 of the fit evaluation questionnaire. In the fit evaluation questionnaire, a rating of 1 represented poor quality of fit whereas a rating of 9 represented good quality of fit. The data from question 21 was not summarised since all values were positive.

The means for the quality of fit of the experimental test garments and the means for the quality of fit of the traditional test garments were compared to determine whether the experimental size specifications offer South African female students of African descent with triangular body shapes with improved overall quality of fit. The test garments with the highest mean were considered to have improved overall quality of fit.

5.3 FINDINGS

This section (5.3) is divided into three sections; section 5.3.1 relates to the quality of fit attained from the traditional size specifications, whereas section 5.3.2 relates to the quality of fit attained from the experimental size specifications. In section 5.3.3, the quality of fit attained from the traditional size specifications will be compared to the quality of fit attained from the experimental size specifications to determine whether the experimental size specifications offer improved quality of fit for South African female students of African descent with a triangular body shape.

The data gathered from questions 1 to 17 and from question 21 is presented in this section. Questions 18 to 20 measured aspects of fit that were related to the alignment of centre front, centre back, and the grain line. The panel of professionals did not identify any considerable problems with the alignment of centre front, centre back, and the grain in the test garments, hence, the data from these three questions is presented in addendum C to avoid repetition.

5.3.1 The quality of fit attained from the traditional size specifications

Sizing in the apparel industry is currently based on the ideal body shape (Zwane & Magagula, 2007:283; LaBat & Delong, 1990:44; Rasband, 1994:12); consequently, the test garments developed from the traditional size specifications have similar bust and hip measurements. With the unit of analysis characterised by hips that are larger than the bust, the participants required a test garment sized according to traditional size specifications that was two sizes larger than a test garment sized according to the experimental size specifications in order to accommodate their larger hips. For instance, Participant B (with body measurements corresponding to the size 8/32 in the experimental size specifications) wore a size 12/36 test garment sized according to the traditional size specifications during the fit evaluation session in order to accommodate her larger hips, as shown in table 5.9.

TABLE 5.9: SIZES WORN BY THE PARTICIPANTS

PARTICIPANT	A	B	C	D
Traditional test garments	10/34	12/36	14/38	16/40
Experimental test garments	6/30	8/32	10/34	12/36

5.3.1.1 Quality of fit of the size 10/34 test garment on participant A

In table 5.10, the evaluation of the quality of fit of the size 10/34 test garment developed according to the traditional size specifications is shown. The test garment was unanimously considered to have good quality of fit around the neckline by all three professionals. Across the shoulders, the test garment was considered to have good quality of fit by one professional, whereas the other professional considered the test garment to have moderate quality of fit due to loose fit. The alignment between the shoulders of the test garment and the shoulders of the participant was considered as a good fit by one professional, whereas the other two professionals considered the alignment as a moderate fit.

Across the chest, all three professionals considered the test garment to have moderate quality of fit due to loose fit. The upper back of the test garment was considered by two professionals to have moderate quality of fit due to loose fit, whereas the third professional considered the test garment to have good quality of fit. The armhole of the test garment was considered to have good quality of fit by all three professionals. Around the bust due to loose fit, one professional considered the test garment to have poor quality of fit, whereas the other two professionals considered the test garment to have moderate quality of fit. The position of the bust on the test garment was jointly agreed by all three professionals to be too low in

relation to the bust of the participant and was considered as a poor fit. The test garment was considered by all three professionals to be loose around the midriff; two professionals considered the test garment to have moderate quality of fit, whereas the third professional considered the test garment to have poor quality of fit.

TABLE 5.10: QUALITY OF FIT OF THE SIZE 10/34 TEST GARMENT DEVELOPED ACCORDING TO THE TRADITIONAL SIZE SPECIFICATIONS

	PROFESSIONAL			MEAN
	A	B	C	
The fit of the test garment around the neckline*	3.00	3.00	3.00	3.00
The fit of the test garment across the shoulders*	-	2.00	3.00	2.50
The alignment of the shoulders of the test garment with the shoulders of the participant*	2.00	2.00	3.00	2.33
The fit of the test garment across the chest*	2.00	2.00	2.00	2.00
The fit of the test garment across the upper back*	3.00	2.00	2.00	2.33
The fit of the test garment around the armhole*	3.00	3.00	3.00	3.00
The fit of the test garment around the bust*	2.00	1.00	2.00	1.67
The position of the bust on the test garment*	1.00	1.00	1.00	1.00
The fit of the test garment around the midriff*	2.00	2.00	1.00	1.67
The position of the waist on the test garment*	2.00	2.00	3.00	2.33
The fit of the test garment around the waist*	2.00	2.00	3.00	2.33
The fit of the test garment over the abdomen*	2.00	2.00	3.00	2.33
The position of the hips on the test garment*	3.00	3.00	3.00	3.00
The fit of the test garment around the upper hips*	2.00	3.00	3.00	2.67
The fit of the test garment around the hips*	2.00	3.00	3.00	2.67
The set of the hem at the front of the test garment*	3.00	3.00	3.00	3.00
The set of the hem at the back of the test garment*	2.00	2.00	3.00	2.33
The overall fit of the test garment#	5.0	4.0	6.0	5.0

*Evaluation scale: 3 = good quality of fit; 2 = moderate quality of fit; 1 = poor quality of fit

In the fit evaluation questionnaire, a rating of 1 represented poor overall quality of fit whereas a rating of 9 represented good overall quality of fit.

Two professionals considered the waist of the test garment to be positioned too low in relation to the waist of the participant and considered the test garment to have moderate quality of fit, whereas the third professional considered the position of the waist on the test garment as a good fit. Around the waist, the test garment was considered by two professionals to have moderate quality of fit due to loose fit, whereas the third professional considered the test garment to have good quality of fit. The test garment was considered to have good quality of fit over the abdomen by one professional, whereas the other two professionals considered the test garment to have moderate quality of fit due to loose fit. All three professionals rated the position of the hips of the test garment as a good fit. The test garment was considered to have good quality of fit around the upper hips and the hips by two professionals, whereas the third professional considered the test garment to have moderate

quality of fit due to tight fit. There were no problems observed with the set of the hem at the front of the test garment since all three professionals considered the test garment to have good quality of fit. The hem at the back of the test garment was considered to have moderate quality of fit by two professionals since they considered the hem to be pulling up at centre back, whereas the third professional considered the hem at the back of the test garment to have good quality of fit.

5.3.1.2 Quality of fit of the size 12/36 test garment on participant B

In table 5.11, the evaluation of the quality of fit of the size 12/36 test garment developed according to the traditional size specifications is shown. The test garment was considered to have good quality of fit around the neckline by all three professionals. Across the shoulders, the test garment was considered by one professional to have moderate quality of fit due to loose fit, whereas the other two professionals considered the test garment to have good quality of fit. All three professionals considered the alignment between the shoulders of the test garment and the shoulders of the participant as a good fit.

Across the chest, all three professionals considered the test garment to have moderate quality of fit due to loose fit. The test garment was considered to have moderate quality of fit across the upper back by all three professionals due to loose fit. Around the armhole, the test garment was considered to have good quality of fit by one professional, whereas the other two professionals considered the test garment to have moderate quality of fit due to loose fit. All three professionals considered the test garment to have moderate quality of fit around the bust due to loose fit. The position of the bust on the test garment was jointly agreed by all three professionals to be too low in relation to the bust of the participant; two professionals considered the test garment to have moderate quality of fit, whereas the third professional considered the test garment to have poor quality of fit.

Around the midriff the test garment was considered to have loose fit by all three professionals; two professionals considered the test garment to have moderate quality of fit, whereas the third professional considered the test garment to have poor quality of fit. One professional considered the waistline of the test garment to be well aligned with the waistline of the participant, whereas the other two professionals considered the waistline of the test garment to be positioned too low in relation to the waistline of the participant. All three professionals considered the test garment to have moderate quality of fit around the waist due to loose fit. The test garment was considered to have moderate quality of fit over the

abdomen by two professionals due to loose fit, whereas the third professional considered the test garment to have good quality of fit.

TABLE 5.11: QUALITY OF FIT OF THE SIZE 12/36 TEST GARMENT DEVELOPED ACCORDING TO THE TRADITIONAL SIZE SPECIFICATIONS

	PROFESSIONAL			MEAN
	A	B	C	
The fit of the test garment around the neckline*	3.00	3.00	3.00	3.00
The fit of the test garment across the shoulders*	3.00	3.00	2.00	2.67
The alignment of the shoulders of the test garment with the shoulders of the participant*	3.00	3.00	3.00	3.00
The fit of the test garment across the chest*	2.00	2.00	2.00	2.00
The fit of the test garment across the upper back*	2.00	2.00	2.00	2.00
The fit of the test garment around the armhole*	3.00	2.00	2.00	2.33
The fit of the test garment around the bust*	2.00	2.00	2.00	2.00
The position of the bust on the test garment*	2.00	1.00	2.00	1.67
The fit of the test garment around the midriff*	2.00	2.00	1.00	1.67
The position of the waist on the test garment*	2.00	3.00	2.00	2.33
The fit of the test garment around the waist*	2.00	2.00	2.00	2.00
The fit of the test garment over the abdomen*	2.00	3.00	2.00	2.33
The position of the hips on the test garment*	3.00	3.00	3.00	3.00
The fit of the test garment around the upper hips*	3.00	3.00	2.00	2.67
The fit of the test garment around the hips*	3.00	3.00	3.00	3.00
The set of the hem at the front of the test garment*	3.00	2.00	3.00	2.67
The set of the hem at the back of the test garment*	2.00	1.00	2.00	1.67
The overall fit of the test garment#	6.0	4.0	5.0	5.0

*Evaluation scale: 3 = good quality of fit; 2 = moderate quality of fit; 1 = poor quality of fit

In the fit evaluation questionnaire, a rating of 1 represented poor overall quality of fit whereas a rating of 9 represented good overall quality of fit.

All three professionals considered the placement of the hips on the test garment as a good fit. The test garment was considered to have good quality of fit around the upper hips by two professionals, whereas the third professional considered the test garment to have moderate quality of fit due to loose fit. Around the hips, the test garment was unanimously considered to have good quality of fit by all three professionals.

Two professionals considered the test garment to have no problems with the set of the hem at the front, whereas one professional considered the set of the hem at the front of the test garment to have moderate quality of fit due to the hem sagging at centre front. Due to the hem pulling up at the centre back of the test garment, two professionals considered the test garment to have moderate quality of fit, whereas the third professional considered the test garment to have poor quality of fit.

5.3.1.3 Quality of fit of the size 14/38 test garment on participant C

In table 5.12, the evaluation of the quality of fit of the size 14/38 test garment developed according to the traditional size specifications is shown. The test garment was considered to have good quality of fit around the neckline by two professionals, whereas the third professional considered the test garment to have moderate quality of fit due to loose fit. Across the shoulders, the test garment was considered to have moderate quality of fit by all three professionals due to loose fit. All three professionals considered the alignment between the shoulders of the test garment and the shoulders of the participant as a good fit.

TABLE 5.12: QUALITY OF FIT OF THE SIZE 14/38 TEST GARMENT DEVELOPED ACCORDING TO THE TRADITIONAL SIZE SPECIFICATIONS

	PROFESSIONAL			MEAN
	A	B	C	
The fit of the test garment around the neckline*	3.00	3.00	2.00	2.67
The fit of the test garment across the shoulders*	2.00	2.00	2.00	2.00
The alignment of the shoulders of the test garment with the shoulders of the participant*	3.00	3.00	3.00	3.00
The fit of the test garment across the chest*	2.00	2.00	2.00	2.00
The fit of the test garment across the upper back*	3.00	3.00	3.00	3.00
The fit of the test garment around the armhole*	2.00	3.00	3.00	2.67
The fit of the test garment around the bust*	3.00	2.00	2.00	2.33
The position of the bust on the test garment*	2.00	2.00	2.00	2.00
The fit of the test garment around the midriff*	2.00	3.00	2.00	2.33
The position of the waist on the test garment*	2.00	3.00	2.00	2.33
The fit of the test garment around the waist*	3.00	3.00	2.00	2.67
The fit of the test garment over the abdomen*	3.00	-	3.00	3.00
The position of the hips on the test garment*	3.00	3.00	3.00	3.00
The fit of the test garment around the upper hips*	2.00	3.00	3.00	2.67
The fit of the test garment around the hips*	3.00	3.00	3.00	3.00
The set of the hem at the front of the test garment*	3.00	3.00	3.00	3.00
The set of the hem at the back of the test garment*	2.00	3.00	2.00	2.33
The overall fit of the test garment#	7.0	7.0	6.0	6.7

*Evaluation scale: 3 = good quality of fit; 2 = moderate quality of fit; 1 = poor quality of fit

In the fit evaluation questionnaire, a rating of 1 represented poor overall quality of fit whereas a rating of 9 represented good overall quality of fit.

Across the chest, all three professionals considered the test garment to have moderate quality of fit due to loose fit. The test garment was considered to have good quality of fit across the upper back by all three professionals. The armhole of the test garment was considered by two professionals to have good quality of fit, whereas the third professional considered the test garment to have moderate quality of fit due to tight fit. The test garment was considered to have good quality of fit around the bust by one professional, whereas the

other two professionals considered the test garment to have moderate quality of fit due to loose fit. The position of the bust on the test garment was mutually considered to be too low in relation to the bust of the participant by all three professionals; all three professionals considered the test garment to have moderate quality of fit. The test garment was considered to have moderate quality of fit around the midriff by two professionals due to loose fit, whereas the third professional considered the test garment to have good quality of fit.

Two professionals considered the waist of the test garment to be positioned too low in relation to the waist of the participant and considered the test garment to have moderate quality of fit, whereas the third professional considered the position of the waist on the test garment as a good fit. Around the waist, two professionals considered the test garment to have good quality of fit, whereas the third professional considered the test garment to have moderate quality of fit due to loose fit.

The test garment was considered to have good quality of fit over the abdomen by two professionals. All three professionals considered the position of the hips of the test garment as a good fit. The test garment was considered to have good quality of fit around the upper hips by two professionals, whereas the third professional considered the test garment to have moderate quality of fit due to loose fit. All three professionals unanimously agreed that the quality of fit of the test garment around the hips was good.

The hem at the front of the test garment was considered to have good quality of fit by all three professionals. The hem at the back of the test garment was considered to have good quality of fit by one professional, whereas the other two professionals considered the test garment to have moderate quality of fit due to the hem pulling up at centre back.

5.3.1.4 Quality of fit of the size 16/40 test garment on participant D

In table 5.13, the evaluation of the quality of fit of the size 16/40 test garment developed according to the traditional size specifications is shown. All three professionals considered the test garment to have good quality of fit around the neckline. Across the shoulders, two professionals considered the test garment to have good quality of fit, whereas the third professional considered the test garment to have moderate quality of fit due to loose fit. All three professionals considered the alignment between the shoulders of the test garment and the shoulders of the participant as a good fit.

TABLE 5.13: QUALITY OF FIT OF THE SIZE 16/40 TEST GARMENT DEVELOPED ACCORDING TO THE TRADITIONAL SIZE SPECIFICATIONS

	PROFESSIONAL			MEAN
	A	B	C	
The fit of the test garment around the neckline*	3.00	3.00	3.00	3.00
The fit of the test garment across the shoulders*	3.00	2.00	3.00	2.67
The alignment of the shoulders of the test garment with the shoulders of the participant*	3.00	3.00	3.00	3.00
The fit of the test garment across the chest*	2.00	2.00	3.00	2.33
The fit of the test garment across the upper back*	2.00	1.00	2.00	1.67
The fit of the test garment around the armhole*	3.00	1.00	3.00	2.33
The fit of the test garment around the bust*	2.00	1.00	1.00	1.33
The position of the bust on the test garment*	1.00	1.00	1.00	1.00
The fit of the test garment around the midriff*	1.00	2.00	1.00	1.33
The position of the waist on the test garment*	2.00	2.00	2.00	2.00
The fit of the test garment around the waist*	2.00	3.00	3.00	2.67
The fit of the test garment over the abdomen*	2.00	3.00	3.00	2.67
The position of the hips on the test garment*	3.00	3.00	3.00	3.00
The fit of the test garment around the upper hips*	2.00	3.00	3.00	2.67
The fit of the test garment around the hips*	2.00	3.00	3.00	2.67
The set of the hem at the front of the test garment*	3.00	3.00	3.00	3.00
The set of the hem at the back of the test garment*	2.00	2.00	2.00	2.00
The overall fit of the test garment#	5.0	4.0	6.0	5.0

*Evaluation scale: 3 = good quality of fit; 2 = moderate quality of fit; 1 = poor quality of fit

In the fit evaluation questionnaire, a rating of 1 represented poor overall quality of fit whereas a rating of 9 represented good overall quality of fit.

Across the chest, two professionals considered the test garment to have moderate quality of fit due to loose fit, whereas the third professional considered the test garment to have good quality of fit. The test garment was considered to have loose fit across the upper back by all three professionals; two professionals considered the test garment to have moderate quality of fit, whereas the third professional considered the test garment to have poor quality of fit. The armhole of the test garment was considered by two professionals to have good quality of fit, whereas the third professional considered the test garment to have poor quality of fit due to loose fit.

All three professionals considered the test garment to be loose around the bust; two professionals considered the test garment to have poor quality of fit, whereas the third professional considered the test garment to have moderate quality of fit. The bust of the test garment was mutually considered to be situated too low in relation to the bust of the participant by all three professionals; all three professionals considered the position of the bust on the test garment as a poor fit.

Around the midriff, all three professionals considered the test garment to have loose fit; two professionals considered the test garment to have poor quality of fit, whereas the third professional considered the test garment to have moderate quality of fit. All three professionals considered the position of the waist on the test garment to be too low in relation to the waist of the participant and evaluated the test garment to have moderate quality of fit. The test garment was considered to have good quality of fit around the waist by two professionals, whereas the third professional considered the test garment to have moderate quality of fit due to loose fit.

The test garment was considered to have good quality of fit over the abdomen by two professionals, whereas the third professional considered the test garment to have moderate quality of fit due to loose fit. All three professionals considered the position of the hips of the test garment as a good fit. The test garment was considered to have good quality of fit around the upper hips and the hips by two professionals, whereas the third professional considered the test garment to have moderate quality of fit due to tight fit.

The hem at the front of the test garment was considered to have good quality of fit by all three professionals. On the other hand, the hem at the back of the test garment was considered to have moderate quality of fit by all three professionals; two professionals considered the hem to be pulling up at centre back, whereas the third professional considered the hem to sag at centre back.

5.3.1.5 Summary of the quality of fit attained from the traditional size specifications

In table 5.14, means for the quality of fit attained from the traditional size specifications (last column in table 5.10 to table 5.13) were tabulated together to provide a summary of the quality of fit attained from the traditional size specifications. Around the neckline, three test garments were considered to have good quality of fit, whereas the fourth test garment was considered to have moderate quality of fit due to loose fit. Across the shoulders, all four test garments were considered to have moderate quality of fit due to loose fit. The shoulders of three test garments were considered well aligned with the shoulders of the participants, whereas the shoulders of the fourth test garment were considered misaligned with the shoulders of the participant. Across the chest, all four test garments were considered to have moderate quality of fit due to loose fit.

Across the upper back, one test garment was considered to have good quality of fit, whereas the other three test garments were considered to have loose fit. Two of the three test garments with loose fit across the upper back were considered to have moderate quality of fit, whereas the third test garment was considered to have poor quality of fit.

TABLE 5.14: SUMMARY OF THE QUALITY OF FIT ATTAINED FROM THE TRADITIONAL SIZE SPECIFICATIONS

	10/34	12/36	14/38	16/40
The fit of the test garment around the neckline*	3.00	3.00	2.67	3.00
The fit of the test garment across the shoulders*	2.50	2.67	2.00	2.67
The alignment of the shoulders of the test garment with the shoulders of the participant*	2.33	3.00	3.00	3.00
The fit of the test garment across the chest*	2.00	2.00	2.00	2.33
The fit of the test garment across the upper back*	2.33	2.00	3.00	1.67
The fit of the test garment around the armhole*	3.00	2.33	2.67	2.33
The fit of the test garment around the bust*	1.67	2.00	2.33	1.33
The position of the bust on the test garment*	1.00	1.67	2.00	1.00
The fit of the test garment around the midriff*	1.67	1.67	2.33	1.33
The position of the waist on the test garment*	2.33	2.33	2.33	2.00
The fit of the test garment around the waist*	2.33	2.00	2.67	2.67
The fit of the test garment over the abdomen*	2.33	2.33	3.00	2.67
The position of the hips on the test garment*	3.00	3.00	3.00	3.00
The fit of the test garment around the upper hips*	2.67	2.67	2.67	2.67
The fit of the test garment around the hips*	2.67	3.00	3.00	2.67
The set of the hem at the front of the test garment*	3.00	2.67	3.00	3.00
The set of the hem at the back of the test garment*	2.33	1.67	2.33	2.00
The overall fit of the test garment#	5.0	5.0	6.7	5.0

*Evaluation scale: 3 = good quality of fit; 2 = moderate quality of fit; 1 = poor quality of fit

In the fit evaluation questionnaire, a rating of 1 represented poor overall quality of fit whereas a rating of 9 represented good overall quality of fit.

Around the armhole, one test garment was considered to have good quality of fit, whereas the other three test garments were considered to have moderate quality of fit. The moderate quality of fit around the armhole was attributable to tight fit in one of the test garments, whereas in the other two test garments the moderate quality of fit was attributable to loose fit.

All four test garments developed from the traditional size specifications were considered to have loose fit around the bust; two test garments were considered to have moderate quality of fit, whereas the other two test garments were considered to have poor quality of fit. The bust was additionally considered to be placed too low in all four test garments, with one test garment considered to have moderate quality of fit and the other three test garments considered to have poor quality of fit.

Around the midriff, all four test garments developed from the traditional size specifications were considered to have loose fit; three test garments were considered to have poor quality of fit around the midriff, whereas the fourth test garment was considered to have moderate quality of fit around the midriff. In all four test garments the waist was considered to be placed too low in relation to the waists of the participants. Around the waist, all four test garments were considered to have moderate quality of fit due to loose fit. Over the abdomen, one test garment was considered to have good quality of fit, whereas the other three test garments were considered to have moderate quality of fit due to loose fit.

The hips of all four test garments were considered to be well placed in relation to the hips of the participants. Around the upper hips, all four test garments were considered to have moderate quality of fit. The moderate quality of fit around the upper hips was attributable to loose fit in two test garments, whereas in the other two test garments the moderate quality of fit was attributable to tight fit. Around the hips, two test garments were considered to have good quality of fit, whereas the other two test garments were considered to have moderate quality of fit due to tight fit.

The hem at the front of the test garment was considered to have good set in three test garments, whereas in the fourth test garment the hem was considered to be sagging at centre front. In all four test garments the hem was considered to be pulling up at centre back; three test garments were considered to have moderate quality of fit, whereas the fourth test garment was considered to have poor quality of fit.

5.3.2 The quality of fit attained from the experimental size specifications

5.3.2.1 Quality of fit of the size 6/30 test garment on participant A

In table 5.15, the evaluation of the quality of fit of the size 6/30 test garment developed according to the experimental size specifications is shown. There was no agreement amongst the professionals regarding the quality of fit of the test garment around the neckline. One professional considered the test garment to have good quality of fit around the neckline. Whereas the other two professionals considered the test garment to be tight around the neckline, with one professional considering the test garment to have poor quality of fit and the third professional considering the test garment to have moderate quality of fit.

TABLE 5.15: QUALITY OF FIT OF THE SIZE 6/30 TEST GARMENT DEVELOPED ACCORDING TO THE EXPERIMENTAL SIZE SPECIFICATIONS

	PROFESSIONAL			MEAN
	A	B	C	
The fit of the test garment around the neckline*	1.00	3.00	2.00	2.00
The fit of the test garment across the shoulders*	3.00	3.00	2.00	2.67
The alignment of the shoulders of the test garment with the shoulders of the participant*	3.00	2.00	3.00	2.67
The fit of the test garment across the chest*	2.00	3.00	3.00	2.67
The fit of the test garment across the upper back*	3.00	3.00	3.00	3.00
The fit of the test garment around the armhole*	3.00	3.00	3.00	3.00
The fit of the test garment around the bust*	3.00	3.00	3.00	3.00
The position of the bust on the test garment*	3.00	3.00	3.00	3.00
The fit of the test garment around the midriff*	3.00	3.00	2.00	2.67
The position of the waist on the test garment*	3.00	2.00	3.00	2.67
The fit of the test garment around the waist*	3.00	2.00	3.00	2.67
The fit of the test garment over the abdomen*	2.00	2.00	3.00	2.33
The position of the hips on the test garment*	3.00	3.00	3.00	3.00
The fit of the test garment around the upper hips*	2.00	2.00	3.00	2.33
The fit of the test garment around the hips*	3.00	3.00	3.00	3.00
The set of the hem at the front of the test garment*	3.00	3.00	3.00	3.00
The set of the hem at the back of the test garment*	3.00	3.00	3.00	3.00
The overall fit of the test garment#	7.0	6.0	7.0	6.7

*Evaluation scale: 3 = good quality of fit; 2 = moderate quality of fit; 1 = poor quality of fit

In the fit evaluation questionnaire, a rating of 1 represented poor overall quality of fit whereas a rating of 9 represented good overall quality of fit.

Across the shoulders, two professionals considered the test garment to have good quality of fit, whereas the third professional considered the test garment to have moderate quality of fit due to tight fit. Two professionals considered the shoulders of the test garment to be well aligned with the shoulders of the participant, whereas the third professional considered the shoulders of the test garment to be moderately aligned with the shoulders of the participant. Across the chest, the test garment was considered to have good quality of fit by two professionals, whereas the third professional considered the test garment to have moderate quality of fit due to loose fit. The test garment was unanimously considered by all three professionals to have good quality of fit across the upper back, around the armhole, and around the bust. All three professionals unanimously considered the position of the bust on the test garment as a good fit.

Around the midriff, two professionals considered the test garment to have good quality of fit, whereas the third professional considered the test garment to have moderate quality of fit due to tight fit. Two professionals considered the position of the waist of the test garment in relation to the waist of the participant as a good fit, whereas the third professional considered

the waist of the test garment to be positioned higher than the waist of the participant. The test garment was considered by two professionals to have good quality of fit around the waist, whereas the third professional considered the test garment to have moderate quality of fit due to loose fit.

The test garment was considered to have good quality of fit over the abdomen by one professional, whereas the other two professionals considered the test garment to have moderate quality of fit due to loose fit. All three professionals considered the test garment to have good quality of fit in terms of the position of the hips on the test garment and the fit of the test garment around the hips. The upper hips of the test garment were considered to have good quality of fit by one professional, whereas the other two professionals considered the test garment to have moderate quality of fit due to loose fit. The test garment was considered to have good quality of fit at the hem by all three professionals.

5.3.2.2 Quality of fit of the size 8/32 test garment on participant B

In table 5.16, the evaluation of the quality of fit of the size 8/32 test garment developed according to the experimental size specifications is shown. Around the neckline, two professionals considered the test garment to have moderate quality of fit due to tight fit, whereas the third professional considered the test garment to have good quality of fit. All three professionals considered the test garment to have good quality of fit across the shoulders and the chest. The shoulders of the test garment were considered well aligned with the shoulders of the participant by all three professionals.

Across the upper back, two professionals considered the test garment to have good quality of fit, whereas the third professional considered the test garment to have moderate quality of fit due to tight fit. The armhole was unanimously considered to have good quality of fit by all three professionals. The position of the bust of the test garment was unanimously considered as a moderate fit by all three professionals as they considered the bust to be situated too high in relation to the bust of the participant. With regard to the quality of fit of the test garment around the bust, all three professionals unanimously considered the test garment to have good quality of fit.

TABLE 5.16: QUALITY OF FIT OF THE SIZE 8/32 TEST GARMENT DEVELOPED ACCORDING TO THE EXPERIMENTAL SIZE SPECIFICATIONS

	PROFESSIONAL			MEAN
	A	B	C	
The fit of the test garment around the neckline*	2.00	3.00	2.00	2.33
The fit of the test garment across the shoulders*	3.00	3.00	3.00	3.00
The alignment of the shoulders of the test garment with the shoulders of the participant*	3.00	3.00	3.00	3.00
The fit of the test garment across the chest*	3.00	3.00	3.00	3.00
The fit of the test garment across the upper back*	3.00	3.00	2.00	2.67
The fit of the test garment around the armhole*	3.00	3.00	3.00	3.00
The fit of the test garment around the bust*	3.00	3.00	3.00	3.00
The position of the bust on the test garment*	2.00	2.00	2.00	2.00
The fit of the test garment around the midriff*	2.00	3.00	2.00	2.33
The position of the waist on the test garment*	3.00	3.00	3.00	3.00
The fit of the test garment around the waist*	2.00	3.00	3.00	2.67
The fit of the test garment over the abdomen*	2.00	3.00	2.00	2.33
The position of the hips on the test garment*	3.00	3.00	3.00	3.00
The fit of the test garment around the upper hips*	2.00	3.00	3.00	2.67
The fit of the test garment around the hips*	3.00	3.00	2.00	2.67
The set of the hem at the front of the test garment*	3.00	3.00	3.00	3.00
The set of the hem at the back of the test garment*	3.00	3.00	3.00	3.00
The overall fit of the test garment#	8.0	8.0	7.0	7.7

*Evaluation scale: 3 = good quality of fit; 2 = moderate quality of fit; 1 = poor quality of fit

In the fit evaluation questionnaire, a rating of 1 represented poor overall quality of fit whereas a rating of 9 represented good overall quality of fit.

There was no agreement amongst the three professionals regarding the quality of fit of the test garment around the midriff. One professional considered the test garment to have good quality of fit, the second professional considered the test garment to have moderate quality of fit due to loose fit, whereas the third professional considered the test garment to have moderate quality of fit due to tight fit.

All three professionals considered the position of the waist of the test garment as a good fit in relation to the waist of the participant. Two professionals considered the test garment to have good quality of fit around the waist, whereas the third professional considered the test garment to have moderate quality of fit due to loose fit. Over the abdomen, one professional considered the test garment to have good quality of fit, whereas the other two professionals considered the test garment to have moderate quality of fit due to loose fit.

All three professionals considered the position of the hips of the test garment as a good fit. The test garment was considered to have good quality of fit around the upper hips by two

professionals, whereas the third professional considered the test garment to have moderate quality of fit due to loose fit. Around the hips, the test garment was considered to have good quality of fit by two professionals, whereas the third professional considered the test garment to have moderate quality of fit due to loose fit. The test garment was considered to have good quality of fit at the hem by all three professionals.

5.3.2.3 Quality of fit of the size 10/34 test garment on participant C

In table 5.17, the evaluation of the quality of fit of the size 10/34 test garment developed according to the experimental size specifications is shown. The test garment was unanimously evaluated by all three professionals to have good quality of fit around the neckline, across the shoulders, and across the chest. Across the upper back, two professionals considered the test garment to have good quality of fit, whereas the third professional considered the test garment to have moderate quality of fit due to tight fit. The test garment was considered to have good quality of fit around the armhole by all three professionals. Around the bust, the test garment was considered to have good quality of fit by all three professionals. All three professionals considered the position of the bust on the test garment as a moderate fit in relation to the bust of the participant; two professionals considered the bust of the test garment to be positioned too high, whereas the third professional considered the bust of the test garment to be situated too low.

Around the midriff, all three professionals considered the test garment to have good quality of fit. All three professionals considered the position of the waist of the test garment as a good fit in relation to the waist of the participant. The test garment was considered to have good quality of fit around the waist by two professionals, whereas the third professional considered the test garment to have moderate quality of fit due to loose fit. The test garment was considered to have moderate quality of fit over the abdomen by two professionals due to loose fit, whereas the third professional considered the test garment to have good quality of fit.

TABLE 5.17: QUALITY OF FIT OF THE SIZE 10/34 TEST GARMENT DEVELOPED ACCORDING TO THE EXPERIMENTAL SIZE SPECIFICATIONS

	PROFESSIONAL			MEAN
	A	B	C	
The fit of the test garment around the neckline*	3.00	3.00	3.00	3.00
The fit of the test garment across the shoulders*	3.00	3.00	3.00	3.00
The alignment of the shoulders of the test garment with the shoulders of the participant*	3.00	3.00	3.00	3.00
The fit of the test garment across the chest*	3.00	3.00	3.00	3.00
The fit of the test garment across the upper back*	3.00	3.00	2.00	2.67
The fit of the test garment around the armhole*	3.00	3.00	3.00	3.00
The fit of the test garment around the bust*	3.00	3.00	3.00	3.00
The position of the bust on the test garment*	2.00	2.00	2.00	2.00
The fit of the test garment around the midriff*	3.00	3.00	3.00	3.00
The position of the waist on the test garment*	3.00	3.00	3.00	3.00
The fit of the test garment around the waist*	3.00	3.00	2.00	2.67
The fit of the test garment over the abdomen*	2.00	3.00	2.00	2.33
The position of the hips on the test garment*	2.00	3.00	2.00	2.33
The fit of the test garment around the upper hips*	2.00	2.00	2.00	2.00
The fit of the test garment around the hips*	3.00	2.00	2.00	2.33
The set of the hem at the front of the test garment*	3.00	3.00	2.00	2.67
The set of the hem at the back of the test garment*	3.00	3.00	3.00	3.00
The overall fit of the test garment#	8.0	8.0	7.0	7.7

*Evaluation scale: 3 = good quality of fit; 2 = moderate quality of fit; 1 = poor quality of fit

In the fit evaluation questionnaire, a rating of 1 represented poor overall quality of fit whereas a rating of 9 represented good overall quality of fit.

One professional considered the hips of the test garment to be well aligned with the hips of the participant, whereas the other two professionals considered the hips of the test garment to be positioned too high in relation to the hips of the participant. Collectively all three professionals considered the test garment to have moderate quality of fit around the upper hips due to loose fit. Around the hips, the test garment was considered to have moderate quality of fit by two professionals due to loose fit, whereas the third professional considered the test garment to have good quality of fit. The hem was considered to have good set at the front of the test garment by two professionals, whereas the third professional considered the hem to sag at centre front. All three professionals considered the hem to have good set at the back of the test garment.

5.3.2.4 Quality of fit of the size 12/36 test garment on participant D

In table 5.18, the evaluation of the quality of fit of the size 12/36 test garment developed according to the experimental size specifications is shown. The test garment was considered to have good quality of fit around the neckline by two professionals, whereas the third

professional considered the test garment to have moderate quality of fit due to loose fit. Across the shoulders, two professionals considered the test garment to have good quality of fit, whereas the third professional considered the test garment to have moderate quality of fit due to loose fit. One professional considered the shoulders of the test garment to be well aligned with the shoulders of the participant, whereas the other two professionals considered the shoulders of the test garment to be moderately aligned with the shoulders of the participant.

TABLE 5.18: QUALITY OF FIT OF THE SIZE 12/36 TEST GARMENT DEVELOPED ACCORDING TO THE EXPERIMENTAL SIZE SPECIFICATIONS

	PROFESSIONAL			MEAN
	A	B	C	
The fit of the test garment around the neckline*	3.00	3.00	2.00	2.67
The fit of the test garment across the shoulders*	2.00	3.00	3.00	2.67
The alignment of the shoulders of the test garment with the shoulders of the participant*	2.00	3.00	1.00	2.00
The fit of the test garment across the chest*	2.00	2.00	3.00	2.33
The fit of the test garment across the upper back*	3.00	3.00	2.00	2.67
The fit of the test garment around the armhole*	3.00	3.00	3.00	3.00
The fit of the test garment around the bust*	3.00	3.00	3.00	3.00
The position of the bust on the test garment*	1.00	2.00	1.00	1.33
The fit of the test garment around the midriff*	3.00	3.00	3.00	3.00
The position of the waist on the test garment*	3.00	3.00	3.00	3.00
The fit of the test garment around the waist*	3.00	3.00	3.00	3.00
The fit of the test garment over the abdomen*	2.00	3.00	2.00	2.33
The position of the hips on the test garment*	3.00	2.00	3.00	2.67
The fit of the test garment around the upper hips*	2.00	2.00	2.00	2.00
The fit of the test garment around the hips*	3.00	2.00	3.00	2.67
The set of the hem at the front of the test garment*	3.00	3.00	3.00	3.00
The set of the hem at the back of the test garment*	3.00	3.00	2.00	2.67
The overall fit of the test garment#	7.0	7.0	7.0	7.0

*Evaluation scale: 3 = good quality of fit; 2 = moderate quality of fit; 1 = poor quality of fit

In the fit evaluation questionnaire, a rating of 1 represented poor overall quality of fit whereas a rating of 9 represented good overall quality of fit.

Two professionals considered the test garment to have moderate quality of fit across the chest due to loose fit, whereas the third professional considered the test garment to have good quality of fit. The test garment was considered to have good quality of fit across the upper back by two professionals, whereas the third professional considered the test garment to have moderate quality of fit due to tight fit. The test garment was considered to have good quality of fit around the armhole by all three professionals.

Around the bust, all three professionals considered the test garment to have good quality of fit. The position of the bust of the test garment was jointly agreed by all three professionals to be too high in relation to the bust of the participant; two professionals considered the position of the bust as a poor fit, whereas the third professional considered the position of the bust as a moderate fit. The test garment was unanimously considered by all three professionals to have good quality of fit around the midriff and the waist. All three professionals considered the position of the waist of the test garment in relation to the waist of the participant as a good fit. Over the abdomen, the test garment was considered to have moderate quality of fit by two professionals due to loose fit, whereas the third professional considered the test garment to have good quality of fit.

Two professionals considered the position of the hips of the test garment in relation to the hips of the participant as a good fit, whereas the third professional considered the hips of the test garment to be positioned too high in relation to the hips of the participant. All three professionals unanimously considered the test garment to have moderate quality of fit around the upper hips due to loose fit. Around the hips, the test garment was considered to have good quality of fit by two professionals, whereas the third professional considered the test garment to have moderate quality of fit due to loose fit. As it can be seen in table 5.18, with the exception of one professional that considered the hem to pull up at centre back, the hem was considered to have good set at the front and at the back of the test garment.

5.3.2.5 Summary of the quality of fit attained from the experimental size specifications

In table 5.19, means for the quality of fit attained from the experimental size specifications (last column in table 5.15 to table 5.18) were tabulated together to provide a summary of the quality of fit attained from the experimental size specifications. Around the neckline, one test garment was considered to have good quality of fit, whereas the other three test garments were considered to have moderate quality of fit. The moderate quality of fit around the neckline was attributable to loose fit in one of the test garments, whereas in the other two test garments the moderate quality of fit was attributable to tight fit.

Across the shoulders, two test garments were considered to have good quality of fit, whereas the other two test garments were considered to have moderate quality of fit. In the two test garments considered to have moderate quality of fit across the shoulders, the moderate quality of fit was attributable to tight fit in one of the test garments and to loose fit in the other test garment.

TABLE 5.19: SUMMARY OF THE QUALITY OF FIT ATTAINED FROM THE EXPERIMENTAL SIZE SPECIFICATIONS

	6/30	8/32	10/34	12/36
The fit of the test garment around the neckline*	2.00	2.33	3.00	2.67
The fit of the test garment across the shoulders*	2.67	3.00	3.00	2.67
The alignment of the shoulders of the test garment with the shoulders of the participant*	2.67	3.00	3.00	2.00
The fit of the test garment across the chest*	2.67	3.00	3.00	2.33
The fit of the test garment across the upper back*	3.00	2.67	2.67	2.67
The fit of the test garment around the armhole*	3.00	3.00	3.00	3.00
The fit of the test garment around the bust*	3.00	3.00	3.00	3.00
The position of the bust on the test garment*	3.00	2.00	2.00	1.33
The fit of the test garment around the midriff*	2.67	2.33	3.00	3.00
The position of the waist on the test garment*	2.67	3.00	3.00	3.00
The fit of the test garment around the waist*	2.67	2.67	2.67	3.00
The fit of the test garment over the abdomen*	2.33	2.33	2.33	2.33
The position of the hips on the test garment*	3.00	3.00	2.33	2.67
The fit of the test garment around the upper hips*	2.33	2.67	2.00	2.00
The fit of the test garment around the hips*	3.00	2.67	2.33	2.67
The set of the hem at the front of the test garment*	3.00	3.00	2.67	3.00
The set of the hem at the back of the test garment*	3.00	3.00	3.00	2.67
The overall fit of the test garment#	6.7	7.7	7.7	7.0

*Evaluation scale: 3 = good quality of fit; 2 = moderate quality of fit; 1 = poor quality of fit

In the fit evaluation questionnaire, a rating of 1 represented poor overall quality of fit whereas a rating of 9 represented good overall quality of fit.

The shoulders of two test garments were considered well aligned with the shoulders of the participants, whereas the shoulders of the other two test garments were considered misaligned with the shoulders of the participants. Across the chest, two test garments were considered to have good quality of fit, whereas the other two test garments were considered to have moderate quality of fit due to loose fit. Across the upper back, one test garment was considered to have good quality of fit, whereas the other three test garments were considered to have moderate quality of fit due to tight fit. All four test garments developed from the experimental size specifications were considered to have good quality of fit around the armhole.

Around the bust, all four test garments developed from the experimental size specifications were considered have good quality of fit. However, in three test garments the bust was considered to be placed too high in relation to the bust of the participants, whereas in the fourth test garment the position of the bust was considered as a good fit. Around the midriff, two test garments were considered to have good quality of fit, whereas the other two test garments were considered to have moderate quality of fit due to tight fit.

The waistlines of three test garments were considered well aligned with the waistlines of the participants, whereas in the fourth test garment the waistline was considered to be placed too high in relation to the waistline of the participant. Around the waist, one test garment was considered to have good quality of fit, whereas the other three test garments were considered to have moderate quality of fit due to loose fit. Over the abdomen, all four test garments were considered to have moderate quality of fit due to loose fit.

The hips of two test garments were considered well aligned with the hips of the participants, whereas the hips of the other two test garments were considered to be placed too high in relation to the hips of the participants. Around the upper hips, all four test garments were considered to have moderate quality of fit due to loose fit. Around the hips, three test garments were considered to have moderate quality of fit due to loose fit, whereas the fourth test garment was considered to have good quality of fit.

The hem at the front of the test garment was considered to have good set in three test garments, whereas in the fourth test garment the hem was considered to be sagging at centre front. At the back, the hem was considered to have good quality of fit in three test garments, whereas in the fourth test garment the hem was considered to be pulling up at centre back.

5.3.3 Comparison of the quality of fit attained from the traditional test garments and the quality of fit attained from the experimental test garments

In table 5.20, the means for the quality of fit attained from the experimental size specifications and the means for the quality of fit attained from the traditional size specifications are compared to determine whether the experimental size specifications offer South African female students of African descent with a triangular body shape with improved quality of fit. The means for the quality of fit attained from the traditional size specifications were calculated from table 5.14, whereas the means for the quality of fit attained from the experimental size specifications were calculated from table 5.19. In figure 5.3, the means for the quality of fit attained from the experimental size specifications and the means for the quality of fit attained from the traditional size specifications were plotted to illustrate the differences in the means visually. In section 5.3.3.1 to section 5.3.3.17, the means for the quality of fit of the different areas of the test garments were compared to determine whether the experimental size specifications offer South African female students of African descent with improved quality of fit.

TABLE 5.20: COMPARATIVE MEANS FOR THE QUALITY OF FIT OF THE TEST GARMENTS

	TRADITIONAL	EXPERIMENTAL
The fit of the test garment around the neckline*	2.92	2.50
The fit of the test garment across the shoulders*	2.46	2.83
The alignment of the shoulders of the test garment with the shoulders of the participant*	2.83	2.67
The fit of the test garment across the chest*	2.08	2.75
The fit of the test garment across the upper back*	2.25	2.75
The fit of the test garment around the armhole*	2.58	3.00
The fit of the test garment around the bust*	1.83	3.00
The position of the bust on the test garment*	1.42	2.08
The fit of the test garment around the midriff*	1.75	2.75
The position of the waist on the test garment*	2.25	2.92
The fit of the test garment around the waist*	2.42	2.75
The fit of the test garment over the abdomen*	2.58	2.33
The position of the hips on the test garment*	3.00	2.75
The fit of the test garment around the upper hips*	2.67	2.25
The fit of the test garment around the hips*	2.83	2.67
The set of the hem at the front of the test garment*	2.92	2.92
The set of the hem at the back of the test garment*	2.08	2.92
The overall fit of the test garment[#]	5.4	7.3

*Evaluation scale: 3 = good quality of fit; 2 = moderate quality of fit; 1 = poor quality of fit

[#] In the fit evaluation questionnaire, a rating of 1 represented poor overall quality of fit whereas a rating of 9 represented good overall quality of fit.

5.3.3.1 The quality of fit of the test garments around the neckline

Around the neckline, the experimental size specifications were not considered to offer the unit of analysis with improved quality of fit; the traditional test garments have a mean of 2.92, whereas the experimental test garments have a mean of 2.50. Around the neckline, three of the four traditional test garments were considered to have good quality of fit, while the fourth test garment was considered to have loose fit. Whereas around the neckline, only one of the four experimental test garments was considered to have good quality of fit, with two of the four experimental test garments considered to have tight fit, and the fourth experimental test garment considered to have loose fit. As it can be seen in figure 5.4, the experimental test garment has tight fit around the neckline, whereas the traditional test garment has better quality of fit around the neckline.

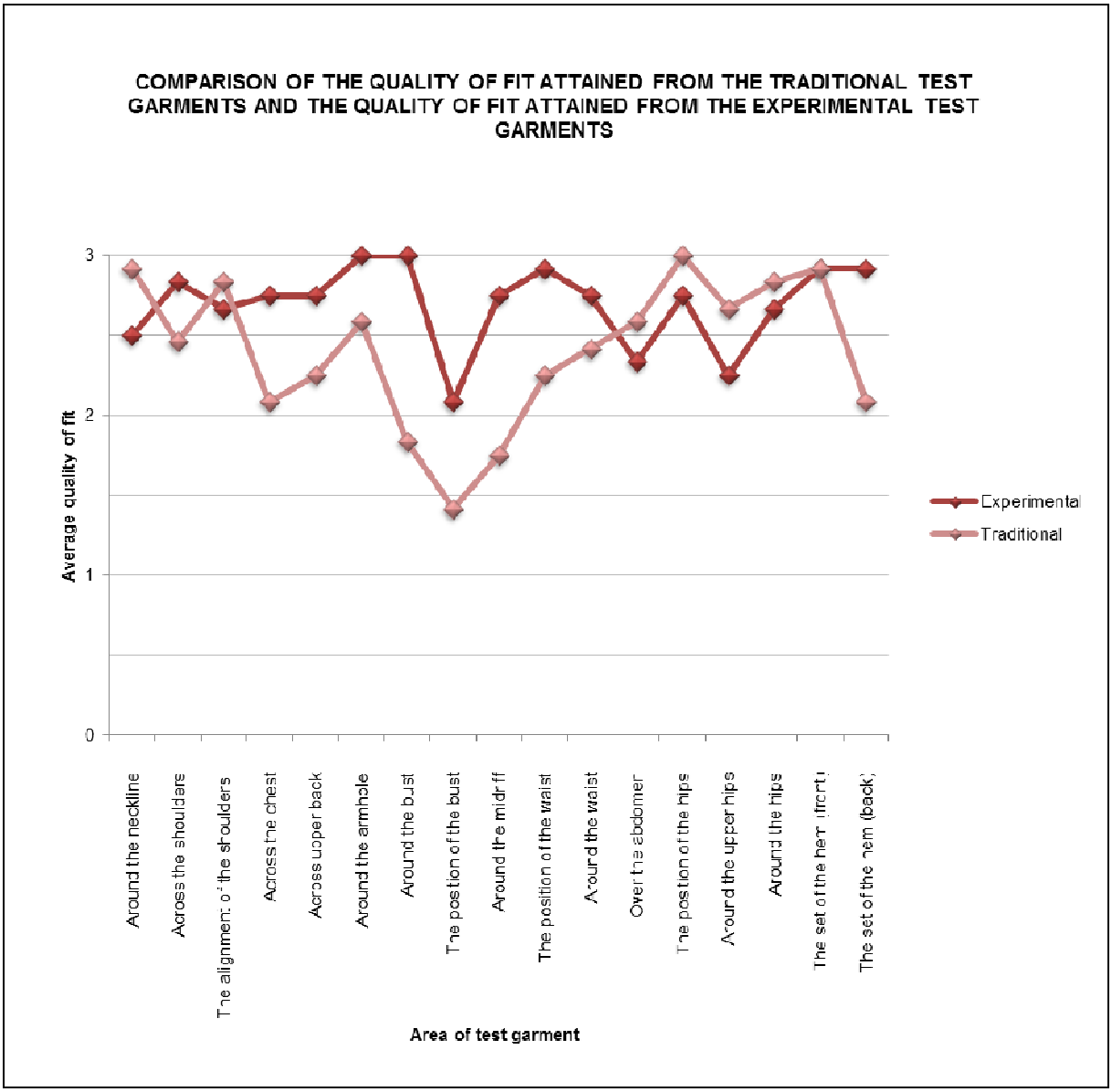


FIGURE 5.3: COMPARATIVE MEANS FOR THE QUALITY OF FIT OF THE TEST GARMENTS

5.3.3.2 The quality of fit of the test garments across the shoulders

Across the shoulders, the experimental test garments were considered to offer the unit of analysis with improved quality of fit; the experimental test garments have a mean of 2.83, whereas the traditional test garments have a mean of 2.46. The experimental size specifications were considered to offer the unit of analysis with improved quality of fit across the shoulders since two of the four experimental test garments were considered to have good quality of fit; the other two experimental test garments were considered to have loose fit

and tight fit respectively. Whereas, all four test garments developed from the traditional size specifications were considered to have loose fit across the shoulders. In figure 5.4, the traditional test garment has loose fit across the shoulders, whereas the experimental test garment despite being somewhat tight across the shoulders has improved quality of fit.

5.3.3.3 The alignment of the shoulders of the test garments with the shoulders of the participants

The experimental size specifications were not considered to offer the unit of analysis with improved quality of fit, in terms of the alignment of the shoulders of the test garments with the shoulders of the participants. The traditional test garments have a mean of 2.83, whereas the experimental test garments have a mean of 2.67. The shoulders of three traditional test garments were considered well aligned with the shoulders of the participants, whereas the shoulders of only two experimental test garments were considered well aligned with the shoulders of the participants.

5.3.3.4 The quality of fit of the test garments across the chest

Across the chest, the experimental test garments were considered to offer the unit of analysis with improved quality of fit; the experimental test garments have a mean of 2.75, whereas the traditional test garments have a mean of 2.08. The experimental size specifications were considered to offer the unit of analysis with improved quality of fit across the chest since two of the four experimental test garments were considered to have good quality of fit; the other two experimental test garments were considered to have loose fit. Whereas, all four test garments developed from the traditional size specifications were considered to have loose fit across the chest. In figure 5.4, the traditional test garment has loose fit across the chest, whereas the experimental test garment has improved quality of fit across the chest despite also having loose fit.

QUALITY OF FIT OF A TRADITIONAL TEST GARMENT		
FRONT	SIDE	BACK
		
QUALITY OF FIT OF AN EXPERIMENTAL TEST GARMENT		
FRONT	SIDE	BACK
		

FIGURE 5.4: THE QUALITY OF FIT OF THE TEST GARMENTS

5.3.3.5 The quality of fit of the test garments across the upper back

The experimental test garments were considered to offer the unit of analysis with improved quality of fit across the upper back; the experimental test garments have a mean of 2.75, whereas the traditional test garments have a mean of 2.25. Across the upper back, one of the four experimental test garments was considered to have good quality of fit while the other three experimental test garments were considered to have tight fit. Whereas across the upper back, one of the four traditional test garments was considered to have good quality of fit while the other three traditional test garments were considered to have loose fit. In figure 5.4, the test garment developed from the traditional size specifications has loose fit across the upper back, whereas the test garment developed from the experimental size specifications has improved quality of fit across the upper back despite being tight across the upper back.

5.3.3.6 The quality of fit of the test garments around the armhole

Around the armhole, the experimental test garments were considered to offer the unit of analysis with improved quality of fit; the experimental test garments have a mean of 3.00, whereas the traditional test garments have a mean of 2.58. The experimental size specifications offer the unit of analysis with improved quality of fit around the armhole since all four test garments developed from the experimental size specifications were considered to have good quality of fit around the armhole. Whereas, only one of the four traditional test garments was considered to have good quality of fit around the armhole, with two of the four traditional test garments considered to have loose fit around the armhole, and the fourth traditional test garment considered to have tight fit around the armhole. As it can be seen in figure 5.4, the traditional test garment has loose fit around the armhole, whereas the experimental test garment has good quality of fit around the armhole.

5.3.3.7 The quality of fit of the test garments around the bust

The experimental test garments were considered to offer the unit of analysis with improved quality of fit around the bust; the experimental test garments have a mean of 3.00, whereas the traditional test garments have a mean of 1.83. All four test garments developed from the experimental size specifications were considered to have good quality of fit around the bust; whereas, all four test garments developed from the traditional size specifications were considered to have loose fit around the bust. As it can be seen in figure 5.4, the traditional

test garment has loose fit around the bust, whereas the experimental test garment has good quality of fit around the bust.

5.3.3.8 The position of the bust on the test garments

The busts of the experimental test garments were considered better aligned with the busts of the participants; the experimental test garments have a mean of 2.08, whereas the traditional test garments have a mean of 1.42. In all four test garments developed from the traditional size specifications, the bust was considered to be placed too low. Whereas, the bust was considered well aligned with the bust of the participant in one experimental test garment; in the other three experimental test garments the bust was considered to be placed too high in relation to the busts of the participants. As it can be seen in figure 5.4, the bust dart is positioned too low in relation to the bust of the participant in the traditional test garment, whereas the bust dart of the experimental test garment is better aligned with the bust of the participant despite the bust dart being positioned above the bust of the participant.

5.3.3.9 The quality of fit of the test garments around the midriff

Around the midriff, the experimental test garments were considered to offer the unit of analysis with improved quality of fit; the experimental test garments have a mean of 2.75, whereas the traditional test garments have a mean of 1.75. The experimental size specifications were considered to offer the unit of analysis with improved quality of fit around the midriff since two of the four experimental test garments were considered to have good quality of fit; the other two experimental test garments were considered to have tight fit. Whereas, all four test garments developed from the traditional size specifications were considered to have loose fit around the midriff. In figure 5.4, loose fit around the midriff is evident in the test garment developed from the traditional size specifications, whereas the experimental test garment has closer fit around the midriff.

5.3.3.10 The position of the waist on the test garments

The waistlines of the experimental test garments were considered better aligned with the waistlines of the participants; the experimental test garments have a mean of 2.92, whereas the traditional test garments have a mean of 2.25. The experimental size specifications were considered to offer the unit of analysis with improved quality of fit since the waistlines of three experimental test garments were considered well aligned with the waistlines of the

participants. Whereas, the waistlines of all four traditional test garments were considered to be placed too low in relation to the waistlines of the participants.

5.3.3.11 The quality of fit of the test garments around the waist

The experimental test garments were considered to offer the unit of analysis with improved quality of fit around the waist; the experimental test garments have a mean of 2.75, whereas the traditional test garments have a mean of 2.42. All four traditional test garments were considered to have loose fit around the waist. Whereas around the waist, one experimental test garment was considered to have good quality of fit, while the other three experimental test garments were considered to have loose fit. All four traditional test garments and most of the experimental test garments were considered to have loose fit around the waist; however, the mean for the experimental test garments is closer to three and thereby suggests that the experimental test garments offer the unit of analysis with improved quality of fit around the waist. As it can be seen in figure 5.4, the traditional test garment is loose around the waist, whereas the experimental test garment has better quality of fit around the waist despite also being loose.

5.3.3.12 The quality of fit of the test garments over the abdomen

The experimental size specifications were not considered to offer the unit of analysis with improved quality of fit over the abdomen; the traditional test garments have a mean of 2.58, whereas the experimental test garments have a mean of 2.33. All four experimental test garments were considered to have loose fit over the abdomen. Whereas around the abdomen, one traditional test garment was considered to have good quality of fit while the other three traditional test garments were considered to have loose fit. As it can be seen in figure 5.4, both the traditional test garment and the experimental test garment have loose fit over the abdomen, however, in the experimental test garment loose fit over the abdomen is particularly visible in the side view of the test garment.

5.3.3.13 The position of the hips on the test garments

The experimental size specifications were not considered to offer the unit of analysis with improved quality of fit in terms of the position of the hips of the test garment in relation to the hips of the participant. The traditional test garments have a mean of 3.00, whereas the experimental test garments have a mean of 2.75. The hips of all four traditional test garments were considered to be well placed in relation to the hips of the participants, whereas in only

two of the four experimental test garments the hips of the test garments were considered to be well placed in relation to the hips of the participants. In the other two experimental test garments, the hips were considered to be placed too high in relation to the hips of the participants. As it can be seen in the side view of the test garments in figure 5.4, the darts of the traditional test garment follow the contours of the body around the hips due to the hips of the test garment being well positioned with the hips of the participant. In the experimental test garment, the darts do not follow the contours of the body around the hips due to the hips of the test garment being positioned higher than the hips of the participants.

5.3.3.14 The quality of fit of the test garments around the upper hips

The experimental size specifications were not considered to offer the unit of analysis with improved quality of fit around the upper hips; the traditional test garments have a mean of 2.67, whereas the experimental test garments have a mean of 2.25. Around the upper hips, all four experimental test garments were considered to have loose fit. Whereas around the upper hips, two of the four traditional test garments were considered to have tight fit while the other two test garments were considered to have loose fit. In figure 5.4, loose fit is noticeable around the upper hips of the experimental test garment.

5.3.3.15 The quality of fit of the test garments around the hips

The experimental size specifications were not considered to offer the unit of analysis with improved quality of fit around the hips; the traditional test garments have a mean of 2.83, whereas the experimental test garments have a mean of 2.67. Around the hips, three of the four experimental test garments were considered to have loose fit, while the fourth test garment was considered to have good quality of fit. Whereas around the hips, two of the four traditional test garments were considered to have good quality of fit, while the other two traditional test garments were considered to have tight fit. As it can be seen in figure 5.4, the experimental test garment has loose fit around the hips, whereas the traditional test garment has closer fit around the hips.

5.3.3.16 The set of the hem in the test garments

The hems of the experimental test garments and the hems of the traditional test garments were considered to have the same quality of fit at the front since they both have a mean of 2.92.

At the back, the hems of the experimental test garments were considered to have improved quality of fit; the experimental test garments have a mean of 2.92, whereas the traditional test garments have a mean of 2.08. In all four traditional test garments, the hem was considered to be pulling up at centre back, whereas the hem was considered to be pulling up at centre back in only one of the four experimental test garments. In the other three experimental test garments, the hems were considered to have good set at the back.

5.3.3.17 The overall quality of fit of the test garments

The experimental test garments were considered to offer the unit of analysis with improved overall quality of fit, as it can be seen in table 5.20. The experimental test garments have a mean of 7.3 on a scale of 1 to 9 for overall quality of fit, whereas the traditional test garments have a mean of 5.4 on a scale of 1 to 9 for overall quality of fit, thereby suggesting that the experimental size specifications offer the unit of analysis with improved overall quality of fit.

The experimental size specifications were considered to offer the unit of analysis with improved overall quality of fit due to the test garments developed from the traditional size specifications being considered to have loose fit in the upper body, as it can be seen in figure 5.4. The test garments developed from the traditional size specifications were considered to have loose fit in the following areas of the upper body: across the shoulders, across the chest, across the upper back, around the armhole, around the bust, and around the midriff.

The loose fit in the upper body of the test garments developed from the traditional size specifications may be attributable to the upper body of the unit of analysis being smaller than the lower body. As it was mentioned previously, the participants required a test garment sized according to the traditional size specifications that was two sizes larger than a test garment sized according to the experimental size specifications to accommodate their larger lower body measurements. Consequently in the test garments developed from the traditional size specifications, the participants experienced loose fit in the upper body when a test garment fitted the lower body of the participant, as it can be seen in figure 5.4.

The experimental test garment in figure 5.4 has closer fit in the upper body due to the absence of the excess ease that is noticeable in the traditional test garment that was designed to fit the balanced ideal body shape. The experimental test garments were designed to accommodate the larger lower bodies of South African female students of African descent with triangular body shapes. Consequently, the experimental test garments were considered to offer South African female students of African descent with triangular

body shapes with improved overall quality of fit. The findings of the study suggest that sizing based on the ideal body shape results in loose fit in the upper body of South African female students of African descent with triangular body shapes.

5.4 CONCLUSION

This chapter began by introducing the methods and procedures that were used to evaluate the quality of fit of the test garments. The test garments were evaluated on one participant per size using the one-group pretest-posttest pre-experimental design. A panel of professionals with experience in apparel fit evaluation evaluated the quality of fit of the test garments on a fit evaluation questionnaire adapted from Yu's (2004a:39) fit evaluation scale. The panel of professionals considered the test garments developed from the experimental size specifications to offer the unit of analysis with improved overall quality of fit compared to the overall quality of fit attained from the traditional size specifications.

In view of the improved quality of fit attained from the experimental size specifications, the experimental size specifications and the traditional size specifications will be compared to explain the differences in the quality of fit of the experimental test garments and the traditional test garments in the forthcoming chapter. Additionally, in the forthcoming chapter overall conclusions regarding the findings and the recommendations for further research will be made.

CHAPTER 6

CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS FOR FURTHER STUDY

6.1 INTRODUCTION

In this study, experimental size specifications for the body measurements required for a basic sheath dress for South African female students of African descent with triangular body shapes were developed. The experimental size specifications were developed for students of medium height with triangular body shapes, wearing size 6/30 to size 14/38, aged between 18 and 25 years, and enrolled at the University of Pretoria. Thereafter, the quality of fit attained from the experimental size specifications and the traditional size specifications was evaluated to determine whether the experimental size specifications offer South African female students of African descent with triangular body shapes with improved overall quality of fit. In this chapter, conclusions regarding the findings of the study are made. Thereafter, the various aspects of the study will be briefly evaluated. The chapter concludes by discussing the limitations of the study and by making recommendations for further study.

6.2 CONCLUSIONS AND IMPLICATIONS OF THE FINDINGS

6.2.1 Conclusions regarding the quality of fit attained from the experimental size specifications and the traditional size specifications

With South African ready-to-wear apparel sizing based on the ideal body shape, problems with the quality fit of ready-to-wear apparel result as the findings of this study suggest. The ideal body shape appears balanced above and below the waist, whereas females with triangular body shapes are characterised by a lower body that is larger than the upper body. In sizing based on the ideal body shape, fit problems such as loose fit in the upper torso are to be anticipated. As it was discussed in chapter 2, a woman with a triangular body shape may experience loose fit in the upper body when a garment designed for the ideal body shape fits the lower body of a woman with a triangular body shape (Mastamet-Mason, 2008:64).

In confirmation, the test garments developed from the traditional size specifications were found to have loose fit in the upper body when the test garment fitted the lower body of the participant, as it can be seen in figure 5.4. In figure 5.4, the set wrinkles in the upper body of the participant are indicative of excess ease in the upper body of the test garment sized according to the traditional size specifications. The findings of the study suggest that loose fit results in the upper body when a garment sized according to the traditional size specifications fits the lower body of a South African female student of African descent with a triangular body shape.

The findings of the study are consistent with the findings of Zwane and Magagula (2007:286) which suggest that sizing based on the ideal body shape is not capable of providing women with a triangular body shape with overall good quality of fit. In Zwane and Magagula (2007:286), the test garments were found to have tight fit in the lower body when the test garment fitted the upper body of a woman with a triangular body shape. On the contrary, in this study the traditional test garments were found to have loose fit in the upper body when a test garment fitted the lower body of the participant. From the findings of the study, it may be concluded that sizing based on the ideal body shape is not capable of providing South African female students of African descent with a triangular body shape with overall good quality of fit.

The test garments developed from the experimental size specifications were considered to offer South African female students of African descent with triangular body shapes with improved overall quality of fit by the panel of professional fit evaluators. The experimental test garment in figure 5.4 has smoother set in the upper body due to the absence of most of the set wrinkles that are present in the traditional test garment. The experimental test garments were designed to accommodate the larger lower bodies of South African female students of African descent with triangular body shapes and by implication, the experimental test garments inherently offer the unit of analysis with improved overall quality of fit.

In table 6.1, the key dimensions of the traditional size specifications, the key dimensions of the experimental size specifications, and the actual key dimensions of the participants are tabulated. As it can be seen in table 6.1, South African female students of African descent with a triangular body shape have larger lower body measurements (in terms of the estimated measurements of the experimental size specifications and the actual body measurements of the participants). During the fit evaluation sessions, in order to accommodate the larger lower body measurements of the participants, the participants required a test garment sized according to the traditional size specifications that was two

sizes larger than a test garment sized according to the experimental size specifications. Consequently, the participants experienced loose fit in the upper body of the traditional test garments due to the traditional test garments having being designed to fit the balanced ideal body shape.

TABLE 6.1: KEY BODY DIMENSIONS

SIZE		6/30	8/32	10/34	12/36	14/38
Bust	Experimental#	81.00 cm	85.00 cm	89.00 cm	93.00 cm	97.00 cm
	Traditional*	81.00 cm	85.00 cm	89.00 cm	93.00 cm	97.00 cm
	Participant	80.00 cm	89.00 cm	90.00 cm	92.00 cm	-
Waist	Experimental#	70.08 cm	73.36 cm	76.64 cm	79.92 cm	83.20 cm
	Traditional*	61.00 cm	65.00 cm	69.00 cm	73.00 cm	77.00 cm
	Participant	73.00 cm	71.00 cm	74.50 cm	77.00 cm	-
Hip	Experimental#	96.37 cm	100.42 cm	104.47 cm	108.51 cm	112.56 cm
	Traditional*	88.00 cm	92.00 cm	96.00 cm	100.00 cm	104.00 cm
	Participant	98.00 cm	100.00 cm	103.50 cm	110.50 cm	-

#The experimental measurements were extracted from the experimental size specifications in table 4.11.

*Please refer to section 6.2.2 for an explanation on how the traditional measurements were calculated.

The test garments developed from the experimental size specifications, despite the participants not having the exact measurements of the experimental size specifications, were considered to offer the unit of analysis with improved overall quality of fit due to the experimental test garments having being designed to accommodate the larger lower bodies of the participants. The findings of this study suggest that body shape is a key aspect of any sizing system as it affects the effectiveness of the sizing system, and corroborate with Mastamet-Mason (2008:224), who points out that classification of body shape is a "core component of a successful sizing system". With ready-to-wear apparel sizing based on the ideal body shape (Zwane & Magagula, 2007:283; LaBat & Delong, 1990:44; Rasband, 1994:12), ready-to-wear apparel sizing needs to cater for different body shapes as the findings of this study suggest. With sizing that accommodates the various body shapes found within the population, the ready-to-wear apparel industry may be able to increase consumer satisfaction with improved quality of fit.

6.2.2 Comparative analysis of the size specifications and the implications on the fit of apparel

In table 6.2, the traditional size specifications and the experimental size specifications were compared to illustrate the key differences between the traditional size specifications and the experimental size specifications. The key differences between the traditional size specifications and the experimental size specifications were analysed and discussed in terms of the implications on the fit of apparel in section 6.2.2.1 to section 6.2.2.3.

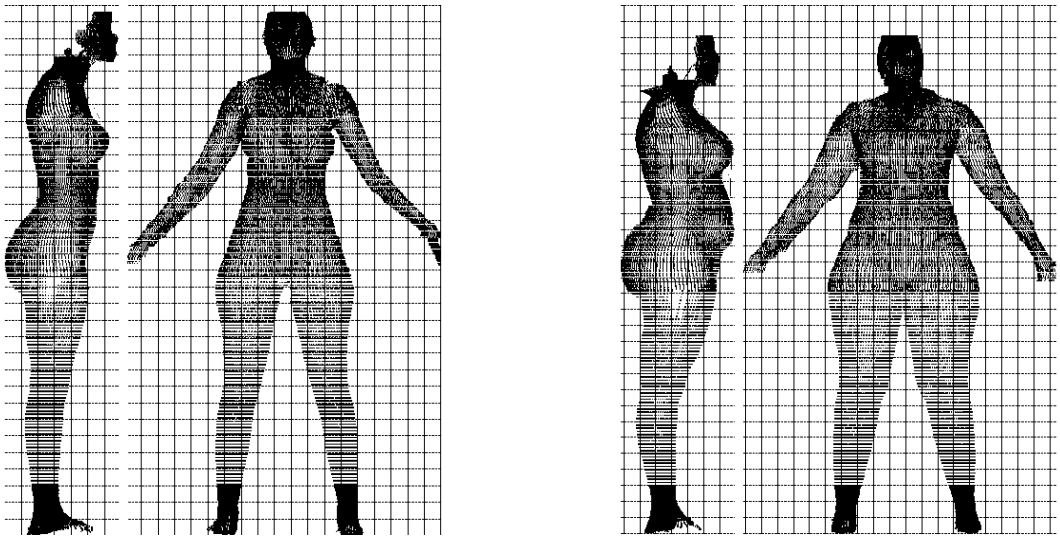
With the absence of representative anthropometric data of South African women, traditional size specifications (for body measurements) for the size 6/30 to size 14/38 size range were estimated from the measurements of the size 10/34 *Figure Forms* dress form. The body measurements for the size 6/30 to size 14/38 size range were estimated from the measurements of the size 10/34 *Figure Forms* dress form by adding or subtracting the grade for each measurement from the measurements of the size 10/34 *Figure Forms* dress form. The amount to be added or subtracted to each measurement was obtained from the grade for the particular measurement suggested by Handford's (2003) 1 ½-inch grading system for a basic sheath dress[19]. Therefore, the measurements for the traditional size specifications in table 6.2 are derived from the measurements of the size 10/34 *Figure Forms* dress form and are not representative of the actual body measurements used in the South African ready-to-wear apparel industry. However, for illustrative purposes they were considered representative since sizing in the apparel industry is based on the measurements of the sample size that are changed incrementally through grading (Keiser & Gamer, 2008:356; Keiser & Gamer, 2008:372; McCulloch *et al.,* 1998:492).

6.2.2.1 Comparative analysis of the horizontal measurements

Drop values were previously defined in the theoretical background as "distinct relationships between key dimensions that" define body shape (Gupta & Gangadhar, 2004:464). In table 6.2, drop values for the traditional size specifications and the experimental size specifications are shown. The traditional size specifications have a drop value of 7.00 cm between the hips and the bust, whereas the experimental size specifications have a drop value between the hips and the bust that ranges from 15.37 cm (for size 6/30) to 15.56 cm (for size 14/38). The smaller drop value between the hips and the bust in the traditional size specifications implies

[19] . Handford's (2003) 1 ½-inch grading system was also used to develop the traditional test garments in objective 2.

that the bust and hip measurements of the ideal body shape are similar. On the other hand, the larger drop value between the hips and the bust in the experimental size specifications indicates that the upper body of a South African female student of African descent with a triangular body shape is smaller than the lower body, as it can be seen in figure 6.1.



SIZE 6/30 SIZE 14/38

FIGURE 6.1: COMPARISON OF 3D BODY SCANS CLASSIFIED AS SIZE 6/30 AND SIZE 14/38

In table 6.2, the bust measurements and bust grades of the experimental size specifications are equal to the bust measurements and bust grades of the traditional size specifications since the bust measurements and bust grades of the experimental size specifications are based on those of the traditional size specifications as it was explained in chapter 4. With South African female students of African descent with triangular body shapes characterised by a lower body that is larger than the upper body, the estimated horizontal measurements of the upper body above the bust were consequently found to be smaller than those of the traditional size specifications with the exception for the bust span measurement (up to size 12/36). In table 6.2, the shoulder, across chest, and across back measurements of the experimental size specifications are smaller than those of the traditional size specifications.

TABLE 6.2: COMPARATIVE SIZE SPECIFICATIONS

HORIZONTAL MEASUREMENTS		6/30	Grade	8/32	Grade	10/34	Grade	12/36	Grade	14/38
Bust	Experimental	81.00	-4.00	85.00	-4.00	89.00	4.00	93.00	4.00	97.00
	Traditional	81.00	-4.00	85.00	-4.00	89.00	4.00	93.00	4.00	97.00
	Difference*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Waist	Experimental	70.08	-3.28	73.36	-3.28	76.64	3.28	79.92	3.28	83.20
	Traditional	61.00	-4.00	65.00	-4.00	69.00	4.00	73.00	4.00	77.00
	Difference*	9.08	0.72	8.36	0.72	7.64	-0.72	6.92	-0.72	6.20
Hips	Experimental	96.37	-4.05	100.42	-4.05	104.47	4.05	108.51	4.05	112.56
	Traditional	88.00	-4.00	92.00	-4.00	96.00	4.00	100.00	4.00	104.00
	Difference*	8.37	-0.05	8.42	-0.05	8.47	0.05	8.51	0.05	8.56
Shoulder	Experimental	11.05	-0.25	11.29	-0.25	11.54	0.25	11.78	0.25	12.03
	Traditional	12.33	-0.33	12.67	-0.33	13.00	0.33	13.33	0.33	13.67
	Difference*	-1.29	0.09	-1.37	0.09	-1.46	-0.09	-1.55	-0.09	-1.64
Across chest	Experimental	29.05	-1.21	30.27	-1.21	31.48	1.21	32.69	1.21	33.90
	Traditional	31.33	-1.33	32.67	-1.33	34.00	1.33	35.33	1.33	36.67
	Difference*	-2.28	0.12	-2.40	0.12	-2.52	-0.12	-2.64	-0.12	-2.76
Across back	Experimental	31.05	-0.72	31.77	-0.72	32.49	0.72	33.21	0.72	33.93
	Traditional	34.33	-1.33	35.67	-1.33	37.00	1.33	38.33	1.33	39.67
	Difference*	-3.28	0.61	-3.90	0.61	-4.51	-0.61	-5.13	-0.61	-5.74
Bust span	Experimental	17.66	-0.35	18.01	-0.35	18.36	0.35	18.70	0.35	19.05
	Traditional	16.67	-0.67	17.33	-0.67	18.00	0.67	18.67	0.67	19.33
	Difference*	0.99	0.32	0.68	0.32	0.36	-0.32	0.04	-0.32	-0.28
VERTICAL MEASUREMENTS		**6/30**	**Grade**	**8/32**	**Grade**	**10/34**	**Grade**	**12/36**	**Grade**	**14/38**
Centre front	Experimental	35.80	0.00	35.80	0.00	35.80	0.00	35.80	0.00	35.80
	Traditional	36.67	-0.67	37.33	-0.67	38.00	0.67	38.67	0.67	39.33
	Difference*	-0.87	0.67	-1.54	0.67	-2.20	-0.67	-2.87	-0.67	-3.54
Centre back	Experimental	40.38	0.00	40.38	0.00	40.38	0.00	40.38	0.00	40.38
	Traditional	40.33	-0.83	41.17	-0.83	42.00	0.83	42.83	0.83	43.67
	Difference*	0.05	0.83	-0.78	0.83	-1.62	-0.83	-2.45	-0.83	-3.28
Front shoulder height	Experimental	42.59	0.00	42.59	0.00	42.59	0.00	42.59	0.00	42.59
	Traditional	43.00	-1.00	44.00	-1.00	45.00	1.00	46.00	1.00	47.00
	Difference*	-0.41	1.00	-1.41	1.00	-2.41	-1.00	-3.41	-1.00	-4.41
Back shoulder height	Experimental	42.29	0.00	42.29	0.00	42.29	0.00	42.29	0.00	42.29
	Traditional	44.00	-1.00	45.00	-1.00	46.00	1.00	47.00	1.00	48.00
	Difference*	-1.71	1.00	-2.71	1.00	-3.71	-1.00	-4.71	-1.00	-5.71
Bust-to-waist	Experimental	17.40	0.00	17.40	0.00	17.40	0.00	17.40	0.00	17.40
	Traditional	15.83	-0.33	16.17	-0.33	16.50	0.33	16.83	0.33	17.17
	Difference*	1.57	0.33	1.23	0.33	0.90	-0.33	0.57	-0.33	0.23
Side seam	Experimental	23.92	0.00	23.92	0.00	23.92	0.00	23.92	0.00	23.92
	Traditional	19.33	-0.33	19.67	-0.33	20.00	0.33	20.33	0.33	20.67
	Difference*	4.59	0.33	4.26	0.33	3.92	-0.33	3.59	-0.33	3.26
Waist-to-hip	Experimental	21.26	0.00	21.26	0.00	21.26	0.00	21.26	0.00	21.26
	Traditional	18.67	-0.67	19.33	-0.67	20.00	0.67	20.67	0.67	21.33
	Difference*	2.59	0.67	1.93	0.67	1.26	-0.67	0.59	-0.67	-0.07
Waist-to-knee	Experimental	52.91	0.00	52.91	0.00	52.91	0.00	52.91	0.00	52.91
	Traditional	51.54	-1.00	52.54	-1.00	53.54	1.00	54.54	1.00	55.54
	Difference*	1.37	1.00	0.37	1.00	-0.63	-1.00	-1.63	-1.00	-2.63
DROP VALUES		**6/30**	**Grade**	**8/32**	**Grade**	**10/34**	**Grade**	**12/36**	**Grade**	**14/38**
Hip - Bust	Experimental	15.37	-	15.42	-	15.47	-	15.51	-	15.56
	Traditional	7.00	-	7.00	-	7.00	-	7.00	-	7.00
Bust - Waist	Experimental	10.92	-	11.64	-	12.36	-	13.08	-	13.80
	Traditional	20.00	-	20.00	-	20.00	-	20.00	-	20.00

*Measurements of the experimental size specifications subtracted from the measurements of the traditional size specifications

#All measurements are in centimetres

In addition, the estimated grades for the measurements of the upper body above the bust for the shoulder, across chest, across back, and bust span, in the experimental size specifications are smaller than the grades for the shoulder, across chest, across back, and bust span, in the traditional size specifications. With regard to the smaller estimated grades for the shoulder, across chest, across back, and bust span, the findings of this study are in accordance with the findings of other researchers. Previous studies suggest that the grades used in the apparel industry for the measurements of the upper body above the bust tend to be larger than necessary (Bye *et al.*, 2008:87-89; Schofield, 2007:189; Taylor & Shoben, 1984:56). Due to the incremental effect of grading, with an increase or decrease in size, the difference between the experimental size specifications and the traditional size specifications becomes larger as it can be seen in table 6.2, which may consequently lead to fitting problems.

The shoulder measurement for size 6/30 in the experimental size specifications is 1.29 cm smaller than the shoulder measurement for size 6/30 in the traditional size specifications. With change in size, the difference between the shoulder measurement of size 14/38 in the experimental size specifications and size 14/38 in the traditional size specifications increases to -1.64 cm (with the experimental size specifications having a smaller shoulder measurement), as it can be seen in table 6.2. The increase in the difference may be attributable to the estimated grade for the shoulder measurement in the experimental size specifications (0.25 cm for a 4 cm bust grade) being smaller than the grade for the shoulder measurement in the traditional size specifications (0.33 cm for a 4 cm bust grade). With the shoulder measurements of the experimental size specifications being smaller than the shoulder measurements of the traditional size specifications, South African female students of African descent with triangular body shapes may experience loose fit across their shoulders in garments sized according to the traditional size specifications due to their narrower shoulders. In confirmation, the test garments developed from the traditional size specifications were considered to have loose fit across the shoulders of the participants. Whereas, the test garments developed from the experimental size specifications were considered to have improved quality of fit across the shoulders.

The across chest measurement for size 6/30 in the experimental size specifications is 2.28 cm smaller than the across chest measurement for size 6/30 in the traditional size specifications. With change in size, the difference between the across chest measurement of size 14/38 in the experimental size specifications and size 14/38 in the traditional size specifications increases to -2.76 cm (with the experimental size specifications having a smaller across chest measurement), as it can be seen in table 6.2. The increase in the

difference may be attributable to the estimated grade for the across chest measurement in the experimental size specifications (1.21 cm for a 4 cm bust grade) being smaller than the grade for the across chest measurement in the traditional size specifications (1.33 cm for a 4 cm bust grade).

Due to the across chest measurements of the experimental size specifications being smaller than the across chest measurements of the traditional size specifications, South African female students of African descent with triangular body shapes may experience loose fit across the chest in garments sized according to the traditional size specifications. In confirmation, the test garments developed from the traditional size specifications were considered to have loose fit across the chests of the participants. Whereas, the test garments developed from the experimental size specifications were considered to have improved quality of fit across the chest despite also being considered to have loose fit across the chest. The loose fit across the chest of the test garments developed from the experimental size specifications may be attributable to the weak correlation (r_{xy}= 0.37) between the bust and across chest measurements.

The across back measurement for size 6/30 in the experimental size specifications is 3.28 cm smaller than the across back measurement for size 6/30 in the traditional size specifications. As it can be seen in table 6.2, with change in size the difference between the across back measurement of size 14/38 in the experimental size specifications and size 14/38 in the traditional size specifications increases to -5.74 cm (with the experimental size specifications having a smaller across back measurement). The increase in the difference may be attributable to the estimated grade for the across back measurement in the experimental size specifications (0.72 cm for a 4 cm bust grade) being smaller than the grade for the across back measurement in the traditional size specifications (1.33 cm for a 4 cm bust grade).

With smaller across back measurements, South African female students of African descent with triangular body shapes may experience loose fit across the upper back in garments sized according to the traditional size specifications. In confirmation, most of the test garments developed from the traditional size specifications were found to have loose fit across the upper back. Whereas, the test garments developed from the experimental size specifications were considered to have improved quality of fit across the upper back despite being considered to have tight fit. The tight fit across the upper back of the test garments developed from the experimental size specifications may be attributable to the weak correlation (r_{xy}= 0.33) between the bust and across back measurements.

With the experimental test garments considered to have tight fit across the upper back, the experimental test garments were also considered to have tight fit around the neckline. The tight fit around the necklines of the experimental test garments may be attributable to the opening of the neckline being based on the across back measurement in the basic sheath dress draft in Bergh (1995). With the low correlation between the bust and across back measurements, the experimental test garments consequently also had tight fit around the neckline.

Of the upper body measurements above the bust, the bust span measurement was the only measurement that was found to be larger in the experimental size specifications (up to size 12/36). The bust span measurement for size 6/30 in the experimental size specifications is 0.99 cm larger than the bust span measurement for size 6/30 in the traditional size specifications. With change in size, the difference between the experimental size specifications and the traditional size specifications reduces to almost 0 cm at size 12/36, and increases from size 14/38 onwards (with the traditional size specifications having a larger bust span measurement), as it can be seen in table 6.2. As a result, in garments sized according to the traditional size specifications, the smaller and larger sizes may have bust points that are misaligned with the bust points of the unit of analysis, whereas the bust points of the intermediate sizes may be better aligned with the bust points of the unit of analysis.

In table 6.2, the experimental size specifications have a smaller drop value between the bust and the waist, and a larger drop value between the hips and the bust. The drop values of the experimental size specifications suggest that South African female students of African descent with triangular body shapes have larger waist and hip measurements. In confirmation, both the waist and hip measurements of South African female students of African descent with triangular body shapes are larger in the experimental size specifications, as it can be seen in table 6.2. In Zwane and Magagula (2007:286), women with a triangular body shape were also found to have larger waist and hip measurements.

The waist measurement for size 6/30 in the experimental size specifications is 9.08 cm larger than the waist measurement for size 6/30 in the traditional size specifications. With change in size, the difference between the waist measurement of size 14/38 in the experimental size specifications and size 14/38 in the traditional size specifications decreases to 6.20 cm (with the experimental size specifications having a larger waist measurement). The decrease in the difference may be attributable to the grade for the waist measurement in the traditional

size specifications (4 cm for a 4 cm bust grade) being larger than the estimated grade for the waist (3.28 cm for a 4 cm bust grade) in the experimental size specifications.

Around the waist, the experimental test garments were considered to have loose fit despite being considered to have improved quality of fit. The loose fit around the waist may be attributable to the waist measurements of the participants being smaller than the waist measurements in the experimental size specifications, as it can be seen in table 6.1. The smaller waist measurements of most of the participants may have also led to the loose fit over the abdomen and the upper hips in the experimental test garments due to the larger drop between the waist and the hips.

The hip measurement for size 6/30 in the experimental size specifications is 8.37 cm larger than the hip measurement for size 6/30 in the traditional size specifications. As it can be seen in table 6.2, with change in size the difference between the hip measurement of size 14/38 in the experimental size specifications and size 14/38 in the traditional size specifications increases to 8.56 cm (with the experimental size specifications having a larger hip measurement). The increase in the difference may be attributable to the experimental size specifications having a marginally larger estimated grade for the hip measurement (4.05 cm for a 4 cm bust grade) compared to the grade for the hip measurement (4 cm for a 4 cm bust grade) in the traditional size specifications.

Around the hips, the test garments developed from the experimental size specifications were not considered to offer South African female students of African descent with a triangular body shape with improved quality of fit due to loose fit. The loose fit around the hips may be attributable to the ease that was included in the experimental test garments since most of the hip measurements of the participants were similar to those of the experimental size specifications, as it can be seen in table 6.1. The traditional test garments were considered to have better quality of fit around the hips due to the hips of the traditional test garments being slightly narrower than the hips of the experimental test garments, as it can be seen in figure 6.2. In future studies it is suggested that less ease should be added around the hips in order to improve the quality of fit around the hips of the experimental test garments.

With the horizontal lower body measurements of the experimental size specifications being larger than those of the traditional size specifications, the participants required a test garment sized according to the traditional size specifications that was two sizes larger than a test garment sized according to the experimental size specifications in order to accommodate their larger lower body measurements. Consequently the participants with their larger lower

body measurements, experienced loose fit in the upper body of the test garments sized according to the traditional size specifications due to the traditional test garments having being designed to fit the balanced ideal body shape.

Within the apparel industry, the bust, waist, and hip girths are assumed to change by the same amount with change in size (Cooklin, 1990:21), as it can be seen in the traditional size specifications in table 6.2. However, according to the experimental size specifications developed in the study, the bust, waist, and hip girths do not change by the same amount with change in size. In the experimental size specifications, the estimated grade for the hip girth (4.05 cm) is marginally larger than the grade of the bust girth (4.00 cm), whereas the estimated grade for the waist girth is considerably smaller than the grade of the bust girth (3.28 cm).

In addition, in table 6.2 it can be seen that the drop values of the traditional size specifications remain constant throughout the size range, thus suggesting that extra weight tends to be distributed evenly above and below the waist in the ideal body shape with increase in size. In the experimental size specifications, the drop value between the hips and the bust marginally increases across the size range, thus suggesting that extra weight mostly goes onto the lower torso in the triangular body shape with increase in size. In the experimental size specifications, the drop value between the bust and waist also increases across the size range, thus suggesting that in the triangular body shape the waist becomes proportionally smaller with increase in size. The findings of the study corroborate with Marshall *et al.* (2004:141) who are of the opinion that with change in size the different body shapes tend to increase the most in size where the silhouette of the body is already the heaviest. According to Marshall *et al.* (2004:141), in the ideal body shape extra weight tends to be distributed evenly above and below the waist due to the ideal body shape being balanced above and below the waist, whereas in the triangular body shape extra weight tends to be distributed to the lower body.

6.2.2.2 Comparative analysis of the vertical measurements

Most of the vertical measurements of the experimental size specifications are slightly shorter than the vertical measurements of the traditional size specifications, as it can be seen in table 6.2. The test garments developed from the experimental size specifications were considered to have better alignment in terms of the position of the bust and waist, thereby suggesting that the vertical measurements of the experimental size specifications are better

reflective of the vertical measurements of South African female students of African descent with triangular body shapes.

The experimental test garments despite being considered to have improved quality of fit in terms of the position of the bust in the test garments, the bust was considered to be placed too high in most of the test garments. The poor alignment between the busts of the experimental test garments and the busts of the participants may be attributable to the manner in which the vertical measurements of the experimental size specifications were calculated. As it was discussed in chapter 4, the vertical measurements of the experimental size specifications were kept constant throughout the size range. However, the negative relationship (r_{xy}=-0.45) between the bust and the bust-to-waist measurement[20] suggests that as the size of the bust increases the position of the bust also drops (i.e. bust-to-waist measurement becomes shorter with a larger bust measurement). The professionals considered the busts of the test garments to be better aligned with the busts of the participants in the smaller sizes, however, in the larger sizes the busts of the test garments were considered to be positioned too high in relation to the busts of the participants. In future studies, the bust-to-waist measurement may be calculated along with the rest of the horizontal measurements using least-squares regression analysis (with the bust measurement used as the independent variable) in order to have better alignment between the bust of the test garment and the bust of the participant.

The waistlines of all four traditional test garments were considered to be placed too low in relation to the waistlines of the participants; whereas the waistlines of three experimental test garments were considered to be well aligned with the waistlines of the participants. The waistline of the fourth experimental test garment was considered to be placed too high in relation to the waistline of the participant.

The hips of the experimental test garments were considered to be placed too high in relation to the hips of the participants, whereas the hips of the traditional test garments were considered to be well aligned with the hips of the participants. The poor alignment between the hips of the experimental test garments and the hips of the participants may also be attributable to the manner in which the vertical measurements of the experimental size specifications were calculated. Looking at the correlation coefficients computed in chapter 4, the waist-to-hip measurement has a mild relationship with the hip measurement (r_{xy}=-0.65). The mild relationship between the hip measurement and the waist-to-hip measurements

[20] The position of the bust is based on the bust-to-waist measurement.

suggests that as the size of the hips increase the hips are positioned lower, whereas in the experimental size specifications the waist-to-hip measurements remained constant throughout the size range. The professionals considered the hips of the test garments to be well positioned in the smaller sizes, however, in the larger sizes the hips of the test garments were considered to be positioned too high in relation to the hips of the participants. In future studies, the waist-to-hip measurement may also be calculated using least-squares regression analysis (with the hip measurement used as the independent variable) in order to have better alignment between the hips of the test garments and the hips of the participants.

In the experimental size specifications, the vertical measurements were not increased as the horizontal measurements increased since the findings of the correlation analysis in chapter 4 indicated a poor relationship between the horizontal measurements and the vertical measurements. However, in the traditional size specifications the vertical measurements increase as the horizontal measurements increase despite findings of previous anthropometric studies suggesting that the vertical measurements do not increase as the horizontal measurements increase (Faust & Carrier, 2010:93; Mpampa *et al.*, 2010:57; Petrova, 2007:67; Schofield & LaBat, 2005a:17; Gupta & Gangadhar, 2004:463; Schofield, 2000:82; Beazley, 1998:268; Chun-Yoon & Jasper, 1996:90; Taylor & Shoben, 1984:16).

6.2.2.3 Comparative analysis of the patterns sized according to the experimental size specifications and the traditional size specifications

In figure 6.2, the patterns sized according to the experimental size specifications and those sized according to the traditional size specifications were compared to illustrate the differences between the traditional size specifications and the experimental size specifications visually. The nests of graded patterns that were used to construct the test garments were used for the comparison; however, the intermediate sizes were omitted from the comparison to enhance clarity. Only the smallest and the largest sizes are shown in figure 6.2. The patterns were superimposed with a common zero point (at the base of the neckline).

In figure 6.2, the patterns sized according to the experimental size specifications are considerably smaller in the upper torso compared to the patterns sized according to the traditional size specifications, hence explaining the loose fit that was experienced in the upper torso in the traditional test garments. Below the waist, the patterns sized according to the experimental size specifications are larger than the patterns sized according to the traditional size specifications due to the unit of analysis being characterised by a larger lower

body. As it was discussed previously, the vertical measurements of South African female students of African descent with triangular body shapes are shorter as it can be seen in the experimental patterns in figure 6.2. Furthermore, the vertical measurements of the experimental patterns remained constant throughout the size range because the vertical measurements were kept constant, as it can be seen in figure 6.2. However, the vertical measurements in the traditional patterns are not static since traditional sizing assumes that height increases with an increase in the girth measurements.

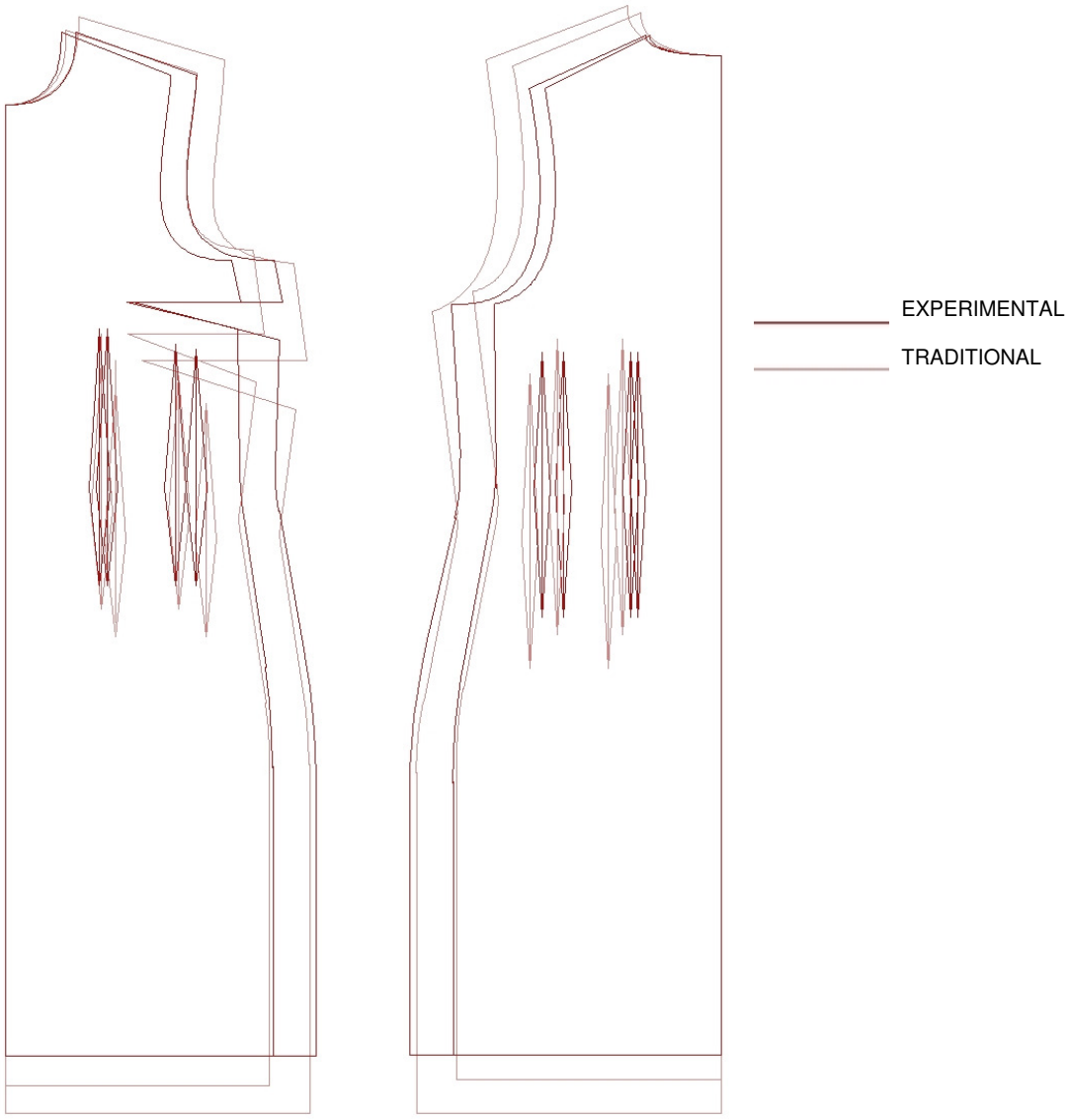


FIGURE 6.2: COMPARISON OF THE EXPERIMENTAL AND THE TRADITIONAL SETS OF GRADED PATTERNS

6.2.3 Recommendations for the South African ready-to-wear apparel industry

From the foregoing discussion and from the improved overall quality of fit attained from the experimental size specifications, suggestions are made to use the experimental size specifications as a guide to size and grade master patterns for South African women of African descent with a triangular body shape. The body measurements of the sample size may be taken directly from the experimental size specifications, whereas the grading system may be derived from the grades specified in the experimental size specifications.

According to Bye *et al.* (2008:86), the grades specified in size charts are not easily translated into grading systems. With the grades in size charts not easily translated into grading systems, grade rules for a simplified two-dimensional grading system were extracted from the nests of graded patterns developed from the experimental size specifications by measuring the distance between the cardinal points of two adjacent sizes. The grade rules for a simplified two-dimensional grading system that were extracted from the nests of graded patterns that were developed according to the experimental size specifications are shown in addendum D.

In the study, the nests of graded patterns developed according to the experimental size specifications were developed using the superimposed method of grading that requires two sets of master patterns. However, in the ready-to-wear apparel industry only one master pattern is made during the product development process. The grading system shown in addendum D is suitable for use in the apparel industry since it requires only one master pattern to develop patterns for the full size range.

With the variations and the abstract nature of size nomenclature in the apparel industry (Keiser & Garner, 2008:357; Schofield, 2000:35), it is recommended that the proposed sizing for South African female students of African descent with a triangular body shape be communicated to consumers using the guidelines recommended by the ISO. As it was stated in the theoretical background, findings of previous studies suggest that consumers prefer sizing nomenclature that makes use of a pictogram and key body dimensions (Marshall *et al.*, 2004:322). With clear communication of apparel sizing, increased satisfaction with the quality of fit of ready-to-wear apparel may be anticipated.

6.3 EVALUATION OF THE STUDY

In phase one of the study, the experimental size specifications were developed. With most statistical techniques used thus far in the development of size specifications being "based on complex mathematical calculations" (Gupta & Gangadhar, 2004:459), the development of the experimental size specifications on the findings of a small-scale anthropometric survey required simple statistical analysis. Complex statistical techniques, according to Beazley (1998:262-263), require a large sample of anthropometric data to produce worthwhile results. In this study, alternative statistical techniques suitable for use with non-representative anthropometric data were explored and were found to produce worthwhile results as demonstrated by the improved overall quality of fit attained from the experimental size specifications.

In the study, the experimental size specifications were developed by statistically analysing an anthropometric database of female students of the University of Pretoria. The anthropometric data used in this study was obtained from a subset of the anthropometric data gathered as part of Makhanya's (2012) doctoral research at the University of Pretoria. The anthropometric database consists of data gathered using a $[TC]^2$ three-dimensional body scanner in 2009. The anthropometric database used in this study is not representative of the general South African population due to the limited size of the database, consequently, the experimental size specifications developed in the study cannot be generalised on to the general South African population.

In the study, the methodology that was used to transform anthropometric data into experimental size specifications was as follows: (1) selection of appropriate anthropometric data for statistical analysis, (2) selection of the key dimensions using Pearson's correlation coefficient (r_{xy}), (3) determining the size range, (4) calculation of the secondary dimensions and the grade between sizes using least-squares regression analysis, and (5) compiling the experimental size specifications from the results of the preceding steps.

According to Beazley (1998:277-278), "professional statisticians find the complexities of clothing manufacture and retailing difficult to grasp … (while) … the majority in clothing manufacture and retailing are not familiar with statistical concepts". The methodology used in the study may prove useful for developing size specifications in the apparel industry, since the statistical techniques used in the study are easily performed in Microsoft Excel; furthermore, they do not require a large sample of anthropometric data to produce worthwhile results.

In phase two of the study, the quality of fit attained from the experimental size specifications and the traditional size specifications was evaluated. Non-probability purposive sampling techniques were used to select the participants on which the quality of fit of the test garments was evaluated on, to ensure that internal validity was attained. The sampling criterion that was used in the study to select the participants for the fit evaluation included aspects such as geographic location, population group, age group, and key dimensions, to ensure that the sample was homogenous and thereby attain internal validity.

The quality of fit attained from the experimental size specifications and the traditional size specifications was evaluated on one participant per size in consideration of the exploratory nature of the study and the time-consuming nature of fit evaluation (Petrova & Ashdown, 2008:234). By implication, the findings of the study cannot be generalised onto the general South African population.

All the test garments were constructed from the same fabric using the same construction techniques and by the researcher, to ensure that the test garments were homogenous in order to avoid bias during fit evaluation (Murphey, 1993:65). The quality of fit of the test garments was evaluated by a panel of professionals with experience in apparel fit evaluation. The panel consisted of professionals (i.e. academics), each with more than five years' experience, in teaching pattern design, pattern fitting, and garment construction. A structured questionnaire was used in the study to guide the evaluation of the quality of fit of the test garments. The questionnaire was based on the principles of apparel fit and the standards of apparel fit in order to attain criterion validity. In previous studies (Song & Ashdown, 2010; Bye *et al.*, 2008; Zwane & Magagula, 2007; Ashdown & O'Connell, 2006), the standards of apparel fit and the principles of apparel fit have been used as the criteria to measure the quality of fit of the test garments. The panel was given the standards on which to evaluate the quality of fit of the test garments to enhance interrater-reliability since the concept of appropriate fit varies amongst people (Ashdown & O'Connell, 2006:137; Leedy & Ormrod, 2010:93; Schofield, 2000:16). Furthermore, the questionnaire was peer reviewed prior to fit evaluation to ensure that content validity was attained.

Descriptive statistical techniques were used to analyse the quality of fit of the test garments due to the small sample that quality of fit was evaluated on and in view of the exploratory nature of the study. With a larger sample size, inferential statistics could have been used to draw conclusions regarding the quality of fit of the test garments in addition to the descriptive statistics that were used in the study. Furthermore, with a larger sample the findings of the

study could have been generalised on to the general South African population and thereby enhance the external validity of the findings.

6.4 LIMITATIONS OF THE STUDY AND RECOMMENDATIONS FOR FURTHER STUDY

The aim of this exploratory study was to develop experimental size specifications that will contribute towards the improvement of the quality of fit of ready-to-wear apparel for South African female students of African descent with a triangular body shape. The findings suggest that the aim of this study was achieved since the test garments developed from the experimental size specifications were found to have improved overall quality of fit. Despite the aim of this study being achieved, it should be noted that there were limitations to this study that provide basis for further study.

This study, as stated in the introductory chapter, was limited to developing experimental size specifications for the body measurements required for a basic sheath dress for South African female students of African descent with triangular body shapes. The experimental size specifications were developed for students of medium height, wearing size 6/30 to size 14/38, aged between 18 and 25 years, and enrolled at the University of Pretoria. This study was limited to this subset of the South African population since the anthropometric database used in the development of the experimental size specifications consisted of data gathered from students aged between 18 and 25 years at the University of Pretoria. Thus, the experimental size specifications developed in the study are not generalizable onto the entire South African population as the experimental size specifications were not developed from representative anthropometric data.

The experimental size specifications were limited to the size 6/30 to size 14/38 size range because most of the anthropometric data used in the development of the experimental size specifications fell into the size 6/30 to size 14/38 size range. The quality of fit attained from the experimental size specifications and the traditional size specifications was evaluated only up to size 12/36 as there were no individuals wearing size 14/38 willing to participate in the study.

In this study, a non-representative sample was used to evaluate the quality of fit of the test garments, as fit was evaluated on one participant per size due to the exploratory nature of this study and the time consuming nature of fit evaluation (Petrova & Ashdown, 2008:234). Due to the limited size of the sample used during fit evaluation, the quality of fit attained from

the experimental size specifications and the traditional size specifications is only indicative of the sample that quality of fit was evaluated on. In future studies, it is recommended that a larger representative sample be used to evaluate the quality of fit of the test garments in order to generalise the findings.

Regardless of the aforementioned limitations of this study, the implications of the findings of this study should not be regarded as insignificant. The findings of this exploratory study merit further research on apparel sizing within the South African context; such research may improve the quality of fit attained from ready-to-wear apparel in South Africa and may thus lead to increased levels of consumer satisfaction.

In view of the improved quality of fit attained from the experimental size specifications, the findings of the study warrant repeating the study with other body shapes found within the South African population. The findings of the study suggest that traditional size specifications do not adequately accommodate consumers with body shapes that differ from the ideal body shape. In a multicultural society such as South Africa, where the populace consists of various ethnic groups with differing body shapes, experimental size specifications need to be developed to accommodate the various body shapes found within the South African population. Such research has the potential of improving the quality of fit attained from ready-to-wear apparel in South Africa.

In future studies it is suggested that improvements should be made to the methodology used in this study to develop the experimental size specifications since the experimental size specifications were not considered to offer the unit of analysis with improved quality of fit in all areas of the test garment as shown in table 5.20. With further research and development, the methodology used in this study may provide a template for developing size specifications in the apparel industry since the experimental size specifications were considered to offer the unit of analysis with improved overall quality of fit.

The findings of the study indicate the need of a representative anthropometric survey of the South African population. Currently in South Africa, ready-to-wear apparel sizing is based on British anthropometric data published in 1957 (Zwane & Magagula, 2007:283; Strydom, 2006:217; Beazley, 1998:263), which does not reflect the shapes and the dimensions of contemporary South African female students of African descent with triangular body shapes. The findings of the study suggest that sizing based on British anthropometric data is inadequate at providing contemporary South African female students of African descent with triangular body shapes with ready-to-wear apparel with acceptable overall quality of fit. With

representative anthropometric data of the South African population available, improvements in the quality of fit of ready-to-wear apparel for South African women may be anticipated.

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ADDENDUM A

PARTICIPANT INFORMATION SHEET AND PARTICIPANT CONSENT FORM

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Natural and Agricultural Sciences
Department Of Consumer Science

March 08, 2012

Dear Participant,

RE: PARTICIPANT INFORMATION SHEET

I am a Master's student in Clothing Management at the Department of Consumer Science in the Faculty of Natural and Agricultural Sciences at the University of Pretoria. My dissertation is titled *Proposed sizing for South African female students of African descent with triangular shaped bodies".*

Most South African women of African descent appear to have triangular body shapes that differ from the ideal body shape that apparel sizing is presently based on. The findings of the study are expected to contribute towards the understanding of sizing for the South African triangular body shape, and may consequently lead to the improvement of the fit of ready-to-wear apparel for South African women with triangular-shaped bodies. Your assistance is needed in the evaluation of the quality of fit attained from the current methods used in the apparel industry and the quality of fit attained from the experimental methods developed in this study, by trying on the test garments during a fit evaluation session.

During the fit evaluation session the following will happen:

- Your body measurements (bust, waist, and hips) will be taken to enable the selection of correct sized test garments. A female assistant will be available to take your measurements if you feel uncomfortable with the male researcher taking your body measurements.
- A panel of professionals will evaluate the fit of the test garments you will be wearing.
- You will be expected to evaluate the comfort of each test garment on a short questionnaire. The questionnaire has five multiple choice questions that measure your perception of the fit of each test garment.

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- Photographs will be taken of you in each test garment you try on. The photographs will be included in the dissertation and in any publications that may emanate from the findings of this study. Your face will be masked from the photographs.

Your identity will be kept confidential. Codes such as, Participant A, Participant B, will used to identify you in the dissertation and in any subsequent publications in order to protect your identity. There will be a fitting room where you will change into the test garments in private.

Participation in the study is voluntary and you have the right to terminate your participation in the study at anytime without giving a reason. The fit evaluation session is expected not take more than thirty minutes. In compensation for the time you have taken to participate in the study, you will receive R 150 at the end of the fit session.

The study is funded by the National Research Foundation and the University of Pretoria, and has the approval of the Ethics Committee of the Faculty of Natural and Agricultural Sciences at the University of Pretoria. If you have any concerns about the way the fit evaluation session have been conducted please contact the Chair of the Ethics Committee at ethics.nas@up.ac.za. The findings of the study will be made available to you once the study is completed.

Thank you for reading this information sheet. Please indicate your consent to participate in study in the participant consent form.

Yours faithfully,

Amukelani Muthambi
(Student number: 252 353 72)

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Faculty of Natural and Agricultural Sciences
Department Of Consumer Science

PARTICIPANT CONSENT FORM

Title of Research Project: Proposed sizing for South African female students of African descent with triangular shaped bodies

Name of Researcher: Amukelani Muthambi (Student number: 252 353 72)

I confirm that I have read and understand the participant information sheet dated 08 March 2012. I confirm that I had the opportunity consider the information and to ask questions. I agree from my own will to participate in the study, and may terminate my participation in the study at anytime without giving a reason. I grant the researcher permission to use the data collected in the dissertation and in any subsequent publications that may emanate from the dissertation.

Name of the participant : _____

Signature of the participant : _____

Date : _____

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ADDENDUM B

QUESTIONNAIRE

UNIVERSITEIT VAN PRETORIA
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YUNIBESITHI YA PRETORIA

PROFESSIONAL FIT QUALITY EVALUATION QUESTIONNAIRE

FOR OFFICE USE

V0 ☐

Dear Professional,

Please evaluate the fit of the test garments. There is no "right" or "wrong" answer; only your honest opinion is sought. All information will be treated as confidential and your identity will not be revealed. Please complete all the questions.

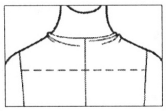
Evaluator:	
Size:	
Date:	

V1 ☐
V2 ☐

Please answer the question 1 to 17 by making a cross (x) in the appropriate block.

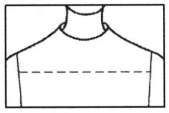
NECKLINE

1



The neckline is too tight.

The neckline is too loose.

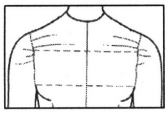


-4	-3	-2	-1	0	1	2	3	4

V3 ☐

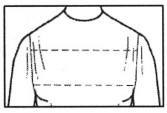
SHOULDERS

2



The bodice is too tight across the shoulders.

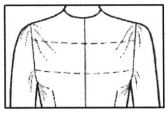
The bodice is too loose across the shoulders.



-4	-3	-2	-1	0	1	2	3	4

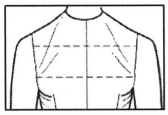
V4 ☐

3



The shoulders are too erect.

The shoulders are too sloped.

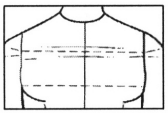


-4	-3	-2	-1	0	1	2	3	4

V5 ☐

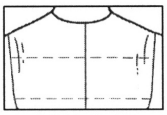
CHEST

4



The bodice is too tight across the chest.

The bodice is too loose across the chest.

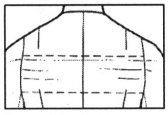


-4	-3	-2	-1	0	1	2	3	4

V6 ☐

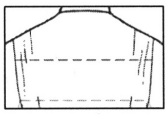
UPPER BACK

5



The bodice is too tight across the upper back.

The bodice is too loose across the upper back.

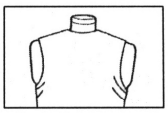


-4	-3	-2	-1	0	1	2	3	4

V7 ☐

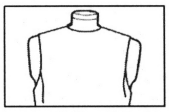
ARMHOLE

6



The armhole is too tight.

The armhole is too loose.

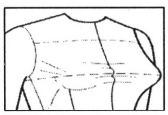


-4	-3	-2	-1	0	1	2	3	4

V8

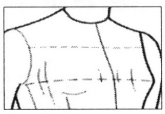
BUST

7



The bodice is too tight over the bust.

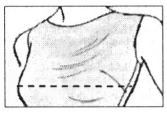
The bodice is too loose over the bust.



-4	-3	-2	-1	0	1	2	3	4

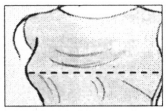
V9

8



Dart shaping lies above the bust.

Dart shaping lies below the bust.

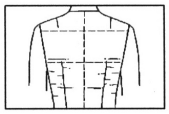


-4	-3	-2	-1	0	1	2	3	4

V10

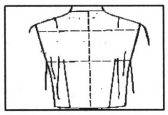
MIDRIFF

9



The bodice is too tight across the midriff.

The bodice is too loose across the midriff.

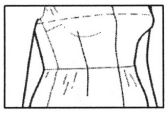


-4	-3	-2	-1	0	1	2	3	4

V11

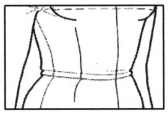
WAIST

10



The waistline rests above the body's waistline.

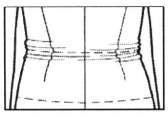
The waistline rests below the body's waistline.



-4	-3	-2	-1	0	1	2	3	4

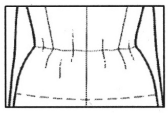
V12

11



The waistline of the dress is too tight.

The waistline of the dress is too loose.

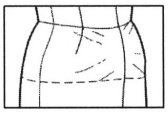


-4	-3	-2	-1	0	1	2	3	4

V13

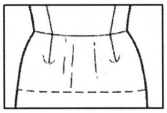
ABDOMEN

12



The skirt is too tight over the abdomen.

The skirt is too loose over the abdomen.

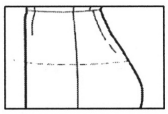


-4	-3	-2	-1	0	1	2	3	4

V14

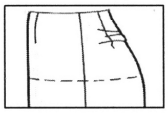
HIPS

13



The skirt's hipline is too high.

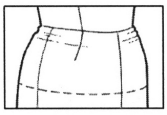
The skirt's hipline is too low.



-4	-3	-2	-1	0	1	2	3	4

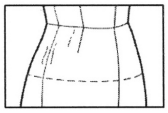
V15

14



The skirt is too tight across the upper hip area.

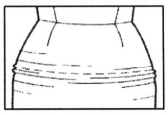
The skirt is too loose across the upper hip area.



-4	-3	-2	-1	0	1	2	3	4

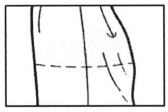
V16 ☐

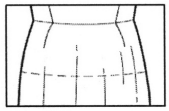
15



The skirt is too tight over the hips.

The skirt is too loose over the hips.



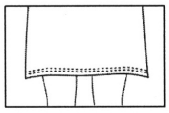


-4	-3	-2	-1	0	1	2	3	4

V17 ☐

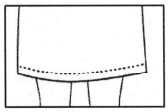
HEM

16



The hemline is pulling up at centre front.

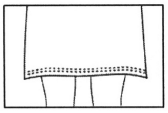
The hemline sags at centre front.



-4	-3	-2	-1	0	1	2	3	4

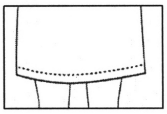
V18 ☐

17



The hemline is pulling up at centre back.

The hemline sags at centre back.



-4	-3	-2	-1	0	1	2	3	4

V19 ☐

CENTRE FRONT AND CENTRE BACK

18 Are centre front and centre back aligned to the centre of the body, and perpendicular to the floor?
(Please note your observations in the space provided below)

Centre front:
Centre back:

V20 ☐
V21 ☐

CROSSWISE GRAIN

19 Is the crosswise grain parallel to the floor at the following points?
(Please note your observations in the space provided below)

Chest:
Upper back:
Bust:
Hips:
Hem:

V22 ☐
V23 ☐
V24 ☐
V25 ☐
V26 ☐

LENGTHWISE GRAIN

Is the lengthwise grain parallel to centre front and centre back, and perpendicular to the floor?
(Please note your observations in the space provided below)

20

Centre front:
Centre back:

V27 ☐
V28 ☐

OVERALL FIT

Please evaluate the overall fit of the test garment on a scale of 1 to 9:

21

Poor fit | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Good fit

V29 ☐

PLEASE NOTE OTHER OBSERVATIONS IN THE SPACE PROVIDED BELOW:

Thank you for your valued assistance in this study.

ADDENDUM C

RAW DATA

TABLE C.1: QUALITY OF FIT OF THE SIZE 10/34 TEST GARMENT DEVELOPED ACCORDING TO THE TRADITIONAL SIZE SPECIFICATIONS

		JUDGE		
		A	B	C
1	The fit of the test garment around the neckline	0	0	0
2	The fit of the test garment across the shoulders	-	1	0
3	The alignment of the shoulders of the test garment with the shoulders of the participant	1	-1	0
4	The fit of the test garment across the chest	1	2	1
5	The fit of the test garment across the upper back	0	1	1
6	The fit of the test garment around the armhole	0	0	0
7	The fit of the test garment around the bust	2	3	2
8	The position of the bust on the test garment	3	3	3
9	The fit of the test garment around the midriff	2	2	3
10	The position of the waist on the test garment	1	1	0
11	The fit of the test garment around the waist	2	2	0
12	The fit of the test garment over the abdomen	1	1	0
13	The position of the hips on the test garment	0	0	0
14	The fit of the test garment around the upper hips	-1	0	0
15	The fit of the test garment around the hips	-1	0	0
16	The set of the hem at the front of the test garment	0	0	0
17	The set of the hem at the back of the test garment	-1	-1	0
18	Is the centre front aligned with the centre of the body and perpendicular to the floor?	Yes	Yes	Yes
	Is the centre back aligned with the centre of the body and perpendicular to the floor?	Yes	Yes	Yes
19	Is the crosswise grain parallel to the floor across the chest?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor across the upper back?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor at the bust?	Yes	No	Yes
	Is the crosswise grain parallel to the floor at the hips?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor at the hem?	No	No	Yes
20	Is the lengthwise grain parallel to centre front and perpendicular to the floor?	Yes	No	Yes
	Is the lengthwise grain parallel to centre back and perpendicular to the floor?	Yes	Yes	No
21	The overall fit of the test garment	5	4	6

TABLE C.2: QUALITY OF FIT OF THE SIZE 12/36 TEST GARMENT DEVELOPED ACCORDING TO THE TRADITIONAL SIZE SPECIFICATIONS

		JUDGE		
		A	B	C
1	The fit of the test garment around the neckline	0	0	0
2	The fit of the test garment across the shoulders	0	0	1
3	The alignment of the shoulders of the test garment with the shoulders of the participant	0	0	0
4	The fit of the test garment across the chest	1	1	1
5	The fit of the test garment across the upper back	2	1	2
6	The fit of the test garment around the armhole	0	2	1
7	The fit of the test garment around the bust	1	2	2
8	The position of the bust on the test garment	2	3	2
9	The fit of the test garment around the midriff	2	1	3
10	The position of the waist on the test garment	1	0	1
11	The fit of the test garment around the waist	2	1	1
12	The fit of the test garment over the abdomen	1	0	1
13	The position of the hips on the test garment	0	0	0
14	The fit of the test garment around the upper hips	0	0	1
15	The fit of the test garment around the hips	0	0	0
16	The set of the hem at the front of the test garment	0	1	0
17	The set of the hem at the back of the test garment	-1	-3	-1
18	Is the centre front aligned with the centre of the body and perpendicular to the floor?	Yes	Yes	Yes
	Is the centre back aligned with the centre of the body and perpendicular to the floor?	Yes	Yes	No
19	Is the crosswise grain parallel to the floor across the chest?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor across the upper back?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor at the bust?	Yes	No	Yes
	Is the crosswise grain parallel to the floor at the hips?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor at the hem?	Yes	No	No
20	Is the lengthwise grain parallel to centre front and perpendicular to the floor?	Yes	Yes	Yes
	Is the lengthwise grain parallel to centre back and perpendicular to the floor?	Yes	Yes	No
21	The overall fit of the test garment	6	4	5

TABLE C.3: QUALITY OF FIT OF THE SIZE 14/38 TEST GARMENT DEVELOPED ACCORDING TO THE TRADITIONAL SIZE SPECIFICATIONS

		JUDGE		
		A	B	C
1	The fit of the test garment around the neckline	0	0	1
2	The fit of the test garment across the shoulders	1	1	1
3	The alignment of the shoulders of the test garment with the shoulders of the participant	0	0	0
4	The fit of the test garment across the chest	1	2	1
5	The fit of the test garment across the upper back	0	0	0
6	The fit of the test garment around the armhole	-1	0	0
7	The fit of the test garment around the bust	0	1	1
8	The position of the bust on the test garment	1	1	2
9	The fit of the test garment around the midriff	1	0	1
10	The position of the waist on the test garment	1	0	1
11	The fit of the test garment around the waist	0	0	1
12	The fit of the test garment over the abdomen	0	-	0
13	The position of the hips on the test garment	0	0	0
14	The fit of the test garment around the upper hips	1	0	0
15	The fit of the test garment around the hips	0	0	0
16	The set of the hem at the front of the test garment	0	0	0
17	The set of the hem at the back of the test garment	-1	0	-2
18	Is the centre front aligned with the centre of the body and perpendicular to the floor?	Yes	Yes	Yes
	Is the centre back aligned with the centre of the body and perpendicular to the floor?	Yes	Yes	Yes
19	Is the crosswise grain parallel to the floor across the chest?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor across the upper back?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor at the bust?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor at the hips?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor at the hem?	Yes	Yes	Yes
20	Is the lengthwise grain parallel to centre front and perpendicular to the floor?	Yes	Yes	Yes
	Is the lengthwise grain parallel to centre back and perpendicular to the floor?	Yes	Yes	Yes
21	The overall fit of the test garment	7	7	6

TABLE C.4: QUALITY OF FIT OF THE SIZE 16/40 TEST GARMENT DEVELOPED ACCORDING TO THE TRADITIONAL SIZE SPECIFICATIONS

		JUDGE		
		A	B	C
1	The fit of the test garment around the neckline	0	0	0
2	The fit of the test garment across the shoulders	0	2	0
3	The alignment of the shoulders of the test garment with the shoulders of the participant	0	0	0
4	The fit of the test garment across the chest	1	2	0
5	The fit of the test garment across the upper back	2	3	2
6	The fit of the test garment around the armhole	0	3	0
7	The fit of the test garment around the bust	1	3	3
8	The position of the bust on the test garment	3	3	3
9	The fit of the test garment around the midriff	3	2	3
10	The position of the waist on the test garment	2	1	1
11	The fit of the test garment around the waist	1	0	0
12	The fit of the test garment over the abdomen	2	0	0
13	The position of the hips on the test garment	0	0	0
14	The fit of the test garment around the upper hips	-1	0	0
15	The fit of the test garment around the hips	-1	0	0
16	The set of the hem at the front of the test garment	0	0	0
17	The set of the hem at the back of the test garment	-1	-1	1
18	Is the centre front aligned with the centre of the body and perpendicular to the floor?	Yes	No	Yes
	Is the centre back aligned with the centre of the body and perpendicular to the floor?	Yes	Yes	Yes
19	Is the crosswise grain parallel to the floor across the chest?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor across the upper back?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor at the bust?	Yes	No	Yes
	Is the crosswise grain parallel to the floor at the hips?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor at the hem?	Yes	No	Yes
20	Is the lengthwise grain parallel to centre front and perpendicular to the floor?	Yes	Yes	Yes
	Is the lengthwise grain parallel to centre back and perpendicular to the floor?	Yes	Yes	Yes
21	The overall fit of the test garment	5	4	6

TABLE C.5: QUALITY OF FIT OF THE SIZE 6/30 TEST GARMENT DEVELOPED ACCORDING TO THE EXPERIMENTAL SIZE SPECIFICATIONS

		JUDGE		
		A	B	C
1	The fit of the test garment around the neckline	-3	0	-2
2	The fit of the test garment across the shoulders	0	0	-2
3	The alignment of the shoulders of the test garment with the shoulders of the participant	0	-1	0
4	The fit of the test garment across the chest	2	0	0
5	The fit of the test garment across the upper back	0	0	0
6	The fit of the test garment around the armhole	0	0	0
7	The fit of the test garment around the bust	0	0	0
8	The position of the bust on the test garment	0	0	0
9	The fit of the test garment around the midriff	0	0	-1
10	The position of the waist on the test garment	0	-1	0
11	The fit of the test garment around the waist	0	1	0
12	The fit of the test garment over the abdomen	2	1	0
13	The position of the hips on the test garment	0	0	0
14	The fit of the test garment around the upper hips	2	1	0
15	The fit of the test garment around the hips	0	0	0
16	The set of the hem at the front of the test garment	0	0	0
17	The set of the hem at the back of the test garment	0	0	0
18	Is the centre front aligned with the centre of the body and perpendicular to the floor?	Yes	Yes	Yes
	Is the centre back aligned with the centre of the body and perpendicular to the floor?	Yes	Yes	Yes
19	Is the crosswise grain parallel to the floor across the chest?	Yes	No	Yes
	Is the crosswise grain parallel to the floor across the upper back?	Yes	Yes	No
	Is the crosswise grain parallel to the floor at the bust?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor at the hips?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor at the hem?	Yes	Yes	Yes
20	Is the lengthwise grain parallel to centre front and perpendicular to the floor?	Yes	Yes	Yes
	Is the lengthwise grain parallel to centre back and perpendicular to the floor?	Yes	Yes	Yes
21	The overall fit of the test garment	7	6	7

TABLE C.6: QUALITY OF FIT OF THE SIZE 8/32 TEST GARMENT DEVELOPED ACCORDING TO THE EXPERIMENTAL SIZE SPECIFICATIONS

		JUDGE		
		A	B	C
1	The fit of the test garment around the neckline	-1	0	-1
2	The fit of the test garment across the shoulders	0	0	0
3	The alignment of the shoulders of the test garment with the shoulders of the participant	0	0	0
4	The fit of the test garment across the chest	0	0	0
5	The fit of the test garment across the upper back	0	0	-1
6	The fit of the test garment around the armhole	0	0	0
7	The fit of the test garment around the bust	0	0	0
8	The position of the bust on the test garment	-1	-1	-1
9	The fit of the test garment around the midriff	1	0	-1
10	The position of the waist on the test garment	0	0	0
11	The fit of the test garment around the waist	1	0	0
12	The fit of the test garment over the abdomen	1	0	1
13	The position of the hips on the test garment	0	0	0
14	The fit of the test garment around the upper hips	1	0	0
15	The fit of the test garment around the hips	0	0	1
16	The set of the hem at the front of the test garment	0	0	0
17	The set of the hem at the back of the test garment	0	0	0
18	Is the centre front aligned with the centre of the body and perpendicular to the floor?	Yes	Yes	Yes
	Is the centre back aligned with the centre of the body and perpendicular to the floor?	Yes	Yes	No
19	Is the crosswise grain parallel to the floor across the chest?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor across the upper back?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor at the bust?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor at the hips?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor at the hem?	Yes	Yes	Yes
20	Is the lengthwise grain parallel to centre front and perpendicular to the floor?	Yes	Yes	No
	Is the lengthwise grain parallel to centre back and perpendicular to the floor?	Yes	Yes	No
21	The overall fit of the test garment	8	8	7

TABLE C.7: QUALITY OF FIT OF THE SIZE 10/34 TEST GARMENT DEVELOPED ACCORDING TO THE TRADITIONAL SIZE SPECIFICATIONS

		JUDGE		
		A	B	C
1	The fit of the test garment around the neckline	0	0	0
2	The fit of the test garment across the shoulders	0	0	0
3	The alignment of the shoulders of the test garment with the shoulders of the participant	0	0	0
4	The fit of the test garment across the chest	0	0	0
5	The fit of the test garment across the upper back	0	0	-1
6	The fit of the test garment around the armhole	0	0	0
7	The fit of the test garment around the bust	0	0	0
8	The position of the bust on the test garment	1	-1	-1
9	The fit of the test garment around the midriff	0	0	0
10	The position of the waist on the test garment	0	0	0
11	The fit of the test garment around the waist	0	0	1
12	The fit of the test garment over the abdomen	1	0	1
13	The position of the hips on the test garment	-1	0	-1
14	The fit of the test garment around the upper hips	2	1	1
15	The fit of the test garment around the hips	0	1	1
16	The set of the hem at the front of the test garment	0	0	1
17	The set of the hem at the back of the test garment	0	0	0
18	Is the centre front aligned with the centre of the body and perpendicular to the floor?	Yes	Yes	Yes
	Is the centre back aligned with the centre of the body and perpendicular to the floor?	Yes	Yes	Yes
19	Is the crosswise grain parallel to the floor across the chest?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor across the upper back?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor at the bust?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor at the hips?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor at the hem?	Yes	Yes	Yes
20	Is the lengthwise grain parallel to centre front and perpendicular to the floor?	Yes	Yes	Yes
	Is the lengthwise grain parallel to centre back and perpendicular to the floor?	Yes	Yes	Yes
21	The overall fit of the test garment	8	8	7

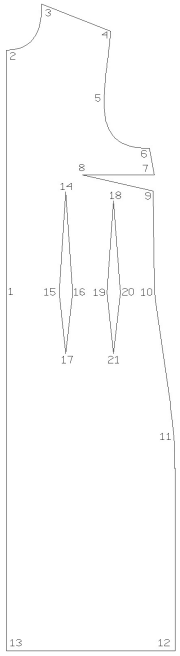
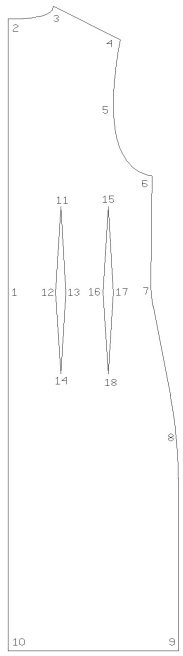
TABLE C.8: QUALITY OF FIT OF THE SIZE 12/36 TEST GARMENT DEVELOPED ACCORDING TO THE TRADITIONAL SIZE SPECIFICATIONS

		JUDGE		
		A	B	C
1	The fit of the test garment around the neckline	0	0	1
2	The fit of the test garment across the shoulders	2	0	0
3	The alignment of the shoulders of the test garment with the shoulders of the participant	-1	0	3
4	The fit of the test garment across the chest	2	2	0
5	The fit of the test garment across the upper back	0	0	-1
6	The fit of the test garment around the armhole	0	0	0
7	The fit of the test garment around the bust	0	0	0
8	The position of the bust on the test garment	-3	-2	-3
9	The fit of the test garment around the midriff	0	0	0
10	The position of the waist on the test garment	0	0	0
11	The fit of the test garment around the waist	0	0	0
12	The fit of the test garment over the abdomen	1	0	1
13	The position of the hips on the test garment	0	-1	0
14	The fit of the test garment around the upper hips	2	2	1
15	The fit of the test garment around the hips	0	1	0
16	The set of the hem at the front of the test garment	0	0	0
17	The set of the hem at the back of the test garment	0	0	1
18	Is the centre front aligned with the centre of the body and perpendicular to the floor?	Yes	Yes	Yes
	Is the centre back aligned with the centre of the body and perpendicular to the floor?	Yes	Yes	No
19	Is the crosswise grain parallel to the floor across the chest?	No	Yes	Yes
	Is the crosswise grain parallel to the floor across the upper back?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor at the bust?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor at the hips?	Yes	Yes	Yes
	Is the crosswise grain parallel to the floor at the hem?	Yes	Yes	Yes
20	Is the lengthwise grain parallel to centre front and perpendicular to the floor?	Yes	Yes	Yes
	Is the lengthwise grain parallel to centre back and perpendicular to the floor?	Yes	Yes	No
21	The overall fit of the test garment	7	7	7

ADDENDUM D

EXPERIMENTAL TWO-DIMENSIONAL GRADING SYSTEM FOR A BASIC SHEATH DRESS

TABLE D.1: EXPERIMENTAL TWO-DIMENSIONAL GRADING SYSTEM FOR A BASIC SHEATH DRESS

BASIC SHEATH DRESS (FRONT)				
	GRADE RULE	***x***	***y***	
1	Zero point/ waist/ centre front	0.0	0.0	
2	Lower neckline/ centre front	0.0	0.0	
3	Upper neckline/ shoulder	3.4	0.0	
4	Shoulder/ armhole	6.1	0.0	
5	Armhole/ across chest	6.1	0.0	
6	Bust/ armhole/ side seam	10.0	0.0	
7	Upper dart leg of bust dart/ side seam	10.0	0.0	
8	Bust point/ dart point of bust dart	1.7	0.0	
9	Lower dart leg of bust dart/ side seam	9.6	-2.6	
10	Waist/ side seam	8.2	0.0	
11	Hip/ side seam	10.1	0.0	
12	Side seam/ hem	10.1	0.0	
13	Centre front/ hem	0.0	0.0	
14	Upper dart point of first dart/ bust point	1.7	0.0	
15	Inner dart leg of first dart	1.7	0.0	
16	Outer dart leg of first dart	1.7	0.0	
17	Lower dart point of first dart	1.7	0.0	
18	Upper dart point of second dart	5.0	-1.3	
19	Inner dart leg of second dart	5.0	0.0	
20	Outer dart leg of second dart	5.0	0.0	
21	Lower dart point of second dart	5.0	0.0	
BASIC SHEATH DRESS (BACK)				
	GRADE RULE	***x***	***y***	
1	Zero point/ waist/ centre back	0.0	0.0	
2	Lower neckline/ centre back	0.0	0.0	
3	Upper neckline/ shoulder	0.9	0.0	
4	Shoulder/ armhole	3.6	0.0	
5	Armhole/ across back	3.6	0.0	
6	Bust/ armhole/ side seam	10.0	0.0	
7	Waist/ side seam	8.2	0.0	
8	Hip/ side seam	10.1	0.0	
9	Side seam/ hem	10.1	0.0	
10	Centre back/ hem	0.0	0.0	
11	Upper dart point of first dart	1.8	0.0	
12	Inner dart leg of first dart	1.8	0.0	
13	Outer dart leg of first dart	1.8	0.0	
14	Lower dart point of first dart	1.8	0.0	
15	Upper dart point of second dart	5.0	0.0	
16	Inner dart leg of second dart	5.0	0.0	
17	Outer dart leg of second dart	5.0	0.0	
18	Lower dart point of second dart	5.0	0.0	

*All measurements are in millimetres