THE BODY AS SEPARATES: AN EXPLORATION IN WOMEN’S SIZE DEFINITIONS FOR MASS MARKET APPAREL BASED ON THE BODY AS SEPARATE PARTS

Project Exegesis

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Textiles – Master of Technology by Research

2009

RMIT
Acknowledgements

I wish to thank the following for their generous help and assistance:

David and Charlie Ettershank, and Daphne Woods for their love, encouragement, and endless support.

Juliette Peers and Keith Cowlishaw for academic supervision and motivation.

Kerry Jennings for assisting with proofing.

Jo Kellock and Claire Fitzpatrick for their ongoing encouragement and industry advice.

Barbara Davis for the loan of the Berlei Figure Type Indicator.

Amanda Paterson for providing access to the RAW database.

Paul Wilson, Powerhouse Museum, for assistance with material from the Berlei Archive.

Lise Mellor, Sydney Medical School History Projects and Publications, for instigating the search for archival material.

David Bruner [TC]² for the approval to use three dimensional scan data.

Mark Michel for assistance with data analysis.

This work is dedicated to Noreen Kennedy, my Mother and atelier who inspired my career
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THE BODY AS SEPARATES: AN EXPLORATION IN WOMEN’S SIZE DEFINITIONS FOR MASS MARKET APPAREL BASED ON THE BODY AS SEPARATE PARTS
1 INTRODUCTION

1.1 Research Methodology

This research has been undertaken by theoretical and practical investigation via a critique of the historical and contemporary topics surrounding women’s apparel size definitions. This analysis has informed the development of an alternative size model to assist design and production of mass market apparel. There is expectation from both apparel manufacturers and consumers that apparel standards are necessary for the efficient production and distribution of mass market apparel. This is predominantly a post second world war phenomenon to firstly, efficiently mass produce apparel and, secondly, direct consumers to the most suitable size. Standards inherently demand strict compliance (with their terms) to successfully maintain their purpose. The act of deviation from the terms subsequently renders them non-compliant and undermines credibility, the impact of which is rarely addressed in a professional context.

It is broadly considered in industry, fashion education and popular media that the fit of women’s clothing sold in Australia is inconsistent and does not conform to a size standard. The current technical framework that directs the design and production of apparel is a flawed model based on an obsolete clothing standard, inherited practice and professional assumptions. However, demand for consistent and contemporary clothing standards is high. The question exists nevertheless: to what degree can standardisation of apparel be achieved, considering the contradictions between the prescriptive nature of a standard and the complexities of the function of apparel as the sartorial expression of contemporary social trends? The essence of this research investigates, from a practitioner’s perspective, alternate approaches to, and views of, apparel size by prototyping models that facilitate a self-determined quantifiable approach. It explores whether anthropometric diversity rather than conformity can be represented and how to approach size definition outside the didactic standardisation framework. An understanding of anthropometric measurement and data is now a necessary part of apparel practitioner knowledge (Otieno 2008, p. 63). How to apply data to develop appropriate fit profiles, according to market definitions is a fundamental skill. It is no longer feasible to expect that a standard data set is sufficient to achieve a satisfactory outcome for the complex requirements of the modern apparel consumer.

The rationale for the primary investigation was to deconstruct the premise of clothing size as defined in the Australian Standard AS1344-1997: Size coding scheme for women’s clothing – Underwear, outerwear and foundation garments (Standards Australia 1997) via a theoretical critique of its technical structure. Inherently its format requires conformity to conditions such as wearing a foundation garment to achieve the prescribed ‘average’ shape regardless of actual body size, undermining its technical and cultural relevance. The prescribed shape of the ‘average’ figure identified in AS1344-1997 represents an hourglass shape and depends on a fixed relationship between bust, waist and hip. The standard primarily operates in this mode as it represents women’s dress culture of the late 1960s (when it was introduced). This mode is defined in a number of size standards including the United States standard ASTM D 5585 and can be described as ‘monomodal’ as it embodies one body form. It has a limited capacity to represent the anthropometric diversity of the modern consumer in a non-dictatorial fashion paradigm. What has evolved as a consequence of these demands and in the absence of an informed methodology is an ad hoc approach resulting in skewed size specifications beyond an identifiable norm. Conflating issues around body image and
obesity with clothing size has added another potential for error. Apparel size is often mistakenly cited as the social benchmarking measurement tool for women's bodies. Thus, this research has ramifications beyond the industrial issues of fit and production.

Deconstructing the principle of the monomodal format espoused in AS1344-1997 literally bifurcates the body into separate zones according to 1) the lower body and 2) the upper body, making it possible to construct a multimodal prototype model. This prototype is multimodal because it allows for the selection of lower body size independently of upper body size and when combined creates a customised approach for size definition.

While possibly appearing to disjoint the female form, further consideration shows that this approach is the common mode for garment size selection amongst retail consumers: garments that fit the lower body e.g. skirts and trousers, and garments that fit the upper body e.g. jackets, blouses and dresses. In the case of the skirt the primary measurement is the hip and for the upper body it is the chest. The fitting of a skirt is not dependent on chest size. This approach has the potential for greater representation within the current market conditions. Such formats have been proposed by the European Committee for Standardization CEN/TC 248/WG 10 with the European Standard EN 13402 for labelling clothing sizes. (Wikipedia, EN13402).

The theoretical and practical investigation in this exegesis responds to three central research questions:

What are the parameters for a definition of women’s size based on separate parts?

To transmit this definition to a working technical model:

What is the technical framework that best suits this definition?

To examine if this model facilitates size and shape customisation for development of mass market apparel:

What do the definitions look like in the constructed form and how are they applied?

The enquiry has an industrial as well as a theoretical underpinning and has been informed by the author’s practitioner knowledge in developing apparel for the corporate or uniform market for many of Australia’s major public and private corporations since the early 1990s. This sector provides an alternative perspective to apparel design and development, primarily because it places functionality over fashionability and thus operates on a different supply cycle to the fashion model. Technical information on body dimensions for all age groups, rather than the often narrowly targeted fashion consumer, is required to develop effective corporate product. A viable working knowledge not based on incorrect assumptions of the body is necessary, as garment size must be accountable. This condition of fit for a wide range of consumers is also pertinent to internet online apparel shopping where trying garments on is not possible. The current perspective in Australia is still dependent on a

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1 The notion of quantifying if a sizing system based on a garment driven model would be a more efficient approach evolved during my career as a designer and product developer of uniform apparel for Australian corporations such as Telstra, Australia Post, Department of Defence, NAB, ANZ, CML, Big W, NSW Health, NSW RailCorp, KFC, and Pizza Hut; and the 2000 and 2004 Australian Paralympic teams. It became apparent that the limited size framework for women’s clothing misrepresented shape diversity and imposed size stereotypes that inhibited design and supply options.
dominant sizing culture instilled in AS1344-1997, which is well cited as not meeting consumer or industry needs (Brown 2009).

1.1.1 Research in an historical context

Having been nominated in 1994 to the Standards Australia Committee CS-092 Sizing Systems for Clothing by the Council of Textile and Fashion Industries of Australia (TFIA) to represent and inform the industry, the author has had a significant exposure to this issue during her career. The size reform agenda continues to focus on industry and consumer demands for a standard based on reliable anthropometric data. In May 2009, consumer group Choice highlighted the issue of inconsistent sizing in an online forum ‘Clothing Size Irregularities’, stating that ‘sizing inconsistencies pose real difficulties for clothes shopping online’ (Brown 2009).

A quote from the introduction to the 1941 US Department of Agriculture publication Women’s Measurements for garment and Pattern Construction (O'Brien & Shelton 1941, p. 1) ‘Garments labelled the same size but made by different manufacturers vary greatly, and few of them fit without alteration’, shows that this issue has indeed been on the agenda for over half a century.

Anthropometric surveys are frequently seen as a way to solve this problem; certainly O'Brien & Shelton’s 1941 report proposed such. Yet ten years after it was enacted as the first United States (US) Standard, the Mail Order Association of America requested it be amended (National Bureau of Standards 1971, p. 14), highlighting that surveys do not necessarily provide the perfect or long term solution to this problem.

As valid anthropometric surveys undertaken in the public domain are expensive and logistically difficult projects, there is not likely to be a solution to this problem within the foreseeable future. Accordingly, an approach that deconstructs the current framework and builds a new model based on available knowledge and practical industry based research offers a viable way forward. Ironically, this approach was employed in the past by the Berlei corset company in 1926 when they undertook extensive industry funded scientific research to resolve a similar problem. The extent of the relevance of the Berlei research to directly inform this project became apparent in the later stages of the research journey, providing the greatest methodological direction in quantifying the body as separates model.

1.1.2 Research in a dynamic context

Additionally this research has been informed by an International Specialised Skills Institute (ISS Institute) overseas study fellowship sponsored by the Department of Education, Employment and Workplace Relations (DEEWR). The study provided the opportunity to gain first hand and direct source information on SizeUSA, SizeUK and the French National Measurement Campaign. Much of the information around these projects is not published because they are restricted by proprietary ‘commercial in confidence’, making it difficult to assess their effectiveness. Discussing first hand information around logistics and applications of data to assist with apparel size reform provided an invaluable off-the-record resource for this research.

It has continued to become apparent throughout the research journey that large scale anthropometric surveys undertaken by three dimensional body scanning technologies, while assisting the measurement capture, do not directly resolve apparel sizing problems. In many respects it is what has not happened to survey data that is of greater interest than the effect on current...
industry practice. For example no new sizing standards have been adopted, including little evidence of take up of the proposed European Standard EN 13402.

The report from the international study *3 Dimensional Body Scanning Techniques and Applications for the Australian Apparel Industry* was launched at an industry forum *Forming a TCF Future: Showcasing Textile Clothing and Footwear Innovation Beyond 2010* at Parliament House in Canberra 22 September 2009. Consequently the report has directed the Textile Clothing and Footwear (TCF) Policy Group within the Department of Innovation Industry, Science and Research on three dimensional body applications. A copy of this report is included in the appendix.

During the course of this research there have been a number of developments in areas that directly relate to this topic within the Australian TCF industry. Most notable has been the withdrawal of *AS1344-1997* by Standards Australia (March 2009) at the request the Fashion Technicians Association of Australia (FTAA)\(^2\). In addition, Recommendation 10 of the Australian Government’s 2008 review of the TCF industry, *Building Innovative Capability*, has advanced the issue to a new level:

> A new Australia National Sizing Standard for clothing and footwear is long overdue and should be developed as a matter of urgency, with a funding allocation of $5 million, to meet the changing needs of customers and ensure that Australia TCF firms and organisations are not placed at a competitive disadvantage (Green 2008, p. 111).

The Government’s response to the report in the May 2009 budget announced ‘innovation and renewal in the Australian textiles, clothing and footwear (TCF) industries’ by commissioning ...

> the TCF Industries Innovation Council to provide further advice on the introduction of a voluntary ethical quality mark, voluntary national sizing standards for clothing and footwear, and a national anthropometric (human measurement) database; ... (Carr 2009).

This resulted in the National Measurement Institute (NMI) undertaking a scoping exercise to report to the TCF Industries Innovation Council on the requirements for developing a national sizing standard and anthropometric database. The author has been engaged to inform this process.


> stocking a broader range of sizing that reflects the diversity of Australian body sizes

and

> reflecting these sizes with a more diverse and realistic range of mannequins (The National Advisory Group on Body Image 2009, p. 23)

has ensured that this topic maintains a high profile and has continued to drive the reflective and dynamic research methodology for this exegesis.

\(^2\) The author is a member of the FTAA.
1.2 **Content Overview**

The theoretical underpinnings for this exegesis are drawn from three referred papers presented at conferences over the course of the research candidature. This research and investigation has instructed the development of the shape schema and research tools that has allowed for the schema to be quantified. The most significant body of knowledge has evolved around the unearthing of the methodology employed by the Berlei Corset Company to develop their typological shape model in 1927. Whilst the Berlei Corset Company has been the subject of previous scholarly studies, this is the first time it has been examined with a view to assessing its value in terms of workplace innovation as well as its cultural and historical value.

1.2.1 **What size am I?**

The first paper, presented at the Cultural Studies Association of Australasia’s Annual Conference 2006 titled, *What size am I?: Decoding women’s clothing size*, explores the background to clothing size culture in Australia. It critiques the system of size codification for women’s clothing sold in Australia and poses issues around the definition of women’s size. Subsequently, this paper was referred to in the journal *Fashion Theory*, Volume 13, Issue 4. It forms the basis for Chapter 2.

This paper was also presented to students from the Department of Fibre Science and Apparel Design at Cornell University and at an industry seminar at [TC]2 (the Textile/Clothing Technology Corporation) in North Carolina in April 2007, while undertaking the ISS Institute international study fellowship.

Reference material was predominantly drawn from primary sources and the availability of some of this source material expanded during the course of the project. An analysis of *AS1344-1997* revealed the major link to the history of women’s clothing in Australia via its various editions. In the initial paper, the significance of the Berlei 1926 anthropometric research was not fully realised, including its possible influence on the O’Brien and Shelton (1941) publication, *Women’s Measurements for Garment and Pattern Construction*. The *Sizing for the Clothing Industry Using Principal Component Analysis – An Example* publication by Veitch, Veitch & Henneberg, 2007 has updated the mean size data for the *Size and Shape Survey* previously unavailable. The *Standards Australia sizing system: quantifying the mismatch*, (Honey & Olds 2007) has also confirmed data for this research.

*Clothing Sizes International Standardization*, by Winks (1997) has provided a comparative resource on international sizing systems. Two Australian Bureau of Statistics (ABS) reports, *How Australians Measure Up*, (Australian Bureau of Statistics 1995a) and *National Nutrition Survey: National Nutrition Survey Selected Highlights* (Australian Bureau of Statistics 1995b) have been used as a reference for nutritional and health statistics for the Australian population. Sue Best’s (1991) seminal paper ‘Foundations of Femininity: Berlei Corsets and the (Un)making of the Modern Body’ has informed the research from a feminist perspective on the relationship between the constructed and the unconstructed body. However it is equally possible to challenge Best’s critique via industry practice that affirms the Berlei technical methodology.

1.2.2 **Critical mass**

*Critical mass: how size inflation is displacing small* was presented in 2008, at the IFFTI conference, *The Body: Connections with Fashion*, and forms Chapter 3. It primarily investigates issues that have contributed to size dysfunction from ad hoc approaches to size: the system of identifying clothing by
a number or code that does not reference body size. ‘Ad-hoc sizes have changed with time, often due to 
vanity labelling, an inflation in body dimensions associated with a size, to avoid confronting aging 
customers with uncomfortable anthropometric truth’ (Wikipedia, EN13402). It questions if size 
inflation is a deliberate strategy of deceit or simply a technical adjustment by apparel companies to 
produce garments to fit an expanding market demographic.

It is possible to argue the size culture inherent in 
L9: Size coding scheme for women’s clothing when 
first adopted as the technical framework for mass market apparel in Australia in the early ’70s, was a 
plausible representation of female size. It identified size 16 as the ‘average’ woman’s size with 
measurements of bust/chest 95 cm, waist 75 cm, and hip 100 cm. This is supported by the definition 
of the size of an 18 year old in AS1182-1980: Size coding scheme for infants’ and children’s clothing – 
Underwear and outerwear, with identical girth measurements. Today this size definition is closer to 
that labelled a size 12 by Myer (bust 95 cm, waist 75 cm, and hip 102 cm) (QAM 1995).

Has the average woman increased or has size 12 been appropriated to satisfy the changing physique 
of the ageing fashion consumer? What are the consequences of size inflation for smaller sizes? Have 
smaller sizes become marginalised as ‘skinny’? The analysis is provided via an ongoing technical and 
historical critique of cross referencing Australian Standards for women’s and children’s apparel 
against public health children’s growth tables. It looks at the consequences of fixed incremental size 
inflation on smaller sizes, and what happens when a 16 becomes a 12, an 8 becomes a 4, and a 6 
becomes a 2 and then, inevitably, a size 0. It also links size culture and identification with 1970s mass 
market retail culture.

1.2.3 The Berlei approach

This section is based on a paper presented at the Human Factors and Ergonomics Society of Australia 
2008 Conference in Adelaide, which examined the function and application of the Berlei Figure Type 
Indicator as an investigation into models for multimodal size definition. In this context the research 
provided segue between the theoretical investigation and the development of the shape schema for 
the body as separates model. Archival Berlei technical documents were an important source for the 
practical research scaffold for this model.

The Berlei Figure Type Indicator was a customer sales device used to identify women’s shape and 
size from the late 1920s to the early 1960s. However, while considered a significant Berlei artefact, 
the device has not been analysed from a technical perspective. This researched aimed to deconstruct 
the methodology underpinning how the measurement device computed shape categories. This 
firstly, was a way to examine the extent of its measurement capabilities and secondly to investigate if 
this format could be used to represent a new size model. The operating principles of the Figure Type 
Indicator are explained in Chapter 4 and this devise informed the conceptual development of the 
bifurcated size model set out in Chapter 5.

A significant amount of additional research has now been documented in Chapter 4 since the original 
paper was presented. The main reference material is a direct result of much Hurley Burley: the 
Hurley Family Collection, archived at the Library of New South Wales and the Berlei Archive at the 
Museum of Applied Arts and Sciences, Powerhouse Museum, Sydney. Included in the Hurley papers

\[3\] John Hurley at the age of 15 became Fred Burley’s personal assistant in 1921 and remained with the company until he retired in 1969, 
having attained the level of Managing Director.
are a number of rare documents previously uncited in academic papers. Amongst the most detailed first hand analyses of the Berlei corporate culture is a manuscript from the company’s sales and training manual from 1930 (Hurley Family 1906–1991) that has been an insightful historical record. This document, along with material from the Berlei Archive (Wilson 2008), has provided a direct source to the technical and scientific framework of the Berlei 1926 anthropometric survey and its commercial application.

1.2.4 Practice into shape

The development of the shape schema exemplifies the notion of the body as separates as a working model. The practical components of this research are experiments in how to approach, research and test alternate size models. This methodology has been shaped throughout the research journey by the complexities of this debate and driven the requirement to tease out various component parts.

Fundamental to the practical research component has been the approval to use anthropometric measurement data from the Real Australian Woman (RAW) survey. This data set has provided the resource to undertake the experiments in data modelling and fit mapping prototypes. Although it is not a large data set (450 survey subjects) it is sufficient to prototype the shape schema.

In 1999, Hestia Pty Ltd, a Berlei brand, commissioned researchers at the Research Institute for Gender and Health at the University of Newcastle to conduct a study to explore changes in women’s body size and shape since the 1920s (Patterson 1999, 2000). This survey, which sought to identify the Hestia real Australian woman, referenced the Berlei Corset Company’s original anthropometric survey of 6,000 women conducted between January 1926 and May 1927 (Pratt 1930b, p. 1). The measurement data from the 450 RAW survey subjects has been used to develop and test the bifurcated model. Chapter 5 provides the plan and schematics for how the model works. The results show that it is a quantifiable way to define body shape as it is based on a logic that uses proportional relationships to maintain its integrity. This approach to size instructs a different notion for apparel design and development as it identifies body shape as well as size to inform design parameters. Without clarification of the scope of body size and shape, the design and technical development of apparel will always be misinformed. The results have demonstrated that a far greater representation of the population can be achieved by providing shape solutions rather than simply by adding additional sizes on a linear scale of increase. It provided a multi dimensional approach rather than a limited lineal view, which is inherent in standards such as AS1344-1997. Pre clothing standards, Berlei in 1926 pioneered this approach with industry directed scientific research and created a model that capitalised on women’s shape diversity. It successfully directed their design, product development and consumer interface for over thirty years by operating in this mode.

Practical research in Chapter 5 demonstrates three stages (investigation, validation and application) and draws from Berlei historical artefacts to assist the validation of the shape model.

The first investigation was an experiment in plotting the size specifications of the technical model to the format of the Berlei Figure Type Indicator, a nomogram used for over thirty years at point of sale to graphically calculate shape categories. Having decoded the indicator’s trivariate structure it became integral to the development of the bifurcated shape model. It is a working example of how the shape model functions and how it can be used to identify individual size. Being able to translate
the new model into this format confirms the validity of the original Berlei research and the culmination of this investigation.

While the Berlei research predates three dimensional body scanning, their surviving anthropometric charts reveal their system of shape classification was validated by manually plotted transverse slice maps of the lower torso. Thus the somatic topography mapped in Chapter 5 of this exegesis presents an extension of the Berlei methodology in a digital format derived from three dimensional body scanned images.

This research therefore offers a unique approach for apparel practitioners to rethink how to identify and apply both size and shape definitions to apparel design and development. What can be described as a wicked problem as the complexities surrounding apparel size definition continue to undermine feasible reform, this investigation offers an independent approach to developing a size framework.
2 SIZE CRITIQUE – WHAT SIZE AM I?

What are the parameters for a definition of women’s size based on separate parts?

2.1 Introduction

It is broadly accepted that the fit of women’s clothing sold in Australia is inconsistent and does not conform to a size standard. But what size are we really, and what influences our perception of size?

An ad hoc system has evolved that labels women’s clothing size as defined in Standards Australia AS1344-1997: Sizing coding scheme for women’s clothing but disregards the specified measurement data. This chapter details factors that have influenced this evolution including Australia’s adoption of a United States Standard and a codified system for size code designation. It aims to highlight the ambiguous and inconsistent aspects of the technical reference data that contribute to misinformed assumptions by the industry and the media. This includes material presented from body scanning surveys such as SizeUK and SizeUSA.

Having considered the generally problematic nature of size coding systems, in this chapter the question is posed about the future relevance or applicability of such systems. As an alternative method, the viability of a non-codified system that references clothing size to body measurements is discussed.

Given that the consumer perception of size has been distorted by industry non-compliance to AS1344-1997, the approach is to benchmark average measurement data from four Australian anthropometric surveys: Berlei (Lancaster 1957, p. 898), the Real Australian Woman survey (Patterson, A 2000), the 2002 National Size and Shape Survey of Australia (Henneberg & Veitch 2003, p. 35), and 2003 Rip Curl survey (Stalls 2006), to data from the National Nutrition Survey (1995b) to identify the degree to which Australian women’s size and shape has changed.

2.2 Identifying the problem

The popular press regularly reports on the changing shape of the average Australian woman. We are told she is getting bigger in all dimensions. A feature article, ‘Now and then’, in Sunday Life (the magazine of The Sunday Age), describes body size as having changed significantly:

NOW a SIZE 10 measures 95 centimetres (bust), 75 (waist), and 100 (hips)

THEN in the 1970s it was 80-60-85 (Fazzino 2006, p. 11).

The article suggests a size 10 women’s clothing size has increased 15 cm in the bust, waist and hip since the 1970s. This is not the case. This dissertation seeks to present data that contradicts this statement and to examine how a codified size identification system contributes to size distortion.

This irrational focus on women’s size is inextricably linked to dialogues on obesity, eating disorders, and other less attractive aspects of our ageing population such as ‘the demographic bulge’ (Australian Bureau of Statistics 2007, Introduction). As the Australian population ages, it gains weight. This applies to both men and women (Australian Bureau of Statistics 1995b, p. 37). Yet discussions on our changing shape focus almost exclusively on the aberrant female form.
Contrary to popular assumptions, this high profile debate is largely unsupported by reliable data or methodological rigor. This research explores how the absence of both such elements contributes to a distorted view of women’s size. A distortion that is supported by the historical legacy of disputed standard AS1344-1997.

When body size or changing body size is discussed in academic writing, the focus is usually on cultural/scientific perspectives such as body image, anthropometrics, nutrition and health. For the apparel industry, size definitions are reported in professional and trade literature in technical/practical terms. It could be thought that such literature generated by the industry does not provide valid points of insight for an audience viewing dress as a social and artistic medium. This research seeks to indicate aspects of this professional literature that resonates with and will inform a more general audience. At the same time the study endeavours to highlight the ambiguous and inconsistent aspects of the professional technical reference data that contributes to misinformed assumptions by the industry and cultural commentators on this question. These margins of uncertainty or ambiguity themselves contribute to the complexity and volatility of the debate.

2.3 The background to size dysfunction

It is broadly considered that the fit of women’s clothing sold in Australia is inconsistent and does not conform to an acceptable size standard. This generates much confusion and frustration for women when determining clothing size. A quote from Maggie Alderson in an article ‘Size Matters’ summarises the issue:

\[
\text{What dress size are you? I’m a size 4. Well, that’s what it says in the label of my Donna Karan jacket, so I must be. But on my Zimmermann dress it says 14. I’ve got Collette Dinnigan garments in small, medium and large. My jeans are 30, my agnes b. skirts are 38 and my Giorgio Armani jacket is 44. I’m a size 10 trouser at David Lawrence, but a size 12 jacket. My Easton Pearson new best dress is a 10, but I can’t even fit into a size 14 Alannah Hill. So what size am I really? Damned if I know} \quad (Alderson 1999, p. 28).
\]

This confusion over size is mainly attributed to the general non-compliance by the apparel industry to a size standard. The standard that defines the size and shape of women’s clothing and underwear AS1344-1997, is a voluntary code and is considered to be based ‘on body measurements that are not representative of the Australian population’ (Krieken and Kellock [joint TFIA and FTAA letter to stakeholders] 2005, pers comm. 24 March). This view is supported by Kath Berry and Maciej Henneberg (1997, p. 83), who propose that body shape ... ‘has increased substantially over the past few decades’.

In AS1344-1997 size designations are identified by an ad hoc single size scale (scalar) for example, size 12. As they have no obvious relationship to body measurements they are able to be manipulated or easily changed (Ashdown 1998, p. 326). The premise of an ad hoc code is to define size by a single scalar rather than a different size for different body dimensions. For example, if body shape determines that a different size is required for a different part of the body, a size 14 upper body garment and a size 16 lower body garment, this change suggests that the body shape does not
conform to that size. This adds to the sense of size uncertainty as highlighted in the quote by Alderson.

The impact of this uncertainty on body image was acknowledged by Phillipa Seagrove, Standards Australia’s Director Consumer Standards, when she addressed the clothing industry at CS-092-F0000: Sizing Forum in December 2003:

Also, there is evidence that such stresses during shopping can lead to shoppers questioning the accuracy of their body perception, Do I see what others see, or I must be bigger/smaller than what I thought? There is also some evidence that this has led to some people grossly overestimating the size of certain body sites (such as waist and hip size) when compared to objective measurements, which can lead to body dysmorphic disorder (Standards Australia 2003a).

By way of comparison, size inconsistency is not an issue for men’s clothing. Male clothing is commonly identified by body dimensions such as trouser size ‘87R’ which fits a waist measurement of 87 cm or shirt size ‘42’, which fits a neck that can be identified by a measurement of 42 cm. Size definitions are treated as separate elements that relate to body dimensions rather than as the unquantified unimodal code of AS1344-1997. But while the relevance of AS1344-1997 for the modern woman is widely discussed, it is questionable if it has ever represented the physical dimensions of the average woman.

2.4 The Standard’s history

It is possible to trace the anthropometric data tabled in AS1344-1997 to 1959 when the first standard L9 was developed at the request of the Apparel Manufacturers Association of NSW. Based on a US Department of Commerce Standard (CS) 215-58: Body Measurements for the Sizing of Women’s Patterns and Apparel, its preparation was assisted by Berlei Ltd and Dr H O Lancaster (Standards Australia, 1970, 1975 & 1997). In 1957 Berlei commissioned the University of Sydney medical school alumnus Henry Oliver Lancaster to review the original data from the Berlei Corset Company’s anthropometric survey of 6,000 women conducted between January 1926 and May 1927, as explained by Lancaster:

The directors thought these might be of general anthropometrical interest, especially as they had received a number of requests for the figures (1957 p. 898).

In his final paper ‘Some Anthropometric Values of Women in Australia’ published in the Medical Journal of Australia, Dr Lancaster compared his findings to similar anthropometric surveys conducted in the United States by O’Brien and Shelton in 1941 and in Britain by Kemsley in 1950, and notes:

As has already been mentioned, the figures obtained in this inquiry are very close to the American figures for O’Brien and Shelton (1941), wherever the comparison can be made (p. 899).
Dr Lancaster’s comparison of relevant mean data of the 1926 Berlei anthropometric data to the American data validated the adoption of CS 215-58 as the basis for first women’s clothing standard in Australia confirmed the validity of the original Berlei 1926 data within an international context by publishing his findings in a respected academic journal. CS 215-58 adopted in 1958 at the request of the Mail Order Association of America was derived from data collected in July 1939 to June 1940 under a ‘Federal-project grant of the Work Projects Administration’ (O’Brien & Shelton 1941, p. III). Of the 14,698 United States women measured (predominantly from urban areas, with the specific exclusion of non-white women and under-representation of the ‘foreign born element’), the final sample quota of 10,042 was tabulated in Women’s Measurements for Garment and Pattern Construction (p. 26). It is from this report that CS 215-58 was formulated by the NBS, and is currently endorsed by its successor the National Institute of Standards and Technology:

The resulting standard is still used by manufacturers to make clothing that fits a majority of today’s diverse female population (National Institute of Standards and Technology 2004 b).

The question of fitting the majority of the female population was raised in May 1968, 10 years after the adoption of CS 215-58 by a request from the Mail Order Association of America for an update to ‘the existing standard to reflect more accurately the current population of women’ (National Bureau of Standards 1971, p. 14). The statistical source for how this was determined is not detailed, but public health surveys of 1960–62 showed that adults were somewhat taller and heavier (Devarajan, Istook & Simmons 2002, p. 53; LaBat 2007, p. 95).

The 1968 NBS review of CS 215-58, presented an opportunity for the Standards Association of Australia, to review standard L9 via a self-reported survey 1969, and published a survey titled ‘Calling All Girls’ in the 10 September edition of The Australian’s Women’s Weekly. The article explains a similar problem to size and fit in 1969, as highlighted by Alderson in 1999, and requested all females between the age of 10 and 75 to assist the Standards Association of Australia, as:

They want every woman and girl in Australia who is interested in being able to find clothes to fit her properly.

and

One of our biggest problems in Australia is that we do not have a standard sizing system of our own. We follow American standards or European Standards. This is very unfortunate as, many Australian girls and women lead a more active sporting life, and as a result our shapes are often different from women in other parts of the world.

Fashion pages in The Australian’s Women’s Weekly of July 30 1969 confirm the variety of size references, with garments featured on the same page showing sizes 32 to 36 ins for blouses, evening pants 24 to 30 ins and 29 to 36 ins, a crimplene coatdress in sizes XxSSW to W and a crossover style.
dress from the David Jones’ Better Dresses Department in 12 to 18. The 10 September edition highlighted the limited use of American sizing:

Some of the larger stores have adopted the American method sizing by numbers for example, size 12 is a 32 in bust measurement, size 14 is a 34 in, a 16 a 36 in, bust measurement and so on.

The motivation for these amendments is confirmed by the May 1968 request from the Mail Order Association of America to update CS 215-58 which resulted in a new standard that was published in 1971 as PS42-70, and adjusted sizes with bust girth being increased by one incremental size. This was explained in The Australian’s Women’s Weekly, 10 September:

But now a new system of sizing has been adopted in the US by the Measurement Standard Committee of the Pattern Fashion Industry, size 12 is now a 34 in, bust measurement, size 14 a size 36 in bust measurement, and so on.

While the statistical validity of the survey conducted via self-reporting may be questionable, it is the level of response from readers that illustrates the enormous public interest in this subject. 11,455 women self-reported height, bust, waist and hip measurements, (Standards Australia 1997, p. 3) which were taken as advised. Volunteers were instructed in the Australian’s Women’s Weekly, 10 September to measure:

over your foundation garments. For young girls or women who don’t wear foundations, take them over a thin vest and briefs.

Imperial Standard L9-1970 was updated from a well meaning but tenuous self-reported survey. More variables were added with the 1972 metric conversion, which:

was made on the basis of 5 cm steps in bust, waist and hip measurements and where the conversion was not an exact arithmetical one, figures were rounded-off to give clarity and flow within the size coding charts (Standards Australia 1975, p. 3.)

In short, forget the impact on the female figure: just round off the numbers to make them easy to read. The new metric size 12 of 85-65-90 centimetres was a conversion from the equivalent size 12 imperial 34-26-36 inches.

What became AS1344-1972 was subsequently amended in 1975 to AS1344-1975 and included body measurements for ‘brassieres and bodysuits’, an addition which provides the greatest insight into its idealised form. The last edition AS1344-1997, when published, confirmed the data was drawn from a previous edition ‘due to the absence of a more up-to-date survey’ (Standards Australia 1997, p. 2).

It is plausible that the current size definitions of AS1344-1997, directly linked to the culture of the late 1950s via standard L9, may never have been representative of the average figure, but more to the ideal hourglass iconic figures of Marilyn Monroe and Brigitte Bardot (Chenoune 1999, p. 180). The importance of the discourse on the ‘modern glamorous body promoted by Hollywood films’ has
been identified by Sue Best from 1920s Berlei advertising images ‘in the glamorous body model, corsets enhance the body’ (Best 1991, methodology section); to this end achieving an hourglass silhouette is conditional upon wearing foundation garments. This is stated in the forward of current standard AS1344-1997, as the mandatory condition for determining size for outerwear: ‘tables A1, A2, A3, and A4 are body measurements taken over foundation garments’ (Standards Australia 1997, p. 4).

The outerwear tables summarised in Table 1, define a shape for the average size woman that is hourglass in proportion. As described by Simmons et al., ‘The hourglass shape has the appearance of being proportional in the bust and hips with a defined waistline’ (Simmons et al. 2004, p. 12). The size table below for average as detailed in standards AS1344-1970, -1975 and -1997, shows that shape is replicated in a proportional lineal progression from smallest to largest size by 5 centimetre increments.

<table>
<thead>
<tr>
<th></th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>14</th>
<th>16</th>
<th>18</th>
<th>20</th>
<th>22</th>
<th>24</th>
<th>26</th>
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<tr>
<td>To fit Bust</td>
<td>75</td>
<td>80</td>
<td>85</td>
<td>90</td>
<td>95</td>
<td>100</td>
<td>105</td>
<td>110</td>
<td>115</td>
<td>120</td>
</tr>
<tr>
<td>To fit Waist</td>
<td>55</td>
<td>60</td>
<td>65</td>
<td>70</td>
<td>75</td>
<td>80</td>
<td>85</td>
<td>90</td>
<td>95</td>
<td>100</td>
</tr>
<tr>
<td>To fit Hip</td>
<td>80</td>
<td>85</td>
<td>90</td>
<td>95</td>
<td>100</td>
<td>105</td>
<td>110</td>
<td>115</td>
<td>120</td>
<td>125</td>
</tr>
</tbody>
</table>

Table 1: Size Coding Chart for Average Fittings AS1344-1970, 1975, 1997 (in cm)

However, the key to decoding the size of the un-corseted woman can be found in the forward of AS1344-1975, by the inclusion of data for foundation garments (Standards Australia 1975, p. 2).

The associated tables for ‘brassieres and bodysuits’ are presented as ‘related measurements for underbust and bust circumferences … and are actual body measurements’ (Standards Australia 1975, p. 14). It provides insight into the conditional extent of the shape definitions presented in the outerwear tables and defines the differences between the constructed body (for outerwear) and the unconstructed body (for underwear).

Consideration must therefore be given to what effect foundation garments have on the shape and size of the body, and whether the effect can be calculated.

2.5 Defining size – the blur of the (un)constructed body

The extent of the amount of calculated figure suppression applied by girdles to the body is revealed in the forward of the 1975 edition of the standard when describing how to determine the measurements for foundation garments for the lower part of the body:

Girdles of lightweight flexible material are to be based on outerwear tables and manufactured to fit a waist which is 2cm below and 2cm above the measurement in the code and a hip which is up to 4cm above the hip measurement shown in the code (Standards Australia 1975, p. 5).

As a result, all outerwear tables listed should be viewed with the variables of waist +/- 2 cm and hip + 4 cm. The expectation was that an average girdle would constrain the hip by 4 cm. This is almost a full size variation. It was an oversight that this conditional definition was omitted from the 1997 edition of the standard, but of little consequence to the standards relevance.
It is not commonly understood that there is a different methodology in the calculation of the outerwear tables for the constructed body: measured over foundation garments and underwear, measured over the unconstructed body, as the size designations are benchmarked at the same size and measurement designations, for example:

*outerwear Size 12 ‘to fit bust’ = 85 cm (over foundation garments)*

*brassieres Size 12 ‘to fit bust’ = 85 cm (body measurements)*

The size codes and body measurements for brassieres and bodysuits add another confused methodology to identify women’s true shape. It defines the range of bust circumference for each size as 10 cm (see Table 2) (Standards Australia 1975, p. 14). In contrast the measurement range for each size for outerwear is 5 cm (as in Table 1). Thus if we identify size by bust size, there is more scope for size definition within a size. It is also a methodology that accommodates the variables of bust size in a non-idealised (unconstructed) form.

<table>
<thead>
<tr>
<th>Code</th>
<th>Bust size</th>
<th>Under bust</th>
<th>AA</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>DD</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>75</td>
<td>65</td>
<td>76</td>
<td>78</td>
<td>80</td>
<td>82</td>
<td>84</td>
<td></td>
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<td>10</td>
<td>80</td>
<td>70</td>
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<td>83</td>
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<td>89</td>
<td>91</td>
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<tr>
<td>12</td>
<td>85</td>
<td>75</td>
<td>86</td>
<td>88</td>
<td>90</td>
<td>92</td>
<td>94</td>
<td>96</td>
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<td>14</td>
<td>90</td>
<td>80</td>
<td>91</td>
<td>93</td>
<td>95</td>
<td>97</td>
<td>99</td>
<td>101</td>
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<td>etc</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Size Code and Body Measurements for Brassieres and Bodysuits AS1344-1975, 1997 (in cm)

This confusion is confirmed by what Best describes as a ‘border dispute, the confusion about what the body is or should be’. There is an inherent border dispute within AS1344-1997 with the confusion between size measurement tables for brassieres that identifies ‘what the body is’ and outerwear, which describes what the body ‘should be’ (Best 1991, Introduction).

The abandonment of the panty girdle in the early seventies (Chenoune 1999, p. 181) rendered the outerwear tables obsolete, as women’s lower bodies were now unconstructed. Breasts however remain in the constructed zone. The technique first described in AS1344-1975 for determining bra fittings is still current and in common use internationally. This is determined by the difference in the lineal measurement of the under bust girth to over bust girth, and criticised as not representative of the ‘complex 3D geometry of the breast’ (Zheng et al. 2007, p. 697).

Significant failings in AS1344-1997 included using data from a non-empirical source, a different methodology between outerwear and underwear size definitions, and an ad hoc size designation system that said the standard cannot be ignored. It still informs the common practice size designation system and fixed incremental size grade profile used by the clothing industry in Australia. It forms the reference points for female size identification.4

### 2.6 Modern creative sizing practices

Given the lack of confidence in the standard, it is common for designers and manufacturers to develop their own size specifications based on sales history, customer feedback and professional

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4 The apparel industry in Australia’s grade protocol is according to the grade/size definitions detailed in Table 1.
hunches. The obesity debate also has an influence on the perception of size and is contributing to a
tendency to increase size specifications.

For example, in 2000 the retailer Myer increased its ‘to fit body
measurements taken over underclothing’ for the mainstream women’s
house brand retail ranges to represent what the buying office
considered a better fit (QAM 1995).

Retailers and designers have been accused of the practice of ‘vanity
sizing’, by inflating sizes and making them more generous in a bid ‘to
deceive customers into believing they are smaller than they really are’
(Wells 2006, p. 3). It could be argued that size inflation is a simply an ill informed attempt to adjust
the average size, referenced by the obesity debate and an aging population.

Vanity sizing may be a myth that co-exists with other size myths such as the American woman being
larger than the Australian woman. This judgement should only be considered in the context of
adjustments made by the United States National Bureau of Standards when standard CS 215-58 was
reviewed to reflect the post depression physical development of the US woman into PS42-70 sizes
that increased bust girth up by one incremental size (Devarajan et al. 2002, p. 53; LaBat 2007, p. 95).

Size as a marketing opportunity was first presented in the 1900s when corset manufacturers adopted
a scientific methodology to measure and classify women’s body shapes. As described by Fields:

_Gossard’s early twentieth-century chart defined nine figure types, Warner’s 1921
classification had eight, and Berlei’s 1926 study of Australian women found five_ (Fields 1999,
p. 372).

As a counter attack to the influence of the 1920s, corset-less Flapper trends, corset manufactures
had adopted (as Fields described) the ‘weapon of ideology’ with the discourses in ‘professionalized
medicine, the eugenics movement, and Victorian constructions of femininity’ (1999, p. 363). The
blend of science and sales was well understood by Fred Burley, who after ten years of success in the
corset trade in Australia along with his brother Frank, registered Berlei Ltd as a public company in
1920 (Wilson 2008). In their trade journal _The Berlei Review_, published monthly from 1922 to
disseminate the Berlei brand and business philosophy, the brothers warned the willowy ‘flapper’
against lasting damage to ‘muscles and vital organs’ or ‘excessive figure development in the middle
years’ and urged her to ‘corset for the future’ (Burley cited by Hyslop 1993).

In his opening discourse ‘An Ambitious Project’ in the 26 July 1926 edition of _The Berlei Review_, Fred
announced the company’s plans to conduct an anthropometric survey and the company’s
commitment to research:

_It has long been our ambition to render the women of Australia a quality of scientific corsetry
that would far excel not only that provided by anybody else in Australia, but which would be
even better than that provided by corset manufacturers the world over._

<table>
<thead>
<tr>
<th>Size</th>
<th>Myer 1995</th>
<th>Myer 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bust</td>
<td>92</td>
<td>95</td>
</tr>
<tr>
<td>Waist</td>
<td>71</td>
<td>75</td>
</tr>
<tr>
<td>Hip</td>
<td>98</td>
<td>102</td>
</tr>
</tbody>
</table>

Table 3: Myer ‘to fit body size’ (in cm)
No corset manufacturer has yet specialised in the application of scientific industrial research – we mean to be the first.

thus

... came into being the Berlei Research Department under the direction of a skilled scientist and anthropologist, which has already embarked upon a gigantic task, the like of which has never yet been attempted (Burley 1926a, pp. 1–2).

Berlei had commissioned physiologists at the University of Sydney in January 1926 under the direction of Professor Henry Chapman and Dr S A Smith to undertake a survey of 20,000 women with the aims as minuted by the Berlei Research Committee:

1. To achieve crystallisation, specification and confirmation of our present knowledge of the fundamental facts on which our design is based.

2. The addition to the knowledge and completion of the knowledge of the female form as it exists in Australia – the complete classification to type and what the proportions are of each type (Pratt 1930a, p. 1).

The project ceased in May 1927 after measuring over 6,000 women, enough to formulate five distinctive shape categories: big abdomen, heavy bust, big hips, sway back and average proportions. (Pratt 1930a, pp. 1–2). These definitions, decreed Best, for body ‘types other than average’ were labelled in extremely pejorative terms. Best suggests this strategy exploited women’s vulnerability by classifying them according to their figure faults, which could be ‘supplemented’ by a correctly fitted corset (1991, the blighted body section). However it can also be argued that given Berlei’s commitment to ‘scientific service to the women of Australia’ that was supported by a significant investment in research and development, their shape classification system realistically described the anthropometric diversity of the female form (Burley 1926b, p. 1).

Over eighty year later, British stylists Trinny and Susannah, re-established ‘it’s shape that matters, not size’ with a visual classification of twelve body types as their marketing narrative to help women ‘feel good’ about themselves (Woodall & Constantine 2007, p. 6). Their ‘Original Magic KnickersTM’, offer figure transformation and control by lifting bums, flattening tummies and reducing thighs, (http://www.trinnyandsusannah.com/live/content.php?Category_ID=44)5. The major difference between the Berlei figure classifications and the Trinny and Susannah visual figure shape classification is that the Berlei definitions are based on anthropometric research and can be quantified by measurement, as confirmed by Lancaster:

Some 26 measurements were made on some 5000 women. As a result, it was found possible to classify the figures into five types for corsetry purposed, and to construct a nomogram by

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5 Viewed 11 November 2009.
which the type could be determined from three measurements – namely, hip, waist and bust circumferences (1957, p. 897).

As previously identified, Berlei were instrumental in the development of the first standard L9 in 1959 and confirmed the importance of the foundation garment in the history of AS1344-1997.

2.7 Quantifying size

But can the issue of clothing size standardisation ever be resolved, i.e. this wicked problem? ‘Ever since garments were first mass-produced as ‘ready-mades’, the problems of what sizes to make and how to label them, have existed’ (Winks 1997, p. 1). As outlined by the Royal Statistical Society in a 1958 review of British ‘Women’s Measurements and Sizes’ study sponsored by the Joint Clothing Council, Board of Trade:

These problems have of course worried the progressives in the clothing trades for well over thirty years ... The field is essentially one for art and craft (Review 1958, p. 143).

The most recent development in quantifiable size designation systems has come from the European Committee for Standardization CEN/TC 248/WG 10, which in 1996 started the process of developing a new system for labelling clothing size. CEN 34021 parts 1–4 for labelling clothes size ‘is based on body dimensions, measured in centimetres, and aims to replace many older national dress-size systems, most likely after the year 2007’ (Wikipedia, EN13402). Sizes describing body measurements are accompanied by a pictogram. The standard is designed to be used in conjunction with data from many of the large scale anthropometric three dimensional body scanning surveys undertaken in some EU countries since the late 1990s. EN 13402 is intended as a policy framework for garment size rather than a technical manual of anthropometric measurements. As yet no major European retailer has adopted this standard, and media attention in Britain when reporting in July 2007 on the potential introduction of EN 14302-4 size codes exploited the myth, ‘thanks to meddling European bureaucrats’ that by changing size codes from sizing 8, 10, 12, 14, 16, etc. to European size 40, ‘every woman in Britain could find she is suddenly a lot BIGGER’ (CEN, 1997, myth). The Spanish Government in releasing the results in February 2008 of the Instituto Nacional del Consumo Anthropometric Study of 10,415 women conducted by body scanning, proclaimed their intention to adopt a new clothing size framework

on the basis of standard EN 13402-3-2004, to develop a homogenous sizing system, adapted to users, which can be used by all designers, manufacturers and distributors (2008 [d]).

This survey project may have the greatest global influence on the adoption of the EN 13402 framework, as influential multinational retailers Zara and Mango are partners in this project (Catan 2008).

Body scanning is considered the most comprehensive approach to body measurement capture as it ‘is capable of extracting an infinite number of data types and measurements’ (Simmons and Istook 2003, p. 306). It is a digital approach to classical anthropometric measurement techniques and capable of acquiring three dimensional body shape data to accompany measurement statistics. This creates the opportunity for data mining and statistical modelling according to market definitions.
Otieno confirms the importance of ‘efficient sizing and fit’ as a marketing tool (2008, p. 64). However, in their research on the comparison of three dimensional body scanning equipment, Simmons and Istook concluded that:

* A significant finding was the incomparability of measuring techniques between scanners.
* Among the growing number of scanners that are currently available, significant variance exists in how each scanner captures specific body measurements and in the terms that are used (Simmons and Istook 2003: 326).

Thus scanning projects conducted prior to the publication of the International Organization for Standardization ISO 20685:2005 3-D scanning methodologies for internationally compatible anthropometric databases, lack standardised measurement protocols, a requirement highlighted by Honey and Olds (2007, p. 329).

Body scanning projects that have been conducted to address clothing size inconsistencies and/or update existing survey data such as SizeUK (2000–2002 [a]) SizeUSA (2002-2003[b]), the French Campagne Nationale de Mensuration (2003–2004 [c]), and the Spanish Instituto Nacional del Consumo Anthropometric Study (2008 [d]), show a variety of scanning techniques, mix of public and private funding, and data access options. Anthropometric data and size charts are considered ‘as proprietary, and hence such information is not easily accessible in the public domain’ (Otieno 2008, p. 65) Summary data has been publicly released and compares new data with previous survey data. In all cases data shows that average size has increased. This increase was linked to age in the SizeUSA press release March 5, 2004, with the statement that ‘People in this survey get larger as they get older’ ([ITC]2).

Updated public size standards are not necessarily the primary aim of these projects. SizeUSA does not intend to use data to standardise a national size scale. SizeUSA members, clothing manufacturers and retailers aim to use data to improve garment fit. This amended fit is advertised to consumers via garment tags identifying ‘Fit by SizeUSA’. Vanity sizing is recognised as a legitimate marketing tool, to be kept in check by a superior fitting garment (2002–2003[b]).

The first large scale three dimensional body scanning project was undertaken in Australia by the Australian Defence Force (ADF) in conjunction with the University of South Australia. The Australian Defence Anthropometric Personnel Testing (ADAPT) project commenced body scanning potential members aged 17–29 in 2004 to provide data for ergonomic profiles to assist future aircrew recruitment and equipment development strategies. Before the commencement of this project, Alex Doyle from the Australian Defence Force advised the Australian clothing industry at a CS-092-F0000: Sizing Forum in December, 2003 that:

* The ADF would like to open up a dialogue with Standards Australia in order for this information to be used. We are looking for input now, from industry, on what their needs are so this information can be fed back into the community (Standards Australia 2003a).

Since the project’s completion there has been no formal feedback to the community, however Honey and Olds have used the data to quantify the mismatch between self-reported dress size i.e. size 11.1,
to a calculated ‘best-fit’ size according to AS1344 as size 15.6 (2007, p. 328). Fifty percent of the 282 survey subject’s ‘best fit’ size was two sizes larger and thirty three percent, three sizes larger (2007, p. 327), which confirms the skewed definition of the size 10 in the ‘Now and Then’ article. It highlights the variations that exist between the ‘ideal self’ and the ideal body size and ‘actual self’ and actual body size (Apeagyei et al. 2007, p. 334).

Given the ongoing criticism of AS1344-1997, Standards Australia initiated industry forums in 2003 to discuss the process for updating the standard. Standards Australia clearly stated their role in this process as recorded in the working group CS-092-M000, Minutes of Meeting MTG-001 Sizing Systems for Clothing:

The secretary advised the Committee that Standards Australia was also keen to revise the Standard so that it can be of more use to the industry. However it was not in a position to do this without adequate data. The Committee was informed that it was up to the clothing industry to fund surveys to provide this data (Standards Australia 2003b).

This decree from Standards Australia to the clothing industry initiated the formation of the Sizing Consortium of Australia Landmark Evaluation (SCALE) (Murphy 2005). SCALE stakeholders included the Textile and Fashion Industry Association (TFIA), the Fashion Technicians Association Australia (FTAA) and the Victorian Government. The SCALE lobby for funding from industry and Federal Government to conduct a survey by ’3D scanning to measure a cross-section of Australians’ (Murphy 2005), has been encouraged by Recommendation 10 of the Australian Government’s 2008 review of the TCF industry, Building Innovative Capability:

A new Australia National Sizing Standard for clothing and footwear is long overdue and should be developed as a matter of urgency, with a funding allocation of $5 million, to meet the changing needs of customers and ensure that Australia TCF firms and organisations are not placed at a competitive disadvantage (Green 2008, p. 111).

and by the Government’s response to the TCF industry report, Building Innovative Capability with the May 2009 budget announcement for ‘innovation and renewal in the Australian textiles, clothing and footwear (TCF) industries’ and

… commission the TCF Industries Innovation Council to provide further advice on the introduction of a voluntary ethical quality mark, voluntary national sizing standards for clothing and footwear, and a national anthropometric (human measurement) database; ...

(Carr 2009).

2.8 Identifying average

In a radio interview with Dr Susie Orbach, described as the ‘most famous psychotherapist to set up couch in Britain since Sigmund Freud’, presenter Geraldine Doogue, while discussing Orbach’s image of the body, posed the question: ‘Is there something then, about reinvigorating the notion of the average?’ Orbach propositioned that ‘we need to be promoting the notion of the ordinary beauty of ordinary people’ and ‘we need a notion of the average’, suggesting ‘average’ as more constructive social benchmark than the extremes of thinness or obesity (Doogue 2009).
There are a few sources of data from which to draw information to help identify the supposed increasing size and shape of the average Australian woman. The Berlei survey of 1926 still provides a significant benchmark definition of the size and shape of the average Australian woman (Lancaster 1957, p. 989). An anthropometric survey of this size has not been undertaken since in Australia.

The most valid source of benchmark data for determining average height and weight is the National Nutrition Survey 1995 (NNS). It was conducted between February 1995 and March 1996, by the Australian Bureau of Statistics and Department of Health and Family Services. The survey measured 13,800 respondents aged two years and over from urban and rural areas. ‘It is the largest and most comprehensive and recent Australian survey of food and nutrient intake, dietary habits and body measurements’ (The Obesity Society).

A sub-survey of the NNS, How Australians Measure Up 1995, was released in October 1998, and reports on the comparison of self-reported data for height and weight against the measured height and weight data from the NNS. It provides insight into how people see themselves and how they report ‘often in imperial units and rounding-off to larger units, such as multiples of 5 cm, or to the nearest half stone.’ The majority of males and females overestimated their height and underestimated their weight (Australian Bureau of Statistics 1995a, p. 3). It further confirms the unreliability of self-reported measurement surveys.

In 1999, Hestia Pty Ltd, a Berlei brand, commissioned researchers at the Research Institute for Gender and Health at the University of Newcastle to design a study which would explore changes in women’s body size and shape since the 1920s as defined by the original Berlei survey and to identify the Real Australian Woman (RAW) (Patterson 1999). Issues relating to body image, health and fitness were also surveyed. 450 women age 25–39 were measured to compare body shapes of women in 1999 of those with women in 1926.

Two comprehensive anthropometric surveys have been conducted in Australia since 2002. Both were undertaken as private ventures. In 2002, the National Size and Shape Survey of Australia, co-funded by SHARP Dummies, and the Wood Jones Chair of Anatomy, at the University of Adelaide, measured 1,408 volunteers of whom 1,320 were women at ‘The Needlework Craft and Quilt Fair’ at capital cities around Australia. The project was co-ordinated by Daisy Veitch from SHARP Dummies, and Professor Maciej Henneberg from the University of Adelaide.

‘SHARP Dummies proposes to use the anthropometric survey data to construct a range of charts and mannequins representing the most common body sizes and shapes in the population’ (Henneberg and Veitch 2003, p. 35).

The survey has been included in the World Engineering Anthropometry Resource (http://ovrt.nist.gov/projects/wear/) database and was offered to Standards Australia working group CS-092 in 2003 to update AS1344-1997. It was not accepted by CS-092 on the basis that the data was not ‘sufficiently comprehensive and representative to allow the revision of the current Standard, considering the size of the survey and the average age of 50 of the participants’ (Standards Australia 2004).
The Rip Curl anthropometric survey undertaken in 2003, measured 2,300 females aged 12 to 24 over a twelve day period on the beach at Surfers Paradise and Bondi; at suburban shopping centres in Warringal Mall in Sydney and Highpoint Shopping Centre in Melbourne; and at Rip Curl’s beachside office in Torquay. Toni Stalls, the project instigator and manager, reported that there was an overwhelming response from both measurement volunteers and the press. Rip Curl implemented new size standards in the 2003–04 summer season and reported an 86% increase in sales for that season attributed in part by Stalls to a better fitting product. Stalls also reported that the size profiles identified from the survey were adopted by Rip Curl’s French licensee for product developed for the European market (Stalls 2006). The Rip Curl study illustrates efficient size and fit as described by Otieno as a ‘marketing tool’ in the creation of ‘niches’ and ‘targeting customers’ (2008, p. 64).

The survey was conducted under the anthropometric supervision of Professor Henneberg. Rip Curl has not released the full range of findings citing commercial sensitivity (Byrnes 2004). The average size of the 17 year old Rip Curl girl was made available (Lunn 2005).

Both The National Size and Shape and Rip Curl survey attracted a great deal of media attention when released, as this topic borders the areas of fashion, popular science, body image and health. To paraphrase the New York Times masthead, it appears ‘the fit is news to print.’

Professor Henneberg has been able to attract much media interest in the topic by presenting a scientific analysis of our changing shape. ‘Australians growing in the wrong direction’, wrote Penny Fannin, Science Reporter for The Age highlighting our changing shape, based upon research from Professor Henneberg’s Masters student, Kathleen Berry. Fannin reported that Berry’s study showed that ‘the average height of Australian women in the 1920s was 161 cm. Their weight averaged 59.1 kilograms. But in the 1990s, the average height was 163 cm and weight 66 kg’ (Fannin 2001, p. 3). These measurements suggest the comparison of the average size of the 1926 woman identified in the Berlei survey (Lancaster1957, p. 898) to the average size for the Real Australian Woman survey (Patterson 1999).

A similar story made front page of the Sydney Morning Herald on the previous day. ‘Fashion and science size up Australia as Marilyn Monroe goes missing’ reported Berry as saying ‘once we had Marilyn Monroe figures, with a smaller waist … now we seem to be getting more thick around the waist’ (Nixon 2001, p. 1). Janice Breen Burns fashion editor for The Age, reported in an article titled ‘Why the nation’s stylish women are having a fit’ that ‘Now, the worlds of science and fashion are stitching up a deal to accurately map the many forms of the female figure’ (Breen Burns 2002).

However, the subject of our increasing waistline is not a modern phenomenon. Farid Chenoune cites that the size of the average woman’s waistline changed from 22 inches in 1889, to 28 inches by 1922. In this period, women had abandoned their corsets for liberating flapper underwear of flattener bras and cami-knickers (1999, p. 44).

The press release of SizeUK in September 2004 benchmarked the average woman’s statistics against what was described as ‘a comparable national sizing survey carried out in the 1950s’ (fashion.arts [a]) showing an increase in the waist is from 70 cm to 86 cm in 2004 (fashion.arts [b]). No mention was made that the 5,000 women measured in the 1950s survey were measured over foundation garments, and were from a different age range, 18–64 in the 1950, verses 16–65 plus in SizeUK, and
‘drawn in clusters through women’s organisations, and was not prima facie representative’, as critiqued in 1958 by Royal Statistical Society (Review 1958, p. 143).

The fickleness of this debate is further exacerbated by widely publicised issues of eating disorders and dieting, constantly contrasted against reports of our increasing levels of body mass index (BMI) being in the overweight and obese range (Australian Bureau of Statistics 1995a, p. 11). The ban of models with a BMI under 18 at the 2006 Madrid Fashion Week claims to have ‘struck a blow for real women’ (Kizilos 2006, p. 3). Karl Lagerfeld entered the debate in October 2009, proclaiming that fashion was all to do with ‘dreams and illusions’ and ‘no one wants to see round women’ (Connolly 2009).

In light of such debates what information can we draw from the available Australian data in an attempt to identify if the average female’s size as cited ‘has increased substantially over the past few decades’ (Berry and Henneberg 1997, p. 83)?

Table 4 compares average measurements from the Berlei, RAW, Rip Curl, and National Size & Shape surveys, and the age segmented mean averages for height and weight from NNS:

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Height</strong></td>
<td>161.0</td>
<td>164.7</td>
<td>164.7</td>
<td>162.0</td>
<td>164.1</td>
<td>163.9</td>
<td>162.9</td>
<td>161.1</td>
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<tr>
<td><strong>Bust</strong></td>
<td>88.0</td>
<td>93.5</td>
<td>88.0</td>
<td>101.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Waist</strong></td>
<td>72.3</td>
<td>76.5</td>
<td>71.0</td>
<td>87.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hip</strong></td>
<td>98.6</td>
<td>101.0</td>
<td>97.0</td>
<td>109.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>59.1</td>
<td>66.0</td>
<td>58.0</td>
<td>73.5</td>
<td>61.4</td>
<td>63.4</td>
<td>67.3</td>
<td>71.2</td>
</tr>
<tr>
<td><strong>Age Range</strong></td>
<td>15-65</td>
<td>22 – 39</td>
<td>12 – 24</td>
<td>18 – 70+</td>
<td>16-18</td>
<td>19-24</td>
<td>25-44</td>
<td>45-64</td>
</tr>
<tr>
<td><strong>Average Age</strong></td>
<td>28</td>
<td>30</td>
<td>17</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BMI</strong></td>
<td>23</td>
<td>24.3</td>
<td>21.6</td>
<td>28</td>
<td>22.8</td>
<td>23.7</td>
<td>25.4</td>
<td>27.4</td>
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<tr>
<td><strong># Participants</strong></td>
<td>&gt;5000</td>
<td>450</td>
<td>2300</td>
<td>1265</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4: Comparison of size measurements from different surveys (in cm)

A comparison of height shows an increase of 3 cm for the RAW woman from the Berlei woman, but is equal when comparing to Berlei to the NNS average. A comparison of bust measurements to the Berlei woman shows an increase of 5.5 cm in the bust for the RAW woman, but is equal for the Rip Curl. The Shape and Size measurements show the greatest variation to Berlei however as the average age of 50 years to Berlei, 28 years is not comparable. Lancaster (1957, p. 898) noted that the Berlei sample over represented ‘young women between the ages of 15 and 24 years’ by 50% to that recorded in the 1933 census.

Waists have increased by 4.2 cm for the RAW woman from the 1926 Berlei average woman but decreased by 1.3 cm for the Rip Curl figure. This is less than the tolerance allowed for waist

7 (Lancaster, 1957, p.898)  
8 (Patterson, 1999)  
9 (Byrnes, 2004)  
10 (Veitch, D, Veitch, L & Henneberg, M 2007, p. 5), (Henneberg, M & Veitch, D 2003)  
11 (Australian Bureau of Statistics 1995b, pp.36-37)
expansion foundation garments in AS1344-1975 of +/- 2cms = 4 cm. Hips have increased by 3 cm for the RAW but decreased by 1 cm for Rip Curl average shape. Again this is less than the corset suppression allowance in AS1344-1975 of 4 cm for the hip.

In summary, a comparison of this data tells us that as the average age of our population increases, so does the average weight. It appears that the ‘demographic bulge’ is real. We gain weight with age. A point confirmed by the SizeUSA survey ([TC]²). Age was acknowledged as a factor for consideration by the Royal Statistical Society in 1957, in its review of Women’s Measurements and Sizes: A Study:

*It might have proved interesting, therefore, if some attempt had been made to discuss the likely effect on the main tables of average measures expectable from changes in the age distribution between 1951 and 1956 and between 1956 and 1960.* (Review 1958, p. 144)

When comparing the RAW, and Rip Curl average measurements to the 1926 Berlei measurements the changes are less than the standard incremental growth of 5 cm between garment size as shown in the size tables in AS1344. The major variation is between the 5.5 cm bust size increase from the Berlei woman to RAW. However, it is still within the size range for bra size tables for the same size.

Weight has increased by 6.8 kg for the RAW woman, and decreased by 1.2 kg for the Rip Curl figure. The NNS data shows a trend of weight increase with age. There is no evidence that the average size woman has increased 15 cm in the bust, waist and hip since the 1970s.

In addition to examining body dimensions it is possible to assess body shape. Table 5 shows the relationship between hip to bust, hip to waist and bust to waist. Figure shape classifications (Simmons et al. 2004, p. 12) are bottom hourglass or pear shaped and a comparison of the Berlei shape (unconstructed) to the hourglass shape (constructed) of AS1344-1997, shows that the hip to bust ratio is twice the amount for the 1926 woman.

<table>
<thead>
<tr>
<th>Shape</th>
<th>Berlei 1926</th>
<th>Raw 1999</th>
<th>Rip Curl 2003</th>
<th>National Size &amp; Shape 2002</th>
<th>Size 16 AS1344</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip-Bust</td>
<td>10.6cm (0.89) ratio</td>
<td>8.0cm (0.92) ratio</td>
<td>9.0cm (0.91) ratio</td>
<td>8.6cm (0.92) ratio</td>
<td>5.00cm (0.95) ratio</td>
</tr>
<tr>
<td>Hip-Waist</td>
<td>26.3cm (0.73) ratio</td>
<td>25.0cm (0.76) ratio</td>
<td>26.0cm (0.73) ratio</td>
<td>26.0cm (0.80) ratio</td>
<td>25.0cm (0.75) ratio</td>
</tr>
<tr>
<td>Bust-Waist</td>
<td>17.7cm (0.82) ratio</td>
<td>17.0cm (0.82) ratio</td>
<td>17.0cm (0.81) ratio</td>
<td>13.2cm (0.87) ratio</td>
<td>20.0cm (0.79) ratio</td>
</tr>
</tbody>
</table>

Table 5: Comparison of hip to bust ratio (in cm)

According to the Simmons et al. classifications (2005), the measurements show a common trend: the average RAW woman is pear shaped and so was the average woman of 1926. In essence, the shape definition for Berlei, RAW and Rip Curl survey figures are pear shaped with the 50 year old Shape and Size average shape a triangle (larger hip than bust, with no waist definition). A classification of figure shapes from the RAW data shows that only 11% of women fit the hourglass shape, but 66% of women fit the bottom hourglass category. This is followed by 19% rectangle shape (bust and hip in proportion but a bigger waist than hourglass), 3% triangle shape, 0.8% were inverted triangle and 0.2% a top hourglass (Simmons et al. 2004, p. 12).
2.9 Conclusion

This chapter has presented a comparative and historical analysis of women’s apparel size data that demonstrates how arbitrary the conclusions of size are. This has been shown to be attributable to a range of factors including erroneous data, subjective interpretations and dubious methodology.

Methodological confusion exists due to the difference in performance requirements associated with the constructed and the unconstructed body. It has also questioned whether a standard can ever be a statistically correct anthropometric reference, or whether it should simply provide a consumer policy framework, supported by localised size charts and specifications developed according to market demographics from relevant anthropometric data.

There is little question that AS1344-1997 is an irrelevant reference for women’s size and shape, unless women reclaim girdles. It is hard to understand why this misinformed document remained as a formal standard until 2009. It has however contributed to maintaining the (size) myth. Ad hoc sizing further supports this myth.

The hourglass shape as defined in AS1344-1997 does not represent the shape of the average woman ‘NOW’ and most probably did not represent the average corset-less woman of 1959 or 1970 ‘THEN’. The shape was an ideal not real. It does not appear that we have changed shape to the extent of the hype in the media stories that describe expanding waists and missing Marilyn Monroe figures. Using AS1344-1997 as a benchmark for women’s size is not valid.

As the Australian apparel industry once again enters the quest to conduct an anthropometric survey of our population, consideration must be given to a number of issues. Is it worth establishing a new standard if the majority of manufacturers and designers will ignore the standard for marketing advantage or because of reluctance to change existing practices? Can a size designation system that describes body size and shape be considered acceptable for mass market apparel or does the fashion paradigm of the ideal exclude disclosure of the real body?

There does not exist within the industry, an informed debate, let alone consensus as to the purpose and application of any new standard. Will a three dimensional scanning-based anthropometric study in Australia, simply replicate the errors of the past?

Finally, in an age of technologically driven mass customisation, where the reality of manufacturing for the individual is increasingly viable, are (inter)national standards irrelevant?
3 CRITICAL MASS – HOW SIZE INFLATION IS DISPLACING SMALL

3.1 Introduction

The investigation in this chapter is driven by experience in developing apparel for the corporate or uniform market – an area that provides an alternative perspective to apparel design and development, primarily because its purpose places functionality over fashionability and therefore operates on a different supply cycle. Technical information on body dimensions for all age groups is required to develop effective corporate products. A viable working knowledge, not based on incorrect assumptions of the body, is necessary as garment size must be accountable. The current perspective in Australia has been shown still to be dependent on a dominant sizing culture instilled in Australian Standard AS1344–1997: Size coding scheme for women’s clothing – Underwear, outerwear and foundation garments (Standards Australia 1997). This much maligned standard has been shown to be technically irrelevant for most sectors of the Australian apparel industry, who consequently have developed their own laissez faire approach by inflating size to suit changing consumer demands (Cuthbertson 2007, p. 4). The main enquiry is to investigate the reasons for and impact of size transgression that has taken place under the mantle of AS1344 since its introduction in the 1970s.

In particular, this research seeks to investigate the role that non-representational size designations that do not relate to body measurements have played in supporting size inflation. Now called vanity sizing, it implies the deliberate manipulation of size to ‘play to a customer’s vanity’ (LaBat 2007, p. 100). The discussion of such is to the degree to which this is a deliberate strategy or basically a justifiable approach; an approach that has to accommodate an increasingly disparate market demographic within the limits of a viable stock model, existing manufacturing methods and an inadequate sizing framework based on a ‘conjectural patchwork of European and American sizes’ (Hoffman 1990, p. 12). However, what are the assumptions and consequences of size inflation especially for smaller sizes? Have they been displaced by this one way upward trend? If the margins have not been preserved in this process then this is likely to be the case.

This trend is examined firstly by investigating if AS1344 was ever a valid reference. Is there any evidence that this document which prescribes size and shape was ever a legitimate or useful reference for the production of mass market, ready-to-wear apparel in Australia? If so, at what point did it become, as it is now considered, misrepresentative? Is it possible to compare the evolution of women’s apparel size in Australia to those adopted in the US to differentiate these changes? Also, to what extent is the use of a numbered ad hoc code that does ‘not refer to either body or garment measurement’ (Petrova 2007, p. 60), an accomplice to this misrepresentation?

Size definitions that have no obvious relationship to body measurements can be manipulated or easily changed (Ashdown 1998, p. 2). Thus today’s size 12 can become tomorrow’s size 10. Bougourd (2007) however, recommends that a size designation is ‘most useful when it is tied firmly to body measurement’ (p. 115). The system of identifying clothing by a number or code that does not reference body may be the ideal convention for fashion apparel. If fashion survives on change and if ‘Fashion that is anomalous to change is not fashion’ (Lewis 2007, p. 309) then an ad hoc system may perfectly represent the mode, but undermine the process of standardisation.

AS1344 size code descriptors for average proportions represent one shape. It is a monomodal format that excludes shapes different to the prescribed shape, for example a woman with a size 14 upper
body and a size 16 lower body wears a different size top to bottom. This size difference implies that this body shape is outside the normal or ideal and therefore abnormal. Size standards including the US Standard *ASTM D 5585* comply with this mode (*ASTM International*, 1995).

It is possible to argue the size definition for the ‘average woman’, as specified in *AS1344* when first adopted in the early ’70s, was a contrived but plausible representation of average female size. It cannot be proven if it ever represented the ‘statistically average woman’ as it was derived from data from a non-empirical source and there is no surviving statistical audit trail to validate how the standard was determined. Taylor and Shoben in their practical text, *Grading for the Fashion Industry* explain that ‘the average figure ... represents the highest percentage of the population, and radiating out from it are progressively rarer combinations’ (1984, p. 13). However the common point for the assumed ‘average’ figure in *AS1344* can be identified from an analysis of the link between this standard and *AS1182-1980: Size coding scheme for infants’ and children’s clothing (underwear and outerwear)* (*Standards Australia*, 1980) (refer table 6: c. and d.), and the accepted industry practice of the time. A comparison with adopted and amended US apparel standards provides additional support for this description. These amendments can be used to benchmark the ad hoc or informal size shifts that have taken place within the Australian market in women’s apparel and to compare the Australian average to the US size.

<table>
<thead>
<tr>
<th>a. Common size descriptors in use until 1972 (inches)</th>
</tr>
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<tbody>
<tr>
<td>Size code</td>
</tr>
<tr>
<td>Bust inches</td>
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<table>
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<tbody>
<tr>
<td>Size code</td>
</tr>
<tr>
<td>Bust</td>
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<tr>
<td>Waist</td>
</tr>
<tr>
<td>Hip</td>
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</table>

<table>
<thead>
<tr>
<th>c. AS1344-1975 Average Women – Metric conversion (cm)</th>
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</thead>
<tbody>
<tr>
<td>Size code</td>
</tr>
<tr>
<td>Bust</td>
</tr>
<tr>
<td>Waist</td>
</tr>
<tr>
<td>Hip</td>
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</tbody>
</table>

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<thead>
<tr>
<th>d. AS1182-1980 Size coding scheme for infants’ and children’s outerwear (cm)</th>
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</thead>
<tbody>
<tr>
<td>Size code - Years</td>
</tr>
<tr>
<td>chest</td>
</tr>
<tr>
<td>waist</td>
</tr>
<tr>
<td>hip</td>
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<tr>
<td>height</td>
</tr>
</tbody>
</table>

Table 6: Comparative size code reference tables for average women size (a. b. c.) and infants’ and children’s outerwear (d.)

3.2 The average woman of the 70s

As previously explained, Australia’s first clothing standard Australian Standard L9, was adopted in 1959, based on the United States Commercial Standard (CS) 215–58: *Body Measurements for the Sizing of Women’s Patterns and Apparel* (*Standards Australia*, 1997). *CS 215–58* was developed from
anthropometric measurements of a large but ‘unrepresentative sample’ of white women during the late depression years of 1939–1940 (LaBat 2007, p. 94). While survey measurements and recommendations for classifying body types were published by the US Department of Agriculture in *Women’s Measurements for Garment and Pattern Construction* in 1941 (O’Brien and Shelton, cited in LaBat 2007), it took until 1959 to publish *CS 215–58* at the request of the Mail Order Association of America (MOAA). The questionable validity of *CS 215–58* was confirmed by its amendment in 1970 using 1960–62 public health data that showed adults were then somewhat taller and heavier (Devarajan et al. 2002, p. 53). Sizes were amended (‘bust girth was increased by one grade interval’) and published in a new standard *PS 42–70* in 1971 (LaBat 2007, p. 95).

This statistical adjustment requested by the MOAA may be viewed as an early example of vanity sizing. The MOAA whose members had used *CS 215–58* to produce garments, found that the ‘standard did not reduce returns due to poor fit’ (LaBat 2007, p. 95). This is a difficult judgment to define as Van Dyk Lewis has observed ‘absolute expressions of fit do not exist’ (2007, p. 313). Consider also the influence of fashion changes that took place within this period, for example from the womanly constructed shapes of the post 1947 New Look with clinched waists and projected busts, to the youthful androgynous flat silhouettes of the mid sixties (Corps de Mode(S) 2006). Of these changes, Van Dyk Lewis has noted that ‘when fashion changes from tight to loose the concept of fit is further displaced’ (2007). Taylor and Shoben confirm this quandary:

> The problems of grading and sizing increase as the garment fit becomes closer to the actual body shape. Conversely, they decrease as the garment category becomes looser. The extremes may be represented by a sari and a brassiere (1984, p. 12).

Prior to the introduction of the Australian Standard *L9* the Australian apparel industry had adopted the two inch size interval, which was the common practice in the British imperial tailoring system (Aldrich 2007, p. 41). The two inch girth grade was an easy division to a half inch measure when working on a folded front or back pattern piece. It was directly interpreted into the five centimetre grade after Australia converted to the metric system. The following photo from the *David Jones Mail Order Autumn Winter Catalogue 1928* (refer Figure 1), shows a size range starting at size 34 inches for size 1, to 48 inches for size 8. Individual size descriptions for size ranges according to styles offered range from size 1 to 4, or 1 to 6.
The post-1969 Standards Association amendments to the original Australian Standard L9 established the practice of labelling size by the US ‘Misses’ size code, with size descriptors from 8 to 26, rather than the inch size code measures. The origin of the Misses code is attributed to representing a pre-woman’s size in terms of age (e.g. 10, 12, 14, 16, and 18) and was first adopted when Butterick started producing printed paper patterns in 1867 (Ashdown et al. 2007, p. 332). Once past 18 years of age, girls were considered women and sizes moved to bust representations with sizes of 34, 36, 38 inches etc. (p. 336). As the Australian market was less extensive than the US market, it was not viable to differentiate market segments via separate size categories for mass market apparel, for example Juniors, Misses, Women’s and Half-sizes. The 1970 update of L9 explained in the preface of L9-1970; ‘Junior, misses and half sizes in the 1959 edition of L9 are now incorporated in the new size coding scheme’ (Standards Australia 1970). Thus the two inch fixed incremental grade protocol was maintained with Misses size descriptors.

The point of difference between Australia and the US was and still is the method of grading sizes. Since the introduction of CS 215–58, PS 42–70, and the American Society for Testing and Materials current standard ASTM D5585–95 (ASTM International 1995), the US grading system is based on a variable amount per size for girth increases and decreases in the Misses size grade (refer to Table 7.a
and b). Smaller sizes grade one inch, middle sizes grade one and a half inches, and above larger sizes at two inches. Size designation codes identified by the same protocol of 8, 10, 12, 14, 16 etc. consequently have a different meaning to AS1344 size because of grading variables. In AS1344, girth measurements increase and decrease by a fixed amount for each size i.e. by two inches or the metric equivalent of five centimetres. To further explain, when considering this difference, the US grade protocol in former standard PS 42–70, and the current standard ASTM D5585–95, increase a size 8 by one inch (two and a half centimetres) to a achieve a size 10, however in AS1344 the increase from an 8 to a 10 is twice the amount at five cm. Accordingly a direct comparison or conversion between Australian and US apparel size is not possible as they are not developed on an equivalent scale, and state: ‘the size coding used is similar to the numerical system in operation in America and the United Kingdom and should simplify the import of garments from those countries’, is misrepresentative (Standards Australia, 1970 preface).

Early 1900 vintage Misses size pattern

<table>
<thead>
<tr>
<th></th>
<th>BMI</th>
<th>underweight</th>
<th>&gt;18</th>
<th>&gt;20 normal</th>
<th>&gt;25 overweight</th>
<th>&gt;30 obese</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>NBS PS 42-70 Body Measurements for the sizing of Women’s Patterns and Apparel - Misses sizes - Hip</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>inches</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>bmi</td>
<td>17.6</td>
<td>18.9</td>
<td>20.3</td>
<td>21.9</td>
<td>23.5</td>
</tr>
<tr>
<td>b.</td>
<td>ASTM - D 5585-95 (Reapproved 2001) Standard Table of body Measurements for Adult Female Misses Figure Type, Sizes 2-20 - Hip</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>inches</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>cms</td>
<td>87.6</td>
<td>90.2</td>
<td>92.8</td>
<td>95.4</td>
<td>98.0</td>
</tr>
<tr>
<td>c.</td>
<td>Australian Standard AS 1344-1972 Size Coding Scheme For Women’s Clothing - Average Women - Hip (Imperial)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>inches</td>
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<td>4</td>
<td>6</td>
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<td>10</td>
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<td></td>
<td>cms</td>
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<td>90.0</td>
<td>95.0</td>
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<tr>
<td>d.</td>
<td>Australian Standard AS 1344-1975 Size Coding Scheme For Women’s Clothing - Average Women - Hip (Metric Conversion)</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>inches</td>
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<td>4</td>
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<td>e.</td>
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British sizing, while also being labelled by the Misses code has struggled since metrication with the four centimetre size break specified in British Standard BS 3666:1982 (Aldrich, p. 44) and ‘the general practice in the past ... to use the 2 inch or 5 cm grade’ (Taylor and Shoben, p. 15).

As previously explained, motivated by the impending amendment in the late 1960s to CS 215–58 in the US, the Standards Association of Australia adopted a grass roots approach to conducting its own survey (‘Calling All Girls’) via The Australian Women’s Weekly magazine to update Australian Standard L9 and create a unique standard.

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12 Grade increments (the amount of increase or decrease per size) are represented by proportional amounts according to the value of the increase or decrease. The 100 cm or 40 inch measurement point is highlighted on each table. Tables are benchmarked against relative body mass index (BMI) classifications.
'Calling All Girls' requested all females between the age of 10 and 75 to send in their measurements. Height, bust, waist and hip measurements were self-reported by 11,455 women (Standards Australia 1997, p. 3), taken as advised:

... over your foundation garments. For young girls or women who don’t wear foundations, take them over a thin vest and briefs (The Australian Women’s Weekly 10 September 1969, p. 40).

Age categories were defined for women by groupings as 17–19, 20–25, 26–45, 46–75, and for girls as 10, 11, 12, 13, 14, 15, and 16. This was a defining moment for Australian women, as all editions of AS1344 (1972, 1975 and 1997) derive data from this source (Standards Australia 1997, p. 2). AS1344 still influences the size and shape of garments made for the Australian market, albeit in a hybrid format. Numerous attempts to update data in AS1344-1997 have been unsuccessful (Kennedy 2006).

By comparison the process of amendment of women’s apparel standards in the US has undergone a number of formal amendments, albeit without new anthropometric survey data. The introductory paragraph to ASTM D5585, the current voluntary standard for women’s apparel in the US, provides a summary on the variables and intangibilities of these documents:

It is important to note that the body measurements herein have been derived from designer experience and market observations and crosschecked with available databases in the attempt to identify current customer characteristics and changing proportions and not from new nationwide anthropometric research (ASTM D5585).

At the time of the ‘Calling All Girls’ Standards Australia request, fashion pages in The Australian Women’s Weekly showed a variety of size descriptors, in three different formats: imperial measurements for separate item blouses 32 to 36 inches, and pants 24 to 30 inches; whole garment descriptions in XXSSW to W (refer Table 1.a); and references to sizes 8 to 12 for department stores’ garments. AS1344-1972 was therefore derived from the composite of existing accepted practices (the two inch size break), the self-reported data from 11,445 women, and the Misses size codes descriptors. Its ethos rather than methodology was influenced by the O’Brien and Shelton 1941 (cited in Winks 1997; LaBat 2007) anthropometric research that resulted in the inaugural US CS 215–58.

Thus it can be assumed that AS1344 was loosely based on identifying a mid point statistical average (from self-reported data) for the women’s size and shape, constructed by foundation garments (Standards Australia 1997, p. 4), and extrapolated by a fixed lineal incremental two inch decrease and increase in girth. Fixed lineal grade increments simply scale the average shape, and assume as described by Schofield ‘a premise about a relationship between measurements of the body that is not empirically tested’ (2007, p. 179). Efficient mass production is based on achieving an economy of scale, thus ‘size development strives to fit the most people with the least number of sizes’ (Loker 2007, p. 249). In a critique of AS1344, Winks highlighted that the ‘fixed incremental approach shows that the measurements are not directly taken from survey data’ (Winks 1997, p. 48). The advantage in identifying the average size is that it creates a fixed point of consistency which can be easily scaled up or down to attain previous and subsequent sizes. It is the quest for the base size and shape, as
close as possible to ‘the statistical average’, and to be successful should represent the ‘dimensions and proportions’ of the target market (Schofield 2007, p. 158).

The representation of the Australian average was aided in 1969 by the ability to construct shape by the foundation garment, the accepted supplement and necessary addition to the body, since the 1920s (Best 1991). As further explained by Best ‘The sought after ideal became in statistical language the average figure type’ (1991). This addition to the body made size specifications within AS1344 less crucial as the foundation garment helped achieve the homogenous ideal shape, a shape that it constructed and controlled. This premise was subsequently undone by the abandonment of the foundation garment, which having been softened to a ‘panty girdle or control panty’ by the mid 1960s, was abandoned to the hipster brief by the early 1970s (Chenoune 1999, p. 180).

The assumption is that the size of the ‘statistically average woman’ was labelled with an abbreviated narrative description of ‘W’ with a bust, waist and hip of 38–30–40 inches (95–75–100 cm) (refer to Table 1.a). Post the ‘Calling All Girls’ survey this became a size 16 with a bust, waist and hip of 38–30–40 inches (95–75–100 cm) in AS1344. To further support the construct that 16 was the size of the average woman, a comparison of the body dimensions of the size 18 (referring to years in age), with a chest, waist and hip of 95–75–100 cm, specified in the children’s size coding scheme AS1182-1980, shows identical girth measurements (refer to Table 1. c and d). Was this assumed as the point of maturity where a girl becomes a woman? This was the Butterick paper pattern rationale as previously cited (Ashdown et al., p. 336). It is a logic that has been blurred by the confusion of label identifiers not differentiating between size by ad hoc code, or size by age reference, and the transgression of Misses size codes to represent the mature woman.

The mature woman’s stature (size 16) can be defined by weight and height data detailed in AS1344. The importance of which had been identified by O’Brien and Shelton (1941) and as explained by Winks:

> ... a stature-weight combination would be the best basis for classifying women’s body types for the establishment of a standard system for garment and pattern sizes (Winks 1997, p. 14).

As data for weight and height is detailed in AS1344-1997 it is possible to calculate the associated body mass index (BMI) according to size. BMI is defined as the individual’s body weight divided by the square of their height (Australian Bureau of Statistics, 1995b, p. 57). It is a measure that is meant to broadly categorise populations for purely statistical purposes. ‘As noted, its accuracy in relation to actual levels of body fat is easily distorted by such factors as fitness level, muscle mass, bone structure, gender, and ethnicity’ (Wikipedia BMI). However, BMI is a useful benchmark to assess size and provides a better comparative reference than ad hoc size codes. According to O’Brien and Shelton’s 1941 anthropometric research that resulted in the first commercial standard CS 215–58, the stature-weight combination was ‘considered the best basis for classifying women’s body types’ (cited in Winks 1997, p. 14).

Both height and weight information are specified in AS1344-1975/1997. Height information was requested from survey participants in The Australian’s Women’s Weekly survey ‘Calling All Girls’. It is unclear from where weight data was derived. The BMI calculation for the size 16 with a height of 165 cm and 65 kg has a calculated BMI of 23.9 and is within the acceptable weight range. In the
Australian Bureau of Statistics 1995 National Nutrition Survey the mean height for women 19 to 24 years is 163.9 cm and weight is 63.4 kg (Australian Bureau of Statistics 1995b, pp. 36–7). This produces a BMI of 23.6. However, is the size 16 label an acceptable size for the average woman today?

In 1969, women’s magazines confirmed the young and slim market. The Australian Woman’s Weekly (30 July 1969) fashion pages described sizes in the ‘Fashions in the Shops’ pages, by XXSSW to SW, XSSW to SW, 8 to 16, 10 to 16 and 32 to 36 and pages titled ‘FOR THE OLDER WOMAN’, show sizes XXSSW–W, indicating a profile with a BMI index of less than 25. The ‘older woman’ fashion profile was replaced in the 22 October 1969 edition with a title ‘FOR THE OVER THIRTIES’. This page shows dresses in a size range XSSW to XW, pushing the size definition into the BMI overweight classification of 26.5 (refer to Table 7.c). By disclosing size in fashion editorial pages, aspiring consumers were able to assess if styles would be suitable to their size or figure type.

The success of AS1344 as a valid reference for size when introduced in the ‘70s should be considered in the context of the explosion of the youth market and the teenage fashion demands of the baby boomer generation who in 1970 were aged 9 to 24 (Salt 2007, p. 111). This was the first generation whose ‘experience of the world was not shaped by direct experience, but by mass media’ (O’Hanlon 2006, p. 13). Dolly magazine was launched in 1970 as a monthly teen magazine. Its target age group was, and still is, defined as the 14 to 17 year olds (Wikipedia Dolly). There was no need to reference size on its fashion pages. Dolly fashion was for the still developing adolescent female. Mail order advertisements confirm the young and adolescent profile. The buying model that covered young fashion at the time predominantly spanned four sizes, from 8 to 14 (= XXSSW to SW), or 10 to 16 (= XSSW to W). Thus the mid point for a profile in this range of 8 to 16 is a size 12, BMI of 20.4 and a hip of 36 inches (90 cm) (refer Table 7. d.). This size range is within the normal or a BMI of less than 25.
3.3 The young baby boomer

Unlike The Australian Woman’s Weekly, whose readership was mature women, Dolly represented adolescent females. Their size profiles had been aligned to the clothing standards framework by the use of the Misses size profile of 8, 10, 12 and 14. This replaced the women’s codes XXSSW to SW, XSSW to SW, which appears to have lasted to some extent until the introduction of the metric edition of AS1344–1972. This youth size profile was perfectly suited to the new young consumers of the day, baby boomers born between 1946 and 1960 (Davis 1997). As ‘the first generation to be immersed in a media-driven culture of consumerism’ (O’Hanlon 2006), baby boomers have, as described by Davis:

... traditionally lead a clubbish lifestyle organised around happens and trends, from the twist to hula hoops to Frisbees to disco to aerobics to line dancing (1997 p. 7).

Consumer trend forecaster and business advisor, Bernard Salt, sites that this generation has been ‘the defining force in Australian popular culture for three decades’ (2007 p. 85) and that ‘Craig Kimberley invented Just Jeans in 1972 to service the teenage fashion demands of the baby boomers’ (2007 p. 111). The teenage size profile can be identified from an editorial feature in Dolly December 1973, Dolly’s guides to the tops in jeans. A range of brands are featured including Australian labels Daily Planet (8–14), Brian Rochford (8–16), Mr Simon (8–14), Ricky Reed (8–16), and US brands Levis (8–16), Amco (all sizes), and Wrangler (8–18).
In 1970, baby boomers were aged 9 to 24 years, and were a markedly different group to the generation before them – ‘frugals’ (Salt’s description for this older generation) were not into fashion (2007, p. 119). The point of difference in terms of their consumer behaviour is described by Salt as having survived the depression and the war years. Their style was influenced by the post New Look 1950s womanly constructed hourglass silhouette of projecting busts, small waists, and swirling or pencil slim skirts (Corps de Mode(S) 2006). The micro mini, hot pant and girdle-free styles from the late ’60s were styles worn by their daughters who grew up in this era of unprecedented prosperity. With money to spend they were able to ‘impose an aesthetic canon in their own image: an adolescent silhouette (2006).’

Vintage clothing from the ’70s and ’80s found for sale on eBay today shows the level of compliance to size standards described in AS1344. Commonly described as ‘vintage size’, these listings confirm the size demographic. Size labels stating measurements for bust, waist and hip were used during the period of metric conversion to inform customers of the new size.

![Photo of a dress listed on eBay as ‘1970s vintage/retro zip up shirt style dress’ showing complying AS1344 metric size.](image-url)
Metrification in Australia forced a new discipline via the introduction of new labels detailing metric measurements for consumer reference (Standards Australia 1975, p. 2). The introduction of the metric system also provided a technical point of departure from the previous two inch imperial size breaks. The process of metric conversion introduced a new pragmatic approach by ‘rounding off’ the size breaks, ‘to give clarity and flow within the charts’ (1975). For example the 34 inch metric conversion equated to 86.36 cm and was rounded to 85 cm. The effect was a decrease or reverse vanity size of the size scale (refer to Table 7. d.). The five cm break across 10 sizes was a decision that maintained the minimum sizes over the maximum spread. Did this contribute to technical disregard of the Australian Standard or were there other forces at work?

In examining this assertion, it is possible to explain the degree of size appropriation that has taken place over 30 years since the adoption of AS1344 via a case study of the winner of the Dolly (January 1972, p. 32) diet competition. The winner, ‘19 year old Erin from Prospect in Adelaide’, who, ‘after years of being a fattie’, ‘suddenly has a model girl figure’ by shedding ‘19 pounds (8.6 kg) over three weeks’ (1972). Her morphology both pre and post diet and 30 year evolved garment size forecast, can be benchmarked according to the 2000 Myer retail apparel quality assurance size standards to assess the degree of size shift over this period.13

At 5ft 4in (162.5 cm) with a pre diet weight of 9 stone 12 pounds (62.5 kg) ‘fattie’ Erin’s BMI was 23.6 and within the acceptable weight range. Her dress size was described as an SW.

13 The Myer department stores’ quality assurance protocols were established in the mid 1990s for the development of their private label product. They have maintained a methodological commitment to product development and fit since that time and are considered influential in establishing apparel benchmarks for the industry and consumers.
I used to be thin, that was when I first started high school. Then I started putting on weight. By third year I was up to 9 stone and I kept going. At one stage I was over 10 stone (1972).

Her desire to lose weight was also motivated by her desire to fit into a size XSSW wedding dress, as her fiancé said ‘... he wouldn’t marry me unless I could fit into the dress’ (1972). Calculating her 19 pounds loss, Erin’s post diet BMI dropped to 20.4. Her dress size is described as changing two sizes, while her before and after measurement data indicates one size change. Regardless of how Dolly described Erin’s dress size in the account it is possible to benchmark her BMI pre diet size (23.6) against the height and weight data detailed in AS1344 1975/1997 to a size 16 (refer Table 7.d). This is the same BMI previously identified as the average of the 1995 NNS for 19 to 24 years and the W or women’s size.

Translating Erin’s size equivalent by the Myer Quality Assurance Department 2000 guidelines Myer Miss Shop size standards, her size would be a 12 and her post diet BMI at 20.4 defines her as a size 8. Thus in 1970 a BMI of 23.6 = size 16, in 2000 a BMI of 23.6 = 12, according to the Myer Quality Assurance Standards (QAM 2000).

Erin would have been 48 years old in 2000. By Erin’s pre diet morphology, and hypothetically adjusting her BMI by NNS 1995 data by her age group average (45–65), it would be 27.4. At 48 and with a BMI of 27.4 she would fit within the Myer 14 to 16 size range (QAM 2000). Thus, as she has aged, her BMI has increased but her dress size has decreased. She has been lucky enough to be a member of a generation who according to Salt as ‘... they age they evolve fashion to disguise the decline of their bodies’ (2007 p. 86). This level of denial of ageing is supported by O’Hanlon who in his essay My Generation declares:

... we’re reluctant to let go of our youth. If anything, we reject ageing altogether, marketing to ourselves the idea that it’s a state of mind: with the right science and medicine (preferably synthesised within a viable consumer product), a healthy diet, regular exercise and a little hybrid spirituality, we might be able to live forever (2006, p. 15).

Female baby boomers have a powerful bond with the size profile and culture that was adopted for 1970s young fashion merchandise i.e. 8, 10, 12, 14 or 16, where 12 was considered the middle size and 16 the woman’s size. The system was instigated to provide young and groovy 1970s fashion styling, for a generation who grew up in this era of ‘unprecedented prosperity’ (Davis 1997, p. 1) and have remained avid supporters of consumerism ever since. ‘Boomers have made more stuff, and sold more stuff, than any other generation’ (Schultz 2006, p. 9). Their spending power and willingness to stay in fashion has forced the evolution of the traditional buying model of 8 to 16 to suit their
morphology. Ad hoc size definitions that do not relate to body size have been willing accomplices. The system is further distorted as the statistical average size moves further from the ideal of the young and thin.

Fashion merchandise is bought according to an evolutionary model based on sales history, and as explained by David Bush, a buyer with David Jones for 20 years, is a ‘mathematical process’. ‘We look at the previous season’s history, store by store and also which garments – skirts, shirts – sold well’ (Zamiatin 2007, p. 15). Garment size is part of this history. When garments at the larger end of the size scale report strong sales, the assumption is that women are larger and garment dimensions should be changed to satisfy this trend. The trend is hidden by maintaining the traditional size profile within the buying model. Thus brands can age with their customers. This is a factor in brand evolution that has alienated younger and smaller customers. Susie Holt, Country Road’s General Manager for design and product development has been brought in to ‘attract new twenty – and thirtysomething customers without alienating the older ones’ (Zamiatin, 2007, p. 13).

Size inflation has been denounced by Standards Australia who in the forward of AS1344–1997 state:

This edition confirms the data in the previous edition, due to the absence of a more up-to-date survey. With this in mind the committee wishes to mention the increasing trend of labelling size codes by transposing the size code one or more position to the right of its correct measurement currently shown in Table A1. This trend is to be discouraged as it merely creates uncertainty of fit in the minds of consumers and detracts from the usefulness of a size code system (Standards Australia 1997, p. 2).

In April 1995, in a meeting of the Standards Australia Clothing Committee CS/92 – Sizing Systems for Clothing, representatives from the Retailers Council of Australia, Mr D Miller-Randle and Mr M French explained retailers’ concerns with the standards framework:

... retailers have been concerned since the 80’s but have managed with tricks of the trade, especially in relation to older women’s clothing. A 14 has been labelled as a 12 or 10 as it’s perceived as being flattering. Manufacturers had drifted away from the Standard by 1982. Young women 14–21 years were going through the sizes rapidly, the women’s centre of distribution was a 14–16 not a 10–12.

Mr French pointed out that:

It’s when garments get smaller and shorter you realise how wrong sizing is. Not only is the code really a size up but the bust, waist, hip relationship changed (Standards Australia 1995).

This confirms that retailers in their quest to satisfy the fashion demands of ageing consumers, have been able to adjust the size of merchandise to suit the changing ‘centre of distribution’. Workman (as cited in Yu 2004) attributes that ageing contributes to observed changes in the body ‘more than any other single factor’. Yu contends that sizing problems will continue to grow as the number of ageing consumers is expected to double by the year 2030 (p. 177). Brunn (as cited in Workman 1991)
suggests that body measurement charts should be updated in ten year cycles to ‘keep pace with population changes’ (p. 31).

While Bernard Salt’s observations may not be considered a scholarly critique of the boomer generation, his approach links demographic, business and consumer behaviour. He describes that when baby boomers started to approach 40 years in 1982 they ‘shifted from youth to middle age’ they ‘put on weight when they pushed into their 40s’ and that ‘Boomer women moved from ‘hip young mum’ to ‘middle-aged mother’ during this decade’ (Salt 2007, p. 40).

This trend is illustrated in Table 8 which shows increasing levels of BMI moving into the overweight and obese categories with age.

Size inflation is a market correction tool or ‘trick of the trade’ that adjusts the buying model to satisfy demand and maintain merchandise status quo. The quotes from the retailers confirm the expanding market. Mr Miller-Randle confirms this by describing the differentiation of young women’s size for 14 to 21 year olds from women’s size at 14–16. Mr French’s remarks highlight the systemic problem with grade increments that make incorrect assumptions about body size ‘used in practice but not empirically tested’ (Schofield 2007, p. 179). This assumption is especially incorrect when it comes to smaller size and shape, because of the change in the relationship to the bust, waist and hip. AS1344 assumes fixed proportional body measurements for all sizes. This error can be attributed to the fact that the standard’s data was derived from a non-empirical source, and is conditional upon wearing foundation garments to construct the prescribed hourglass shape represented in AS1344 (Kennedy 2006).

### 3.4 US vs Australian standards

Returning to the comparison of US size to Australian size it is possible to trace the trend in size shift that has occurred by way of formal amendment in the US and by surrogate amendment in Australia.
Table 7.a ranks the hip measurement for the US standard PS 42–70 according to grade increments. It shows a size 12 with a hip measurement of 37 inches and a BMI of 21.5. As previously explained this standard was the amended version of the first US standard CS 215–58, based on the O’Brien and Shelton 1941 anthropometric database (NBS 1971). By 2001 standard D5585 ranks a size 12 hip at 40 inches or 101 cm (Table 7.b). This equals the Myer size 12 hip of 102 cm or 40 inches (Table 7.f and Table 7.h). Thus in both countries the ‘women’s centre of distribution’ as described by retailer Miller-Randle prefers to be called a size 12. Retail merchandise models appear to self-regulate by adjusting size 12 to match the shifting mid point. Size 12 has been appropriated to satisfy the changing physique of the ageing fashion consumer, rather than the ageing fashion customer changing size.

Table 9 represents females by percentage of population according to age groups. 

Table 9 represents Australian population data for females as a percentage of population in two age groups spanning ten year periods. Age group 1 in 1970–71 shows the 1970s eligible fashion consumers from the age of 14 and represents 20.5% of the female population. Age group 2 represents 18.9% of the previous generation females when they are 15 years older. Move the 1970s eligible fashion consumers on ten years and include more fashion consumers from the age of 14 and the percentage of population increases to 36.3% in 1980–81. By 2000–1 the eligible fashion female represents 60% of the population. In 2010 the market reaches critical mass when the total number of eligible fashion females are aged from 14–64 and represent 68.8% of the total female population (ABS 2007). At this stage the demographic for the eligible fashion consumer comprises a very complex market profile which has fundamentally moved beyond the parameters of the size 8–16 AS1344 framework. At best it may have provided 10 to 15 years of size guidance. A degree of
compliance can be observed at a time when the fashion and fit ‘represented the dimensions and proportions of their target market’ (Schofield 2007, p. 158), the young and slim. However as ‘baby-boomers shifted from youth to middle age’ (Salt 2007, p. 40), the statistical average size moved beyond the ideal and the AS1344 framework became displaced.

In 1990, SewTrade, magazine the official journal of the Clothing and Footwear Institute in Australia, mounted a campaign on behalf of the industry and consumer groups requesting that the National Nutrition Survey be extended to include anthropometric measurement data to help amend what they correctly described as a sizing system ‘based on a conjectural patchwork of European and American sizes (Hoffman 1990, p. 12).’ While extensive support was received from ‘educationalists ... designers and consumers’, no support was received from apparel manufacturers and the lobby was unsuccessful. Editorial comment from SewTrade magazine at the time posed a number of reasons for this lack of support:

Is the prospect of replacing all existing patterns with revised sizes too costly and troublesome? Is it easier to put this decision in the too-hard basket until this once-in-a-lifetime opportunity is overtaken by events? Is it easier to protest that manufacturers will make whatever retailers specify, therefore if the retailers want it they will ask for it? (p. 12)

This comment pre-dates the significant changes that occurred to the merchandise supply model. Mr Miller-Randle’s statement at the Standards Australia CS/92 meeting in 1995 confirms retailers influence. At this point, department stores began to develop their own in-house brands. They directly controlled their own merchandised product rather than purchasing from wholesale ranges. Quality assurance procedures, including garment size specifications, were required to control the supply of in-house merchandise. With wholesale ranges this function is the responsibility of the wholesaler. Retailers now have great influence over size definitions in the marketplace and are able to make adjustments according to buying trends. A trend since the 1980s has been to adjust up. However has this practice of ‘transposing the size code one or more positions to the right’ (Standards Australia 1997, p. 2) been at the expense of smaller sizes?

3.5 The vanishing small

When AS1344 was introduced in the 1970s the smallest size represented was a size 8 and outlined a petite person who weighed 45 kg and was 160 cm tall (BMI = 17.6). The bust, waist and hip measurement for this size is 75–55–80 cm. This could have been the size of a ten year old as the ‘Calling All Girls’ survey requested size information from age 10 to 75 ‘... to classify figure types of women under various age groups, ‘for girls from ten years to 16 years each year is important in figure development’ (The Australian Women’s Weekly 1969, 10 September, p. 40).

Considering that the eligible fashion consumer has been marketed to, from (and before) the age of 14, size profiles reflect that this demographic is still physically developing. A BMI of less than 18.5 cannot necessarily be classified as underweight, as ‘adolescents below the age of 18 years must be evaluated against age and gender reference standards’ (State Government of Victoria Department of Human Services, Child Health Record).
The 1995 National Nutrition Survey for age 12–15 years, shows that 35% of this cohort is 49 kg and under, and that 44% are under 159 cm in height (1995, p37). Anthropometric measurements of 5,500 children aged 5 to 16 from the NSW Schools Physical Activity and Nutrition Survey (SPANS) 2004 (Booth et al. 2006), shows the median BMI for children aged 13.3 years old to be 19.8 and for 15.3 years to be 20.6 (Booth et al. 2006, Appendix L). Thus half the population for these age groups has a BMI of less than 19.8 and 20.6 respectively. To further support the idea that AS1344 was youth size profile, the median waist measurement for the SPANS 15.3 year old is 64.1 cm, which is within tolerance of the AS1344 size 12 waist measurement of 65 cm. 90% of the SPANS 15 year old population matches the AS1344 size 8 to 16 waist profile (Booth et al. 2006, Appendix L).

The size definitions in AS1344–1975/1997 for size 8, 10 and 12 catered to this size profile (refer to Table 7.d). By Myer Miss Shop size specifications (refer to Table 7.h) a size 6 equals the AS1344 size 10 and a size 8 equals the AS1344 size 12. The AS1344 size 8 is not represented, however if it were, by the equivalent grade it would be a Miss Shop size 4.

To make this comparison to the US ASTM–D 5585–95 Misses size (refer to Table 7.b), a size 2 is slightly larger than the Myer Youth (refer to Table 7.h) size 6. A size 0 would be needed to cover the equivalent sizes. Thus size inflation has displaced small: a systemic shift confirmed by Daisy Veitch, the instigator of the 2002, National Size and Shape Survey of Australia.

These women used to be a size eight, they became a size 6 and then they became a size 4 and now they can’t find anything in the shop that fits them and they are forced to go shopping in the children’s wear department (Cuthbertson 2007, p. 5).

This small size demographic is now associated with the ‘skinny or size 0’ (Kennedy 2006) model syndrome, which is the same size 8 to 10 physical profile detailed in AS1344 (refer to Table 7.d). The ‘women are getting bigger’ argument claiming that the average female’s size ‘has increased substantially over the past few decades’ (Berry & Henneberg 1997, p. 83) is made without the qualification of age. WFF Kemsley acknowledged the age/body relationship in Women’s Measurements and Sizes in the 1957 published results of the British anthropometric survey.

Differences in the size of the British ‘statistical average woman’ according to the Kemsley groupings is explained by Taylor and Shoben by age categories of 18 to 29, 30 to 44, and 45 to 65 years (Kemsley cited in Taylor and Shoben 1984, p. 14), with calculated BMIs of 21.9, 23.6 and 28.5 respectively. Comparing youth size to grown adults is misleading.

Size inflation has displaced youth/small size. The contradiction now being that this subjugation for the ageing fashion consumer has not been supported by an acceptable fashion narrative, a narrative that still prefers to represent the image of the young and the slim. A recent fashion editorial in The Age newspaper featured a report on a fashion agent who represents a stable of ‘trend-transcendent’

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14 AS 1344 Waist measurements/SPANS waist measurements (15.3 years)
size 8 = 65 cm / 5th percentile 65.5 cm
size 10 = 67 cm / 30th percentile 68.5 cm
size 12 = 68 cm / 50th percentile 69.2 cm
size 14 = 70 cm / 80th percentile 70.8 cm
size 16 = 75 cm / 90th percentile 74.0 cm
labels described as meaning ‘they reflect the designer’s vision more than fads’, with a consumer older than ‘fashion’s mainstream core market of 16–24 year olds and prepared to pay a higher price for originality.’ The article discusses the dilemma the agent faces as her newest ‘clever young designer’ refuses to cut anything over a size 12 to maintain a model proportioned image. This ‘unkind snobbery’ prefers to exclude ‘the average sized women, often older and with the intellect and income to afford these designer’s clothes …’ (Breen Burns 2007). An absence of reliable anthropometric data deepens this void. The size and the shape of consumers outside the model proportioned image is not commonly understood or referenced. In short, it is easier to design for and produce apparel within a small and homogenous grouping.

3.6 Conclusion
This section of the research project has examined the changing boundaries of the size definitions of mass market apparel, specifically the trend (vanity sizing) to inflate size profiles while maintaining size code descriptions. This prompts the question: is this practice a deliberate strategy intended to exploit anthropometric denial or a laissez faire approach to satisfy evolving market conditions? Whichever the case, both situations marginalise those it excludes.

The Australian Standards framework for women’s apparel AS1344, a quaint and methodologically questionable composite of 1960s anthropometric stereotypes, showed a level of compliance when first introduced in the 1970s. It represented the size of the emerging fashion consumer; a consumer whose profile fitted the AS1344 size 8 to 16 range and did not extend beyond the BMI definition of normal. Such is the nature of the relationship between this consumer and the market for this early adopter demographic that as they age, the market has been willing to adapt to meet their needs. Non-representative size codes have allowed this subjective reassignment to evolve.

A consequence of this size shift is that within the Australian market, a struggle for ownership of size has developed. Size shift has skewed the limited range of size options, creating a void at the small end, ironically, the profile initially colonised by young baby boomers. In the confusion over market segments that now cover the age ranges from 14 to 65+, smaller people have become displaced. Size codes of 8 to 10, that in the 1970s fitted slim youth, have changed meaning to refer to the smaller numbers of 2 and 4. In the US, these profiles read as 0 and assume an eating disorder. However this group still owns the preferred fashion paradigm, an ideal that is harder to attain from a position of ageing.

There are significant ramifications from size shift, especially for areas that operate on a different product cycle to fashion. This analysis is useful in providing an alternative view on how a system could be better developed to meet the needs of a changing market. The optimum system would transcend a prescriptive definition of size and provide a multimodal framework to reflect changing population profiles. In a complex market that needs to accommodate youth size, adults, a redefined middle age and the elderly, a ‘one profile fits all’ does not work. Size standards that prescribe anthropometric size and shape cannot keep up as the boundaries of what they are meant to define keep changing.
4 THE BERLEI APPROACH TO SIZE DESIGNATION FOR WOMEN’S
MASS MARKET APPAREL

4.1 Introduction
The intension of this chapter is to provide the link between the theoretical investigation as detailed in the previous chapters and the development of the shape schema for the body as separates via an analysis of how Berlei approached their sizing problems in 1926. Prior to the development of formal or public apparel standards, the Berlei motivation was based purely on process improvement: to achieve a better fitting corset and to reduce stock inventories (Higbee 1934, p. 56). The fact that Berlei approached this problem in a self-determined way, and impressively undertook the world’s first large scale anthropometric survey of women and within two years launched (internationally) a better fitting product, shows an astonishing quick-to-market approach. The significance of this achievement has been overlooked in the history of Australian international design achievements, as there has been little investigation into the technical competence of the Berlei research methodology. Furthermore the Berlei experiment paid off as Higbee reported in Rotarian in 1934, ‘in spite of the depression [Berlei’s] earnings have increased steady for the past five years’ (p. 57). This chapter explains the background to the Berlei research, the development of the Berlei figure typology and how the Figure Type Indicator was used to compute the five figure types.

The recent academic analysis of the Berlei figure types often contend that they encouraged feminine anxieties around body image. Best’s post modern feminist critique that the Berlei figure typologies are ‘labelled in extremely pejorative terms’, and that the ‘scientific machine took your measurements and gave you back a complex’, is perhaps contextually erroneous (1991, the blighted body section). Higbee’s 1933 account of the Berlei project, which reports a major finding from the survey that ‘there was no “average” figure in the old sense’ and that the Berlei did not seek to judge women’s size since ‘whether a women was stout or thin made no difference whatever as far as the type of garment she needed’ (p. 56), suggests the Berlei model was inclusive of all figure types.

Other recent academic critiques that claim the:

*Berlei charts suggest a scientific basis for judging most female figures as defective helped unsettle women and give them a diet of anxiety about an imperfect body shape (Neilson 2009)*

repudiate the technical competence of the Berlei methodology and ignore the purpose, function and success of the modern Berlei corset of 1927. The ongoing relevance of the Berlei research was confirmed by Lancaster in 1957, with the validation of the survey data published in the Medical Journal of Australia. This validation further stands to cast doubt on current media and professional discourses around obesity and the supposed blow out of women’s weight and proportion as probable moral panic. Thus contemporary critiques of the Berlei figure classifications are influenced by these discourses rather than the original Berlei intent to build a better foundation garment.
Figure 2: Pre publicity on figure type categories in monthly *The Berlei Review*, October 1927, vol. 6, no. 10, p. 8, prior to the launch of the Berlei Figure Types, citing that ‘These advertisements are appearing in leading Newspapers throughout Australia.’
4.2 Size and shape diversity

In her analysis of the development of mass market apparel since the 1920s, Elizabeth Wilson highlights the contradictions that existed between maintaining the notion of self within the context
of the mass produced garment (1985, p. 124), which she claims had been welcomed as it was ‘seen as both democratic and internationalist’ (p. 178). Conversely the contradiction in the ‘sizing of garments’, which,

*aimed to individualise garments yet sorted individuals into groups, as such could be seen as part of an increasing uniformity of mass society* (1985 p. 124).

Wilson espouses that as a reaction to the mass replication of style, retailers adopted marketing strategies around the notion of personality types and differences, being an approach that offered ‘more refined consumer typologies that tried to classify women according to personality’:

*The in the 1920s, Bullock's department store in Los Angeles had divided customers into six personality types. These were the Romantic; the Statuesque; the Artistic; the Picturesque; the Modern; and the Conventional* (1985 p. 124).

This typological approach had been used since ‘Gossard’s early twentieth-century chart defined nine figure types, Warner’s 1921 classification had eight’ (Fields 1999, p. 15) and ultimately by Berlei who based their figure classification on pure scientific research (refer to Figure 2).

Having employed both internationalist and democratic management practices, the Berlei Corset Company had, since Fred Burley’s acquisition of the corset manufacturer E Glover and Co in 1910 (Wilson 2008) successfully developed a product, marketing and sales ethos by acknowledging the variations in women’s body type. The Berlei corset was promoted as being able to manage these variations (Maynard 2007, p. 145). Karl Lagerfeld’s 2009 proclamation that fashion was all to do with ‘dreams and illusions’ and ‘no one wants to see round women’ (Connolly 2009) is a direct contradiction to the Berlei doctrine, based on glamorising anthropometric diversity.
The Berlei commitment to anatomically correct corsets developed by sound anthropometric research is extolled by Mary Craven in her ‘Berlei Fitting School’ lecture, *The Responsibility of Foundation Garments to the Female Body*:

> The foundation garments in vogue today are designed from the viewpoint of correct anatomical support to the abdomen from below upward, and a definite control of the hips and buttock flesh, and represents the nearest approach to the medical conception of the ideal corset that we have ever had (Craven 1930, p. 1).

Craven, appointed designer in 1915, and as a senior manager, travelled internationally to ‘bring the company up to date industry trends and advances’ (Wilson 2008). In her lecture, Craven points out the difference between a correctly fitted and anatomically correct corset, to the corsets of the past:

> Until the activities of the World War emancipated women from fashion designers’ tyranny, the direct pressure of the wrong, or waisty corset upon the side walls of the chest forced the ribs in upon the abdominal content (Craven 1930, p 2).

The anatomical correctness of the Berlei corset had been achieved by Burley’s sophisticated understanding of the role of research by engaging science and mathematics to inform product development and trade craft. His marketing narrative then capitalised and exploited the scientific methodology to the company’s advantage. In July 1926 Fred Burley announced in his monthly article in *The Berlei Review*, ‘An Ambitious Project’ the company’s commitment to product research:

> ... to render the women of Australia a quality of scientific corsetry that would far excel not only that provided by anybody else in Australia, but would be even better than that provided by corset manufacturers the world over (Burley 1926a, p. 1).

Burley had been encouraged by Sir Frank Heath, Head of the Department of Scientific and Industrial Research in Great Britain, who had been invited to Australia in 1925 by the Prime Minister, S M Bruce to advise on the reorganisation of the Institute for Science and Industry, ( Broadman 2001, Council for Scientific and Industrial Research section) ‘to take the first step’, in the ‘application of scientific research to industry’.

‘Thus came into being the Berlei Research Department’ (Burley 1926, p. 2) and early in 1926 Berlei commissioned physiologists at the University of Sydney under the direction of Professor Henry Chapman and Dr S A Smith to undertake a survey of 20,000 women aged 15 years and over to provide information so that ‘ready-made corsets might be designed to fit as if made-to-order’ (Burley cited by Hyslop, 1993).

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15 Chapman attended the 1925 conference on the reorganisation of the Commonwealth Institute of Science and Industry as directed by Sir Frank Heath (Chapman cited by Teale, 1979).
While Chapman is often cited with having created the five figure type categories (Burley cited by Hyslop, 1993), it appears that the ‘Research Department at Berlei House’, was established to ‘handle this big task’ (Warner 1926, p. 9) did most of the work. Mr R W Tannahill, a Sydney University, Bachelor of Science (Hons) graduate, working in conjunction with Chapman and Smith from Sydney University, initially managed the project and research findings. Lecture notes written by Miss Della Pratt, (BSc 1928 USyd), also by 1930 a member of the research department and possibly by that time the manager, explains the methodology:

> After the first 200 sets of measurements were completed, research as to means of classification was entered upon. It was required to divide those measurements into a series of groups so that each group would be comprised of individuals of similar shape, and of shape dissimilar to the members of any other group (Pratt 1930a, p. 2).

As previously cited, measurement ceased in May 1927 after ‘6,000 persons were measured, (5,000 in New South Wales and the remainder in Queensland, Victoria and South Australia)’ (Pratt 1930a, p. 1).

Pratt reports that 22 measurement points were collected (1930a, p. 1), although Lancaster (1957, p. 897) reports 26 and tables.

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16. Della Pratt’s (1930a) qualifications of B.Sc. are recorded in the ‘Consumer Selling Manual’, and she is listed in Sydney University Alumni records as graduating from science in 1928. She is referred to as ‘The Manager Research Department’ in the ‘Consumer Selling Manual’.

17. 1. Vertex height, 2 Shoulder height, 3 Bust height, 4 Waist height, 5 Abdominal prominence height, 6 Thigh fold height, 7 Height of posterior hip projection, 8 Gluteal fold height, 9 Bust circumference, 10A Waist circumference, 10B Waist circumference (sitting), 11 Abdominal prominence circumference, 12 Hip circumference, 13 Waist, lateral diameter, 14 Antero-posterior diameter (abdominal prominence), 15 Hip (lateral diameter), 16 Waist projection 17, Bust projection, 18 Maximum lateral diameter (hip), 19 Weight, 20 Age, (Lancaster 1957, p. 898).
Pratt further explains that the basis of the classification of the figure types was from the ‘length waist to hip, together with the antero-posterior diameter of the waist’:

In all, 24 classes were found, but with the elimination of the factor of size, five individual types remained, each characterised by features peculiar to its members alone. These types were named according to their most characteristic feature, Sway Back, Average, Big Hip, Big Abdomen and short Below Waist. The percentages of each type, after correction for age according to the Census figures for each of the States, are as follows: Sway Back 24.6%, Average 24.3%, Big Hip 16.3%, Big Abdomen 30.2%, Short Below Waist 4.6% (Pratt 1930a, p. 2).

However it is the creation of the Berlei Figure Type Indicator that is the key to understanding the brilliance of the Berlei research. From Pratt’s notes, her statement ‘with the introduction of the Berlei Type Indicator the objective of the Research Department was achieved’ (a, p. 2), indicates the Figure Type Indicator was implemented at the final stage in the Berlei anthropometric research. The Berlei Review of October 1927 heralds the introduction of the five figure categories (refer to Figure 2), but does not include information on the Figure Type Indicator.
Patent documents show a lodgement date in Australia, 21 May 1928 and are signed by Della Lytton Pratt as the inventor. The device technically a nomogram (Wikipedia nomogram) was also registered in New Zealand, Britain, Canada, South Africa and the United States (P3645-28/4 Chart). Being a nomogram, a graphical calculating device, it was used to easily identify the customer’s shape/size combination by aligning the hip (fixed axis) measurement bust measurement (rotating axis) and plotting waist measurement as the radius.
Sue Best (1991) critiques Berlei as marketing to women’s vulnerability, as descriptions of body ‘types other than average were labelled in extremely pejorative terms’ (p. 11). Granted they are not subtle descriptions but viewed from a technical perspective the figure groups are a realistic and identifiable description of women’s bodies: (A) Average, (S.B) Sway Back, (S.B.W) Short Below Waist [meaning heavy bust], (H) Hips [meaning larger hip], (Ab) Abdomen [meaning larger waist]. Maynard (2007) concurs with the practical explanation that the intention was to ‘assist salespersons in recognising customer sizes and thus to be responsive to their needs’ (p. 149). The Berlei Figure Type Indicator remained as a corsetry fitting aid and maintained the Berlei size/shape standard for foundation garments until the 1960s (Burley cited by Hyslop, 1993).

From the shape categories as plotted on the Figure Type Device, it is possible to deduce the hip to waist ratio as the primary control measure. This relationship is explained by Pratt in her patent records:

> it has been found as the result of research and by measuring some thousands of living persons, that there is a definite ratio of proportions between certain of the measurements of the persons measured.

> Investigation showed that of the measurements taken of the hip and waist were more often related than any other two measurements, and for this reason the measurements of the hip and waist are taken as a basis for the device ... (Pratt 1929, p. 1).

Thus Pratt, indicating a strong correlation between the variables of hip and waist, established these as the principal components and used the bust measurement as the third measurement and a ‘necessary correction’ to determine the total shape (p. 1). This method of analysis follows the mathematical procedures of ‘principal component analysis ... a statistical procedure whereby a set of variables is reduced to a new set of variables called principal components’ (Pertrova 2007, p. 68). Otieno cites that:

> according to ‘Yoon and Jasper (1996), Beazley (1997) and Kemsley (1957), key dimensions should have strong multiple correlations with other dimensions related to the garment, must be a good predictor of size for other body parts, and should be easy to measure (2007, p. 74).

Todd further explains that the ... ‘method finds and simplifies the variation of key body dimensions into two major components expressing the two components as a two-dimensional scatter plot’ (2007 p. 301). Thus the Berlei population was plotted on the Figure Type Indicator according to these principals. The method of statistical analysis used by the Berlei Research Department as documented by Della Pratt was possibly one of the first examples in the world of using principal component analysis to development a sizing/shape framework for ready made apparel.

Maynard (2007) has identified the Berlei Company’s progressive approach to marketing and sales based on ‘scientific’ methods and how since the mid 1920s, the company ‘catered to a variety of age groups and figure sizes’ (p. 147). It is therefore valid to examine Berlei Figure Type Indicator schema to help represent the anthropometric diversity required for the contemporary apparel market.
The recognition of shape diversity has been acknowledged in a number of contemporary anthropometric surveys. The 2003 Rip Curl Survey of 2,300 (n) 12 to 24 year olds reported three body shapes, the X shape with a bigger bottom, the Y shape with a bigger bust than hip, and the A shape with a bigger hip than bust (Byrnes, 2004). Berry and Hennes (2008, p. 5) have identified five shapes, labelled to replicate the shape X, I, A, H, and XH, representing women from the age of 37 to 52. The Spanish Government, in releasing the results in February 2008 of the Instituto Nacional del Consumo Anthropometric Study of 10,415 women, reported that women in Spain can be classified on the basis of ‘three body types’: the hourglass shape represents 39% of the population, the barrel 36% and the pear shape 25%. It further reports that:

*By ages, it is noteworthy how during puberty and youth (from 12 to 30 years) the barrel shape is predominant, while during maturity (from 31 to 60) the hourglass shape is prominent, followed by the barrel and pear in a differing proportion according to the age. From age 60 onwards the pear shape is the most common (2008 [d]).*

This survey acknowledges the need to update apparel standards to better reflect population profiles and confirms the impact of age on shape variables:

*Today’s clothes sizes, which are based on pre-1975 models, are no longer adapted to the current physical profile of women in Spain (2008 [d]).*

Further to this, Instituto Nacional del Consumo directed that the European Standards Committee EN 13402-3-2004 framework be used as the size policy when developing new size profiles for Spanish apparel. As the EN 13402-3 format is based on identifying primary body dimensions, which can be matched to garment size labels, it is a multimodal mix and match format and allows the consumer to select garments according to body type. Petrova suggests that this format as such, is a way of reducing the ‘number of necessary sizes’ (2007, p. 66) as it classifies only that part of the body that will be covered by the garment such as skirts and pants as lower body garments and shirts and jackets as upper body garments.

To further explain this rationale and the need for flexibility, women’s fashion no longer prescribes the dress as women’s most important apparel item, and as cited by Lewis (2007) since the 1960s, when ‘fashion’s leadership become less dictatorial and more democratic’ (p. 313). Separates have long been established as female apparel categories and to consider these options; fitting jeans on the lower body is not dependent on fitting a bra to the upper body.

4.3 Conclusion

The Berlei figure typology, first developed to achieve a better fitting corset in the late 1920s can provide insight to methods to assist with shape and size definitions for outerwear apparel today. The most salient learning from the Berlei investigation is the effectiveness of a self-determined approach to size definition over generic size standards.

It is ironic that the Berlei history in applied anthropometric research in 1927 later influenced the development of women’s clothing standards in Australia in 1959, which as contended in this research, are now inadequate as clothing standards have transgressed into confused and
misrepresentative technical and social benchmarks for women’s bodies. Thus, does anthropometric research best facilitate innovation when undertaken to solve a specific design problem, rather than by the generalist large scale data capture method? The Berlei research quite clearly presented two separate discoveries: the first was the five figure types defined from the anthropometric data; the second was the Figure Type Indicator, which facilitated the definition of shape and size and made a saleswoman ‘as adept as a corsetiere’ (Higbee 1933, p. 56). The first instructed the design and development of the Berlei product according to correct anthropometric profiles; the second informed the sales assistant and customer in an efficient and easily understood manner.

Therefore, the following practical research prototype models draw much from the analysis of the Berlei Figure Type Indicator as a catalyst in rethinking size classifications for apparel development. From reading Pratt’s notes the methodology, which firstly establishes the hip to waist ratio as a starting point and secondly links the chest to the hip to achieve the final shape, presents a multimodal system. It is possible therefore to use this methodology to instruct the development of the body as separates shape schema and feasible to investigate if the model can be represented in an accompanying nomogram to support the construct. Technically, if this is possible, then the opportunity would exist to develop a digital model based on this logic.
5 PRACTICE INTO SHAPE

‘A working technical model’

‘What the definitions look like and how are they applied’

5.1 Introduction

This chart details the three phases of practical research: investigation, validation and application; and the outputs from each stage undertaken to develop and apply the body as separates shape model.

The significance of the 1926–27 Berlei anthropometric survey has been shown via theoretical analysis as a major research thread throughout this exegesis. The research has endeavoured to extract the technical structure of the Berlei research methodology to provide insight into the validity of their research methods. Many hours of investigation guided by experience in pattern construction and sizing have been devoted to the workings and architecture of the Figure Type Indicator (FTI). Once its computing functions were decoded, it provided a mathematically cogent strategy to transmit the body as separates hypothesis into a working model. This has been achieved by developing prototype examples using measurement data for the girth measurements of chest, waist and hip from the Real Australian Woman (RAW) survey.
The actual FTI device used in this investigation is a 1960s version of the indicator (Figure 4). It differs slightly from the original version (refer to Figure 3) which shows the ‘average’ shape category with four subdivisions. The 1960s device shows the ‘average’ with two categories. However, Della Pratt’s lecture notes describe that ‘the average type has two main subdivisions, Slender and Medium’ (Pratt 1930b, p. 3). 1930 versions of the device show the categories complying with later versions (refer to Figure 4). This means the average categories were reduced not long after being introduced. As ‘the members of this group do not require such controlling corsetry as the members of any other type’ (p. 3) the original version may have been found to be over catering to the average figure group. Thus the size shape categories remained without amendment from 1930 until the 1960s and confirm how robust the Berlei measurement protocols were.

Figure 3: Original device with notations by hand

Figure 4: 1960s version
5.2 Investigation: The virtual corset

This investigation was primarily driven by the motivation to understand the shape categories mapped by the FTI and led to the development of the diagrams and shape models that have directed the development of the body as separates hypothesis into a working model. The process of investigation revealed the advantage of using ratios to explain the relationships between hip and waist, and hip and chest being irrespective of size. By mapping these components i.e. hip and waist, hip and chest, on bivariate charts it is possible to identify common figure shapes and relationships. As previously explained, Pratt’s patent notes describe the strong correlation between hip and waist measurements (1929, p. 1). This exercise is therefore a way of testing if this correlation exists.

It is also instructive to investigate the least number of measurements required to effectively describe a body shape. As Berlei were only dealing with a garment type that covered the torso region i.e. the corset, is this approach suitable for other garment types? This question is not possible to validate without a more comprehensive database. These exercises are intended to provide some understanding of the extent and limitations of this approach. Therefore the exclusion of some dimensions, such as those relating to length, has to be considered separately and is an area for further research. At this stage it is envisaged that this will not effect this investigation or the development of the shape model, as length can be considered as a separate dimension.

5.2.1 The virtual corset defined
This investigation was undertaken to test the function of the Berlei Figure Type Indicator to validate the shape categories. Using an original 1960s FTI and following the ‘How to Use’ and ‘Find the Figure Type’ instructions shown here; 443 subjects in the RAW database were given a manual corset fitting. The shape categories were recorded and colour coded according to shape category.

Both the primary schema for lower body and secondary schema for upper body are represented in a principal component bivariate format, with the first chart representing the lower body components of hip on the Y axis and waist on the X axis, and the second chart representing upper body hip on the Y axis and chest on the X axis.

Both charts show that there is a good correlation between the waist and hip (1), and the chest and hip (2). This confirms Pratt’s patent notes describing the strong correlation between hip and waist measurements (1929, p. 1). The trend shows that as the hip measurement increases so does the...
waist and chest respectively. The trend line shows in the lower measurement range that there is a lower waist to hip ratio (WHR) and at the higher measurement range that there is a higher WHR, for example:

\[
\text{hip 95 cm x waist 60 cm} = 0.63 \text{ WHR}
\]

\[
\text{hip 125 cm x waist 105 cm} = 0.84 \text{ WHR}
\]

There is a similar pattern for the chest to hip relationship.

Mapping the data, firstly to show the waist to hip relationship and secondly to show the chest to hip relationship, established the protocol for the shape hierarchy. When the data was mapped it showed distinctive categories consistent with Della Pratt’s descriptions. This consistency confirms the validity and relevance of the original Berlei project in defining shape categories.

The average type (shaded red) as described by Pratt is the ‘ideal of female beauty … this figure is evenly proportioned at shoulders and hips (Pratt 1930b, p. 2)’. Waists for the average type do not exceed 80 cm and hips don’t exceed 102 cm.

However, gaining weight on the waist and hips, the average shape will move into the Big Abdomen Type (shaded yellow):

\textit{As the name implies the type is characterised by the fatty accumulation on the abdominal wall and it is to the reduction of this that the art of the corsetiere is directed (p. 2).}

The Short Below Waist (shaded grey), otherwise know as the ‘heavy bust’ type, is a very small group, with the ‘direct antithesis to this figure’ (p. 3) being the Big Hip Type (shaded pink). ‘The large hip line of this type is accompanied by a narrow waist and small bust line (p. 3)’. The hip measurement is over 100 cm. The Sway Back group (shaded green) is a smaller scale of the Big Hip group and, according to Pratt, is usually ‘the young girl of immature form (p. 2)’.

As Pratt’s notes include a summary of the total population, it is possible to compare the shape summaries for the Berlei population to the RAW population. In making this comparison it needs to be recognised that the RAW population does not include anyone below the age of 22. If we accept Pratt’s description that the ‘Sway Back’ type is consistent with the undeveloped figure prior to reaching maturity, the data can be adjusted to reflect this age bias (Pratt 1930a, p. 3).

Therefore, by adding the Berlei Sway Back and Average percentages together, the data shows a very similar morphology. RAW shows 5% more people in the Big Abdomen category and 5% fewer in the Big Hip category.

More research using a larger database could be undertaken to confirm this trend. As the Berlei type has thirteen subdivisions, it would be possible to continue typological research in this area and further define the specifications of the shape subdivisions.

This exercise was pivotal in clarifying shape categories and in proving that the Figure Type Indicator validly computes shape. There has always been some scepticism within the industry that this device
was simply a clever marketing device; demonstrating its function confirms the Berlei research as the anchor point for this project.

### 5.2.2 Shape schema

This schema was developed to symbolically represent the relationships between hip, waist and bust. The diagrams are intended to be a prototype model to represent the relationships. They represent a transverse or birds-eye view of the relevant body area and in a later section (5.4.2) are replicated from body scanned data transverse views, to show how the schema can be applied to create somatic body maps or somatic topography.

According to Della Pratt’s patent documents and lecture notes, the Berlei shape hierarchy is primarily determined by two measurements as the starting point:

> In determining the figure types, although two measurements would be sufficient to approximately determine the type, a third measurement is necessary as a correction, in order to select a more perfectly fitting garment (Pratt 1929, p1).

This shape model is based on the primary shape definition being the waist to hip ratio (WHR)\(^{18}\), and is supported by the investigation undertaken shown previously in the Virtual Corset investigation in

\[^{18}\text{WHR} = \text{waist measurements divided by hip measurement (75 cm waist /100 cm hip} = 0.75 \text{WHR}\]
Section 5.2.1. For example, if the hip measures 100 cm and the waist measures 75 cm then the WHR is 0.75. Described in another way, the waist is 25% smaller than the hip. The diagram below is the representation of the relationship for standalone lower body garments i.e. pants or skirts. An example would be when fitting a pair of jeans to the lower body; chest or bust size does not need to be considered for fit. Similarly, head size is superfluous to the fit of lower body garments.

The same applies for the chest to hip ratio (CHR)\(^{19}\) which is the secondary shape schema. If the hip measures 100 cm and the chest measures 92 cm then the CHR is 0.92, or the chest is 8% smaller than the hip. This model represents garments that fit the upper body such as shirts, dresses, jackets. It is suitable as a standalone model if the waist can be considered as a flexible region when fitting garments such as a T-shirt, or a blouse or dress with a non-defined waist region.

For garments that require a specific reference to the waist such as a fitted jacket, tailored dress or overalls, the combined model is required. This is the tertiary shape.

\(^{19}\) CHR = chest measurement divided by hip measurement (92 cm chest/100 cm hip = 0.92 CHR)
This approach to defining body shape establishes the shape model as a key indicator for specific garment design. Using Berlei protocols as an example, garments such as corsets were designed and engineered specifically to body types. The shape categories instructed the specific approach to pattern engineering to best fit that shape. As previously shown the common practice for apparel sizing is to develop one prototype or model size to the perceived ‘average’ fit and to grade sizes up and down from that size without necessarily referencing the body.

Using the shape hierarchy, it is possible to construct more body shapes by changing the relationships, for example WHR<0.75 being a more defined or curvier shape than those with a WHR>0.75. The combination of these shape profiles provides the framework for a customised approach to the development and selection of mass market apparel based on the Berlei methodology, and quantifies shape definition by measurement.

Thus, by changing the ratios or the relationships it is possible to change the shapes. The following model constructed via these conditions with hips as a constant, two varying WHRs (1 = 0.75, 2 = 0.85) and two varying CHRs (1 = <0.90, 2 = 0.95), builds four different shapes.
It is therefore possible to use this model to construct a multimodal approach to a size/shape framework by dividing the body into the two separate zones: one defined by the WHR and the other defined by the CHR, using the hip as the primary control measurement. Koblyakova (cited in Petrova 2007, p. 66) proposed ‘that the control measurements must have the largest (or as large as possible) absolute value in order to be representative of the basic shape of the body’. As an analysis of hip and bust data from the RAW survey identifies that 94% of the 443 participants have a larger hip measurement than bust measurement, the hip can be determined as the best primary control point for all shape and size definitions.
5.2.3 Grading protocols – maintaining the relationship

The function and development of apparel sizing protocols i.e. the method of scaling sizes up and down, has been critiqued and explained in previous chapters from a theoretical perspective. As explained in Chapters 2 and 3, the common grade protocol for apparel in Australia is the 5 cm incremental increase and decrease. Apparel standard AS1344-1997 functions according to this protocol\(^{20}\). The historical precedent for this being that it is the accepted protocol derived from the conversion of two inches to the metric five cm equivalent. While this is commonly used and understood by the apparel industry in Australia, the 5 cm increment has been shown in this research to be a somewhat flawed scale for achieving adequate definition of size clothing to best represent women’s bodies.

The methodology demonstrated in the representation of body shape in the shape schema, based on a relational methodology i.e. the waist to hip ratios for lower body and chest to hip ratios for upper body, can be extended to formulate the size group definitions. The incremental growth factor for the size scale profiles can also be based on a percentage. There are two reasons why this approach is feasible. Firstly because the percentage calculation maintains the fit relationships and supports the shape schema methodology, and secondly because a greater measurement range can be achieved for the equivalent number of size units in comparison to the 5 cm fixed incremental pattern. The following diagram represents both scales.

\(^{20}\) The history of grade protocols for women’s apparel is explained in Chapter 2, Section 2.4, Table 1 and the historical comparison of size tables is shown in Chapter 3, Section 3.2, Table 7.
The percentage calculation maintains the fit relationship by using a value that is calculated as a percentage of the body measurement where the value is always related i.e. the smaller the body measurement the smaller the grade gap, the larger the body measurement the bigger the grade gap21.

These relationships can be better described or measured via an index descriptor. Yu (2004b, p. 79) developed a formula for creating an index to compare garment ease allowance against body size as a statistical benchmarking measure. It compares the linear measurement along the surface of the body (LM body) at a given point to the linear measurement (LM garment) of the surface of the garment at the same point. Yu (2004b) describes it as the Linear Index (LI):

\[ \text{linear index (LI)} = \frac{\text{LM Garment} - \text{LM Body}}{\text{LM Body}} \]

An index rather than a straight linear measurement presents a simple benchmark for the comparison of both elements. In this case the comparison is between final garment measurement and the body measurement at the same point. The following table presents the LI calculated for the hip point for two examples. Example 1 uses the common grade protocol of AS1344-1997 and shows a fixed incremental grade of 5 cm and fixed nominal garment ease allowance of 5 cm. Example 2 shows a proportional ease allowance calculated by 5% and a proportional incremental size change based on 5%.

<table>
<thead>
<tr>
<th>size (in cm)</th>
<th>fixed garment ease</th>
<th>LM body hip</th>
<th>LM garment</th>
<th>LI Linear Index</th>
<th>% garment ease</th>
<th>LM body hip</th>
<th>LM garment</th>
<th>LI Linear Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.00</td>
<td>80.00</td>
<td>85.00</td>
<td>0.06</td>
<td>4.07</td>
<td>82.38</td>
<td>86.45</td>
<td>0.05</td>
</tr>
<tr>
<td>2</td>
<td>5.00</td>
<td>85.00</td>
<td>90.00</td>
<td>0.06</td>
<td>4.29</td>
<td>86.45</td>
<td>90.74</td>
<td>0.05</td>
</tr>
<tr>
<td>3</td>
<td>5.00</td>
<td>90.00</td>
<td>95.00</td>
<td>0.06</td>
<td>4.51</td>
<td>90.74</td>
<td>95.25</td>
<td>0.05</td>
</tr>
<tr>
<td>4</td>
<td>5.00</td>
<td>95.00</td>
<td>100.00</td>
<td>0.05</td>
<td>4.75</td>
<td>95.25</td>
<td>100.00</td>
<td>0.05</td>
</tr>
<tr>
<td>5</td>
<td>5.00</td>
<td>100.00</td>
<td>105.00</td>
<td>0.05</td>
<td>5.00</td>
<td>100.00</td>
<td>105.00</td>
<td>0.05</td>
</tr>
<tr>
<td>6</td>
<td>5.00</td>
<td>105.00</td>
<td>110.00</td>
<td>0.05</td>
<td>5.25</td>
<td>105.25</td>
<td>110.50</td>
<td>0.05</td>
</tr>
<tr>
<td>7</td>
<td>5.00</td>
<td>110.00</td>
<td>115.00</td>
<td>0.05</td>
<td>5.51</td>
<td>110.76</td>
<td>116.28</td>
<td>0.05</td>
</tr>
<tr>
<td>8</td>
<td>5.00</td>
<td>115.00</td>
<td>120.00</td>
<td>0.04</td>
<td>5.79</td>
<td>116.55</td>
<td>122.34</td>
<td>0.05</td>
</tr>
<tr>
<td>9</td>
<td>5.00</td>
<td>120.00</td>
<td>125.00</td>
<td>0.04</td>
<td>6.08</td>
<td>122.63</td>
<td>128.71</td>
<td>0.05</td>
</tr>
<tr>
<td>10</td>
<td>5.00</td>
<td>125.00</td>
<td>130.00</td>
<td>0.04</td>
<td>6.38</td>
<td>129.01</td>
<td>135.39</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Example 1: fix ease and fixed grade increments

Example 2: proportional % ease and proportional % grade increments

In Example 1, the LI measure of 0.06 is a higher index for the smallest hip measurement (80 cm) to that of the largest size (125 cm) with a smaller LI of 0.04. This means that there is more garment ease as a proportion of body size at the smallest size and that the largest size has less garment ease as a proportion of body size. This issue is extensively discussed in Chapter 3, Section 3.5.

---

21 Issues around problems with disproportionate values at the margins of size scales were first observed with uniform apparel supplied to health sector workers. In particular, smaller customers were noted to be excessively large in proportion to body size and required additional sizes to fit. This issue is extensively discussed in Chapter 3, Section 3.5.
proportion of body size. Example 2 shows that the relationship is maintained throughout the size scale by the constant LI of 0.05 for all sizes when using a percentage value.

Therefore Yu’s LI formula (2004b, p. 79) can be applied to determine the relationship between adjoining sizes and described accordingly as a fit index (FI):

\[
\text{fit index (FI)} = \left( \frac{\text{LM}_{\text{Body size 100cm}} - \text{LM}_{\text{Body size 95.25cm}}}{\text{LM}_{\text{Body size 95.25cm}}} \right)
\]

This index measures body size only and does not include garment ease. The following table demonstrates the FI when applied to grade increments only. The table again shows the same patterns for fixed grade increments (Example 1) verses proportional grade increments (Example 2). The percentage grade model keeps a constant FI for all sizes.

<table>
<thead>
<tr>
<th>Waist</th>
<th>Hip</th>
<th>Fit index</th>
</tr>
</thead>
<tbody>
<tr>
<td>55.00</td>
<td>80.00</td>
<td>0.07</td>
</tr>
<tr>
<td>60.00</td>
<td>85.00</td>
<td>0.06</td>
</tr>
<tr>
<td>65.00</td>
<td>90.00</td>
<td>0.06</td>
</tr>
<tr>
<td>70.00</td>
<td>95.00</td>
<td>0.06</td>
</tr>
<tr>
<td>75.00</td>
<td>100.00</td>
<td>0.05</td>
</tr>
<tr>
<td>80.00</td>
<td>105.00</td>
<td>0.05</td>
</tr>
<tr>
<td>85.00</td>
<td>110.00</td>
<td>0.05</td>
</tr>
<tr>
<td>90.00</td>
<td>115.00</td>
<td>0.05</td>
</tr>
<tr>
<td>95.00</td>
<td>120.00</td>
<td>0.04</td>
</tr>
<tr>
<td>100.00</td>
<td>125.00</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Example 1: 5 cm grade model

<table>
<thead>
<tr>
<th>Waist</th>
<th>Hip</th>
<th>Fit index</th>
</tr>
</thead>
<tbody>
<tr>
<td>56.02</td>
<td>82.38</td>
<td>0.05</td>
</tr>
<tr>
<td>60.00</td>
<td>86.45</td>
<td>0.05</td>
</tr>
<tr>
<td>64.42</td>
<td>90.74</td>
<td>0.05</td>
</tr>
<tr>
<td>69.50</td>
<td>95.25</td>
<td>0.05</td>
</tr>
<tr>
<td>75.00</td>
<td>100.00</td>
<td>0.05</td>
</tr>
<tr>
<td>81.00</td>
<td>105.25</td>
<td>0.05</td>
</tr>
<tr>
<td>87.00</td>
<td>110.76</td>
<td>0.05</td>
</tr>
<tr>
<td>93.50</td>
<td>116.55</td>
<td>0.05</td>
</tr>
<tr>
<td>100.56</td>
<td>122.63</td>
<td>0.05</td>
</tr>
<tr>
<td>108.37</td>
<td>129.01</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Example 2: 5% grade model

The importance of working with an FI will be demonstrated in a later section when explaining the methodology for determining which size is the best fit according to the identified body measurements.

The second reason for using the percentage grade method (where a greater measurement range can be achieved within the same number of size units) is its potential to increase the population coverage without increasing the number of size units, thus offering a greater size scope.

Another factor for consideration here is that the percentage model is only a slight amendment to the 5 cm method, as the apparel industry in Australia has shown a reluctance to adopt radical changes such as a 4 cm grade or the US grading system. The following table compares the range and distribution for both methods.
5.2.4 Scatter schema – principal components

The size model was developed using lower body bivariate and upper body bivariate charts. An additional chart has been added to reference height which plots height to waist. For the development of the shape model, this dimension has not been included as there was insufficient data in the RAW database. As height can be considered separately as an addition dimension, this does not impact on the primary methodology. Linking a height and waist bivariate chart to the hip/waist chart provides an important reference link and illustrates the height range according to waist/hip profiles. The mean measurement points are also mapped on the three charts as the starting point for shape allocation.
5.2.5 **Shape definitions**

The representation shape has been allocated according to the following ratios for lower body garments i.e. where the shape that represents the waist with the smallest measurement to the hip is represented by the triangle and defined by a WHR of less than 0.70 or for example = a hip of 100 cm with a waist of 70 cm.

The next shape is the mid range shape represented by a trapezoid and defined by a WHR of over 0.70 and less than 0.78, for example = a hip of 100 cm with a waist of 75 cm is within this definition.

The last shape is the waist with the largest measurement against the hip, measured as a WHR of more than 0.78 and represented by a rectangle of square. This shape can also extend beyond the square if the waist is larger than the hip.

<table>
<thead>
<tr>
<th>1. Lower Body</th>
<th>&gt;WHR</th>
<th>&lt;WHR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triangle</td>
<td></td>
<td>&lt;0.70</td>
</tr>
<tr>
<td>Trapezoid</td>
<td>&gt;0.70</td>
<td>&lt;0.78</td>
</tr>
<tr>
<td>Rectangle</td>
<td>&gt;0.78</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Upper Body</th>
<th>&gt;CHR</th>
<th>&lt;CHR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triangle</td>
<td></td>
<td>&lt;0.89</td>
</tr>
<tr>
<td>Trapezoid</td>
<td>&gt;0.89</td>
<td>&lt;0.95</td>
</tr>
<tr>
<td>Rectangle</td>
<td>&gt;0.95</td>
<td></td>
</tr>
</tbody>
</table>

For upper body garments an identical shape representation applies but the ratios are different, for example the ratio for the small bust to hip is 0.88 or matched to a 100 cm hip = 88 cm.

The range for the mid range shape of trapezoid is a ratio range of more than 0.89 and less than 0.95. A chest of 92 cm to the 100 cm hip is an example.

The last shape is represented by the rectangle and is the largest chest measurement at a ratio 0.92. A chest measurement of 98 cm to 100 cm hips is in this definition.

The following shape chart plots the range of shape definitions on an XY axis. The combination of three lower body shape and three upper body shapes achieves nine shape categories.
Given that the hip is a constant, moving up the Y axis (which represents the WHR) the shape groups show the waist moving from smallest to largest, with each row having a common shape. The X axis shows the smallest to largest CHR where each column has a common shape. The circles are a proportional representation of the ratios for bust, waist and hip.
These diagrams represent primary, secondary and combined formats for all shape variables:

- **Primary Format**:
  - Chest: Large
  - Waist: Small
  - Hip: Small
  - Waist Hip Ratio: <0.70
  - Chest Hip Ratio: <0.88

- **Secondary Format**:
  - Chest: Medium
  - Waist: Small
  - Hip: Small
  - Waist Hip Ratio: <0.70
  - Chest Hip Ratio: >0.89 and <0.95

- **Combined Format**:
  - Chest: Small
  - Waist: Large
  - Hip: Large
  - Waist Hip Ratio: <0.70
  - Chest Hip Ratio: >0.95
<table>
<thead>
<tr>
<th>chest</th>
<th>waist</th>
<th>hip</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>chest</th>
<th>waist</th>
<th>hip</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>chest</th>
<th>waist</th>
<th>hip</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>chest</th>
<th>waist</th>
<th>hip</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.3 Validation: The Shape Matrix

Having defined both the measurement protocol for the shape schema profiles by ratios and size grade protocols by an incremental percentage scale, it is possible to apply these definitions to an anthropometric data set and investigate if a bifurcated approach is a valid strategy for size definition. The research in this stage demonstrated the shape and size formulas defined in the previous prototype exercises could be applied to RAW anthropometric data in bivariate charts according to the lower body (primary) and upper body (secondary) definitions. The relative fit relationships can be measured as the grade increments for each size increase or decrease. The parameters of fit can be subsequently defined according to a measurement range referenced from the index of fit (FI) and a value can be placed on how to ascribe the size that is deemed the best fit.

5.3.1 Lower body size – primary shape map

Using the hip starting point for the size and applying the 5% grade protocol, the hip size can be mapped along the population trend line, which then determines the waist measurement. The shape categories emerge by applying the shape schema ratio formulas. Thus the WHR shapes for this group show the triangle group in the two smallest sizes, the trapezoid groups the next four shapes and the four largest sizes are a rectangular.

<table>
<thead>
<tr>
<th>Hip</th>
<th>82.38</th>
<th>86.45</th>
<th>90.74</th>
<th>95.25</th>
<th>100.00</th>
<th>105.25</th>
<th>110.76</th>
<th>116.55</th>
<th>122.63</th>
<th>129.01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waist</td>
<td>56.02</td>
<td>60.00</td>
<td>64.42</td>
<td>69.50</td>
<td>75.00</td>
<td>81.00</td>
<td>87.00</td>
<td>93.50</td>
<td>100.56</td>
<td>108.37</td>
</tr>
<tr>
<td>WHR</td>
<td>0.68</td>
<td>0.69</td>
<td>0.71</td>
<td>0.73</td>
<td>0.75</td>
<td>0.77</td>
<td>0.79</td>
<td>0.80</td>
<td>0.82</td>
<td>0.84</td>
</tr>
</tbody>
</table>

Shape group WHR 1: 5% +/- grade

The size naming protocol is intended to be way of explaining the shape model from a constant reference point being the hip (in metres) in a logical and quantifiable format. In some cases measurements have been rounded to attempt to simplify the numbers e.g. size 1.23 L1 has a hip measurement of 122.63 cm.
5.3.2 Size mapping total population – lower body

The total population can be mapped following the same methodology, with shape categories allocated according to ratios.

The size code designation is identified by the hip with the letter ‘L’ for lower body, with a number to identify the applicable shape category (e.g. size 1.11 – L3 refers to a hip measurement of 1.11 metres) and is from shape category three.

The rationale behind this protocol is based on being accountable to hip and is not ‘ad hoc’. As this approach to size is based on measurement, it can be adapted to many different population profiles, not just specifically women. Its logic can be applied to male and children’s apparel.
5.3.3 Upper body size – secondary shape map

Following the same protocol for the upper body, the hip size can be mapped along the population trend line, which then determines the chest measurement and consequent shapes.

<table>
<thead>
<tr>
<th>Hip</th>
<th>82.38</th>
<th>86.45</th>
<th>90.74</th>
<th>95.25</th>
<th>100.00</th>
<th>105.25</th>
<th>110.76</th>
<th>116.55</th>
<th>122.63</th>
<th>129.01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest</td>
<td>70.00</td>
<td>75.50</td>
<td>81.00</td>
<td>86.00</td>
<td>92.00</td>
<td>98.00</td>
<td>104.50</td>
<td>111.50</td>
<td>119.00</td>
<td>126.00</td>
</tr>
<tr>
<td>CHR</td>
<td>0.85</td>
<td>0.87</td>
<td>0.89</td>
<td>0.90</td>
<td>0.92</td>
<td>0.93</td>
<td>0.94</td>
<td>0.96</td>
<td>0.97</td>
<td>0.98</td>
</tr>
</tbody>
</table>

Shape group CHR 1: 5% +/- grade

The size code designation maintains the hip as the primary identify for the upper body shape, with the letter ‘U’ (for upper body) and a number to identify the applicable shape category (e.g. size 1.00 – U1 refers to a hip measurement of 1.00 metre) and it is from shape category one.
### 5.3.4 Size mapping total population – upper body

<table>
<thead>
<tr>
<th>Hip</th>
<th>82.38</th>
<th>86.45</th>
<th>90.74</th>
<th>95.25</th>
<th>100.00</th>
<th>105.25</th>
<th>110.76</th>
<th>116.55</th>
<th>122.63</th>
<th>129.01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>80.00</td>
<td>85.00</td>
<td>90.00</td>
<td>96.36</td>
<td>104.00</td>
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<td>121.63</td>
<td>129.01</td>
</tr>
<tr>
<td></td>
<td>0.84</td>
<td>0.85</td>
<td>0.96</td>
<td>0.87</td>
<td>0.89</td>
<td>0.90</td>
<td>0.91</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Shape group CHR 2: 5% +/- grade**

<table>
<thead>
<tr>
<th>Hip</th>
<th>82.38</th>
<th>86.45</th>
<th>90.74</th>
<th>95.25</th>
<th>100.00</th>
<th>105.25</th>
<th>110.76</th>
<th>116.55</th>
<th>122.63</th>
<th>129.01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bust</td>
<td>76.00</td>
<td>82.00</td>
<td>88.02</td>
<td>92.39</td>
<td>99.00</td>
<td>105.00</td>
<td>111.87</td>
<td>118.88</td>
<td>126.31</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.92</td>
<td>0.95</td>
<td>0.97</td>
<td>0.97</td>
<td>0.99</td>
<td>1.00</td>
<td>1.01</td>
<td>1.02</td>
<td>1.03</td>
<td></td>
</tr>
</tbody>
</table>

**Shape group CHR 3: 5% +/- grade**

---

![CHEST / HIP RATIOS – UPPER BODY](image_url)
5.3.5 Combined size – tertiary shape map
By combining the lower body map with the upper body map linked by common hip measurements, the tertiary shape is formed, resulting in six shapes out of the nine potential shapes.

Bivariate charts (waist to hip) for lower body, linked to (chest to hip) upper body

Combined shape schemas showing 6 shapes, in transverse view (top) and ratio shape definitions (bottom) (see 5.2.5)
## 5.3.6 Lower body measurement specifications

<table>
<thead>
<tr>
<th>Shape 1</th>
<th>0.82 L1</th>
<th>0.86 L1</th>
<th>0.90 L1</th>
<th>0.95 L1</th>
<th>1.00 L1</th>
<th>1.05 L1</th>
<th>1.11 L1</th>
<th>1.16 L1</th>
<th>1.23 L1</th>
<th>1.29 L1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waist</td>
<td>56.02</td>
<td>60.00</td>
<td>64.42</td>
<td>69.50</td>
<td>75.00</td>
<td>81.00</td>
<td>87.00</td>
<td>93.50</td>
<td>100.56</td>
<td>108.37</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shape 2</th>
<th>0.95 L2</th>
<th>1.00 L2</th>
<th>1.05 L2</th>
<th>1.11 L2</th>
<th>1.16 L2</th>
<th>1.23 L2</th>
<th>1.29 L2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waist</td>
<td></td>
<td>64.00</td>
<td>69.00</td>
<td>73.63</td>
<td>78.14</td>
<td>84.18</td>
<td>90.74</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shape 3</th>
<th>0.82 L3</th>
<th>0.86 L3</th>
<th>0.90 L3</th>
<th>0.95 L3</th>
<th>1.00 L3</th>
<th>1.05 L3</th>
<th>1.11 L3</th>
<th>1.16 L3</th>
<th>1.23 L3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waist</td>
<td>60.96</td>
<td>64.84</td>
<td>69.87</td>
<td>74.77</td>
<td>81.00</td>
<td>88.37</td>
<td>95.86</td>
<td>102.82</td>
<td>110.37</td>
</tr>
</tbody>
</table>

| Hip     | 82.38   | 86.45   | 90.74   | 95.25   | 100.00  | 105.25  | 110.76  | 116.55  | 122.63  |

Measurement chart for lower body for each size

## 5.3.7 Upper body measurement specifications

<table>
<thead>
<tr>
<th>Shape 1</th>
<th>0.82 U1</th>
<th>0.86 U1</th>
<th>0.90 U1</th>
<th>0.95 U1</th>
<th>1.00 U1</th>
<th>1.05 U1</th>
<th>1.11 U1</th>
<th>1.16 U1</th>
<th>1.23 U1</th>
<th>1.29 U1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bust</td>
<td>70.00</td>
<td>75.50</td>
<td>81.00</td>
<td>86.00</td>
<td>92.00</td>
<td>98.00</td>
<td>104.50</td>
<td>111.50</td>
<td>119.00</td>
<td>126.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shape 2</th>
<th>0.95 U2</th>
<th>1.00 U2</th>
<th>1.05 U2</th>
<th>1.11 U2</th>
<th>1.16 U2</th>
<th>1.23 U2</th>
<th>1.29 U2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bust</td>
<td>80.00</td>
<td>85.00</td>
<td>90.00</td>
<td>96.36</td>
<td>104.00</td>
<td>110.00</td>
<td>118.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shape 3</th>
<th>0.82 U3</th>
<th>0.86 U3</th>
<th>0.90 U3</th>
<th>0.95 U3</th>
<th>1.00 U3</th>
<th>1.05 U3</th>
<th>1.11 U3</th>
<th>1.16 U3</th>
<th>1.23 U3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bust</td>
<td>76.00</td>
<td>82.00</td>
<td>88.02</td>
<td>92.39</td>
<td>99.00</td>
<td>105.00</td>
<td>111.87</td>
<td>118.88</td>
<td>126.31</td>
</tr>
</tbody>
</table>

| Hip     | 82.38   | 86.45   | 90.74   | 95.25   | 100.00  | 105.25  | 110.76  | 116.55  | 122.63  |

Measurement chart for upper body for each size
5.3.8 Applying the Fit Index (FI)

In developing these size and shape classifications it became apparent during this research that the degree of shape variables required to satisfy the RAW population quickly escalates into a complex range of size and shape variations. This has been necessary to adequately explain the shape model. It would possibly be too dense as a viable retail or consumer model, and could partly explain why the Misses size format has remained in use. This is another area of potential research. However as the shape model has been quantified it is now possible to ascertain the rules for determining fit profiles, which suggests that the model could be applied in a digital format. This stands to serve the same purpose as the Berlei Figure Type Indicator, a manual computer that easily converted customer measurements to shape categories.

To determine what can be described as the ‘best fit to size relationship’ i.e. the relationship of body size to a designated size profile that has been specified in the shape model, it is possible to measure the relationship of body size to the sizes specified in the shape model.

This concept was previously discussed (in Section 5.2.3) when formulating the grade protocols, where the purpose and application of the fit index (FI) was explained as a way to measure the relationships between two elements i.e. two different sizes or the difference between body size and garment size:

\[
\text{fit index (FI)} = \frac{LM \text{ Body size } 100 \text{ cm} - LM \text{ Body size } 95.25 \text{ cm}}{LM \text{ Body size } 95.25 \text{ cm}}
\]

This formula can also be applied to individual body measurements against defined size profiles for the same body region to assess the fit relationship. For example, using body measurements in centimetres of waist 78.00, hip 104.00 and chest of 96.00, it is possible to rank the difference between the body and a nominated size profile using the following formula:

\[
\text{linear fit index (LFI) waist} = \frac{LM \text{ size } 81.00 \text{ cm} - LM \text{ body } 78.00 \text{ cm}}{LM \text{ body } 78.00 \text{ cm}}
\]

\[
\text{linear fit index (LFI) hip} = \frac{LM \text{ size } 105.25 \text{ cm} - LM \text{ body } 104.00 \text{ cm}}{LM \text{ body } 104.00 \text{ cm}}
\]

\[
\text{linear fit index (LFI) chest} = \frac{LM \text{ size } 98.00 \text{ cm} - LM \text{ body } 96.00 \text{ cm}}{LM \text{ body } 96.00 \text{ cm}}
\]

A score of 0.00 equates to a perfect match. The range of fit tolerance is determined by the grade gap. Therefore referring back to the 5% grade protocol, this equals 0.05. Thus the fit tolerance for the hip is +/- 0.025. Any score outside this range could be deemed outside the ‘best fit to size’ tolerance.

In the example below, the LFI score for the hip to the best fit size is 0.01 (audit size 6) and means that it is a fit match. The fit tolerances for both the waist (+/- 0.045) and the chest (+/- -0.050) are more generous but still comply with the grade gap for these areas.

It is possible to score a LFI for the primary lower body, secondary upper body and tertiary combined shapes. In the case highlighted in the following table, audit size 6 is the best match for all three areas. The lower body fit match is determined by matched aligned score for the waist and hip areas. The same applies for the upper body using the chest to hip best match alignment. These formulas have been applied to the RAW data to select the ‘best fit to size’ by matching the bust, waist and hip measurements. In cases where measurements are on the boundary of the tolerances there may be
some shape migration to the adjoining shape however the designated shape classification for each size remains as the identifier.\footnote{The audit size is a temporary number attributed to size profiles for the size selection process.}

<table>
<thead>
<tr>
<th>LM body</th>
<th>LM size</th>
<th>Linear Fit Index (LFI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waist</td>
<td>Hip</td>
<td>Chest</td>
</tr>
<tr>
<td>78.00</td>
<td>104.00</td>
<td>96.00</td>
</tr>
<tr>
<td>56.02</td>
<td>82.38</td>
<td>70.00</td>
</tr>
<tr>
<td>60.00</td>
<td>86.45</td>
<td>75.50</td>
</tr>
<tr>
<td>64.42</td>
<td>90.74</td>
<td>81.00</td>
</tr>
<tr>
<td>69.50</td>
<td>95.25</td>
<td>86.00</td>
</tr>
<tr>
<td>75.00</td>
<td>100.00</td>
<td>92.00</td>
</tr>
<tr>
<td>81.00</td>
<td>105.25</td>
<td>98.00</td>
</tr>
<tr>
<td>87.00</td>
<td>110.76</td>
<td>104.50</td>
</tr>
<tr>
<td>93.50</td>
<td>116.55</td>
<td>111.50</td>
</tr>
<tr>
<td>100.56</td>
<td>122.63</td>
<td>119.00</td>
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<tr>
<td>108.37</td>
<td>129.01</td>
<td>126.00</td>
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<td>64.00</td>
<td>95.25</td>
<td>80.00</td>
</tr>
<tr>
<td>69.00</td>
<td>100.00</td>
<td>85.00</td>
</tr>
<tr>
<td>73.63</td>
<td>105.25</td>
<td>90.00</td>
</tr>
<tr>
<td>78.14</td>
<td>110.76</td>
<td>96.36</td>
</tr>
<tr>
<td>84.18</td>
<td>116.55</td>
<td>104.00</td>
</tr>
<tr>
<td>90.74</td>
<td>122.63</td>
<td>119.00</td>
</tr>
<tr>
<td>98.05</td>
<td>129.01</td>
<td>118.00</td>
</tr>
<tr>
<td>60.96</td>
<td>82.38</td>
<td>76.00</td>
</tr>
<tr>
<td>64.84</td>
<td>86.45</td>
<td>82.00</td>
</tr>
<tr>
<td>69.87</td>
<td>90.74</td>
<td>88.02</td>
</tr>
<tr>
<td>74.77</td>
<td>95.25</td>
<td>92.39</td>
</tr>
<tr>
<td>81.00</td>
<td>100.00</td>
<td>99.00</td>
</tr>
<tr>
<td>88.37</td>
<td>105.25</td>
<td>105.00</td>
</tr>
<tr>
<td>95.86</td>
<td>110.76</td>
<td>111.87</td>
</tr>
<tr>
<td>102.82</td>
<td>116.55</td>
<td>118.88</td>
</tr>
<tr>
<td>110.37</td>
<td>122.63</td>
<td>126.31</td>
</tr>
</tbody>
</table>

The audit size is a temporary number attributed to size profiles for the size selection process.
### 5.3.9 Shape Matrix – the ‘best fit to size’ RAW score summary

<table>
<thead>
<tr>
<th>Audit Size</th>
<th>Lower Body Total</th>
<th>Upper Body Total</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>nil</td>
<td></td>
<td></td>
<td>nil</td>
</tr>
<tr>
<td>nil</td>
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</tr>
<tr>
<td>nil</td>
<td></td>
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<tr>
<td>nil</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>nil</td>
<td></td>
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<td>nil</td>
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<td>nil</td>
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<td></td>
<td></td>
<td>nil</td>
</tr>
<tr>
<td>nil</td>
<td></td>
<td></td>
<td>nil</td>
</tr>
</tbody>
</table>

| nil        |                  |                  | nil     |

**Total %**

| Total % | 0.2 | 0.7 | 4.7 | 7.2 | 13 | 11 | 7.5 | 2.5 | 0.3 | 0.1 | 1.1 | 5.4 | 7.4 | 2.7 | 1.8 | 1.6 | 0.3 | 2.7 | 5.4 | 9.8 | 5.4 | 5.4 | 1.8 | 0.1 | 0.0 | 93.3 |

### Upper Body Total

<table>
<thead>
<tr>
<th>rank top 10 upper body</th>
<th>size model</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>253</td>
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<tr>
<td>4</td>
<td>21</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>common 10 size profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
</tr>
<tr>
<td>common 10 size profile</td>
</tr>
<tr>
<td>%</td>
</tr>
<tr>
<td>0.23</td>
</tr>
<tr>
<td>39.98</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total - nil size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

**Total %**

| Total % | 0.2 | 0.7 | 4.7 | 7.2 | 13 | 11 | 7.5 | 2.5 | 0.3 | 0.1 | 1.1 | 5.4 | 7.4 | 2.7 | 1.8 | 1.6 | 0.3 | 2.7 | 5.4 | 9.8 | 5.4 | 5.4 | 1.8 | 0.1 | 0.0 | 92.3 |
The scores for the ‘best fit to size’ for the matched RAW data (shown in the shape matrix table on the previous page) present the results for the size model and reports in the three domains: lower body only, upper body only and a combination of lower body to upper body. For lower body scores read across the row; for upper body scores read down the column; and for combined scores read the intersection points as illustrated left.

The central diagonal line is the intersection of the upper and lower body scores and represents the sizes defined in the combined shape model (six shapes). The score for this group = 56.66% of the population. Any scores outside this line make up the additional three shapes to complete the nine shapes model. The top ten sizes in this group represent 41.3% of the population.

The scores for lower body garments show that 84.65% of the population fit a size category for this area; 15.35% of the population cannot be fitted in a size.

Looking at the results from the perspective of a limited number of size units, for example 10, a common number of size stock keeping units (SKUs) for uniform apparel, the best fit size option draws size from all shape categories and covers 67.04% of the population.
When calculating size according to the lineal grade model commonly used in apparel sizing in Australia for 10 SKUs, only 41.3% of the population is covered\(^\text{24}\). This is because this profile only offers size selection from one category and the optimum approach shows that shape diversity as well as size gives the best result. The best 10 sizes option represents a 25.73% increase over lineal size profiles.

\(^{24}\) As grade increments have been calculated according to the percentage grade model rather than the 5 cm fixed increment, a slightly better result has been achieved and is estimated to be less than 41.31%. 

---

**WAIST / HIP RATIOS – LOWER BODY**

41.31% of the population

<table>
<thead>
<tr>
<th>Shape 1</th>
<th>0.82</th>
<th>0.86</th>
<th>0.90</th>
<th>0.95</th>
<th>1.00</th>
<th>1.05</th>
<th>1.11</th>
<th>1.16</th>
<th>1.23</th>
<th>1.29</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waist</td>
<td>56.02</td>
<td>60.00</td>
<td>64.42</td>
<td>69.50</td>
<td>75.00</td>
<td>81.00</td>
<td>87.00</td>
<td>93.50</td>
<td>100.56</td>
<td>110.37</td>
</tr>
<tr>
<td>Hip</td>
<td>82.38</td>
<td>86.45</td>
<td>90.74</td>
<td>95.25</td>
<td>100.00</td>
<td>105.25</td>
<td>110.76</td>
<td>116.55</td>
<td>122.63</td>
<td>129.01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shape 2</th>
<th>0.82</th>
<th>0.86</th>
<th>0.90</th>
<th>0.95</th>
<th>1.00</th>
<th>1.05</th>
<th>1.11</th>
<th>1.16</th>
<th>1.23</th>
<th>1.29</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waist</td>
<td>60.96</td>
<td>64.84</td>
<td>69.87</td>
<td>74.77</td>
<td>81.00</td>
<td>88.37</td>
<td>95.06</td>
<td>102.82</td>
<td>110.37</td>
<td>118.21</td>
</tr>
<tr>
<td>Hip</td>
<td>82.38</td>
<td>86.45</td>
<td>90.74</td>
<td>95.25</td>
<td>100.00</td>
<td>105.25</td>
<td>110.76</td>
<td>116.55</td>
<td>122.63</td>
<td>129.01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shape 3</th>
<th>0.82</th>
<th>0.86</th>
<th>0.90</th>
<th>0.95</th>
<th>1.00</th>
<th>1.05</th>
<th>1.11</th>
<th>1.16</th>
<th>1.23</th>
<th>1.29</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waist</td>
<td>64.00</td>
<td>68.90</td>
<td>74.51</td>
<td>81.14</td>
<td>88.80</td>
<td>95.56</td>
<td>102.74</td>
<td>110.37</td>
<td>118.21</td>
<td>126.00</td>
</tr>
<tr>
<td>Hip</td>
<td>82.38</td>
<td>86.45</td>
<td>90.74</td>
<td>95.25</td>
<td>100.00</td>
<td>105.25</td>
<td>110.76</td>
<td>116.55</td>
<td>122.63</td>
<td>129.01</td>
</tr>
</tbody>
</table>
Upper body garments, show a similar pattern and even better result. The scores for upper body garments cover 92.32% of the population; only 7.67% of the population cannot be fitted in a size.

Looking at the results from the perspective of a limited number of size units (i.e. 10), the best fit size option draws size from all shape categories and covers 69.98% of the population.

When calculating size according to the lineal grade model for 10 size units, only 39.95 % of the population is covered. The best 10 sizes option which covers all shape categories represents a 30.0% increase over lineal size profiles.
There are a significant number of extra shape categories that emerge from the match of lower body primary domain to the upper body secondary domain. While these shape combinations have been identified in the nine shape schema, not all have been identified in the upper and lower body bivariate charts (centre diagonal line) which make up the size specification profiles.

However the ‘best fit to size’ selection process has identified potential shape size combinations that have not been represented in the shape model. This validates the shape matrix as the vital summary document for this model. It is only when operating in the combined tertiary domain that these additional sizes are identified as a new size shape category.

The following chart ranks the shape categories and shows the percentage representation for each shape. Excluded are the ‘no fit’ for either lower body, upper body or both.
<table>
<thead>
<tr>
<th></th>
<th>Primary Lower Body</th>
<th>Secondary Upper Body</th>
<th>Tertiary Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total population</td>
<td>84.65</td>
<td>92.32</td>
<td>80.36</td>
</tr>
<tr>
<td>Best 10 optimised size/shape</td>
<td>67.04</td>
<td>69.98</td>
<td>42.21</td>
</tr>
<tr>
<td>10 Lineal grade</td>
<td>41.31</td>
<td>39.95</td>
<td>24.60</td>
</tr>
<tr>
<td>SKUs required</td>
<td>25</td>
<td>26</td>
<td>56</td>
</tr>
</tbody>
</table>

The bifurcated format based on the (1) lower body domain and (2) upper body, offers a considerable increase in population coverage over the total shape model.

What has emerged from this examination in plotting the RAW data according to the shape schema as defined by the body as separates premise is that the framework provides the map for how to pick the most suitable body shape and size format according to need: each domain can direct the most suitable shape size profile according to design and market demographics. The model offers a flexible approach while still maintaining a systemic logic. It can be described as a multimodal format, offering significant advantages to the common practice size model which follows the AS1344 format.

Being able to map shape and size groups by a population driven model fundamentally changes the approach to apparel, design, development and merchandising. By providing the visual representation of the various shapes according to size categories (as not all shapes exist across the size range), design can take into account shape diversity. Currently the one body shape model under-represents the range of shape diversity required. By being able to quantify the range it is possible to direct design to target the needs of each body shape.

While this research has been based on a relatively small data set, its methodology can be used on any valid population group. It is not restricted to women and can be applied to any valid anthropometric data set.

This approach has developed the primary schematic for a multimodal shape and size model. However further research could be directed towards investigating individual shape characterises for each group. Preliminary work, using body scan data and looking at transverse slices of the body at the regions of the bust, waist and hip has been investigated as a way of validating shape and size categories. The following exercises exhibit these developments.
5.4 Application: Applying Size and Shape
A number of prototype models have been developed during the course of this research to facilitate investigation and to demonstrate practical applications. In addition to those models previously explained such as the shape schema which facilitated the validation of the shape matrix, a number of prototype experiments have been undertaken. The aim was to facilitate potential innovation in the definitions of body shape and size from anthropometric data.

The prototype models as explained here complete the research cycle by demonstrating that the methodology approach formulated in the previous stages can be applied. It also links directly to the two examples of the Berlei research that have provided the greatest reference for practical applications in this research. The first being the discovery of how to plot the body as separates model as a nomogram and the second being the development of somatic maps from transverse slices of three dimensional body scans. These maps in turn, directed the creation of three dimensional body models of various shape categories.

An important aspect of this research has been to establish the scientific and design validity behind the Berlei FTI device. The creation of the somatic maps which mirror the Berlei shape model classification methodology suggests that the Berlei project still has relevance for size and shape definitions today.

The final experimental models in this research are wire frame three dimensional prototype body models and represent the conversion of the two dimensional plane into three dimensional models. Their construction is based on the principles of traditional two dimensional block construction, referenced by the somatic maps. They were developed to investigate shape relationships and are a working demonstration of the body as separates model.

5.4.1 Re-plotting the nomogram
The true brilliance of the Berlei Figure Type Indicator was that it served Berlei’s product selection at the customer interface for over thirty years. As previously explained, it was patented internationally from 1928. One of the first patented devices was co-branded with US department store Newman and Brothers in 1929. Decoding the workings of this device has been the key to the confirmation that a shape model based on ratios is a viable framework.

The Berlei nomogram is a trivariate chart with an axis for hip, bust and waist. It appears that the Berlei population was mapped according to waist to hip ratios and shapes were identified by aligning the bust to the hip and placing the swinging arm (waist axis) to form the shape. When the bust and the hip are aligned or equal the CHR (or bust hip ratio), the ratio is 1.00 and is a rectangle shape. Depending on the waist measurement the shape range moves from small (triangle) to large (rectangle) to form the shape. By rotating the centre disk with the bust measurement clockwise it moves towards a triangle. Rotating anticlockwise from the 1.00 ratio position it moves beyond the rectangle to a bust bigger than hips shape.

Thus, using the size specifications and matching chest to hip for each size, the waist measurement was plotted first (centre continuous line). Then using the LFI calculation to show the range of fit, the size regions have been plotted. Each size category has a separate central plot line. When combining the three sizes in the final version it is interesting to see the size regions that overlap each other. This
is understood to be a function of the geometry of the nomogram, rather than a size overlap. It is useful to see where the boundary cases fall as some members of the data population may have a few best fit size choices. As the measurements have been specified in the LFI formula it is also possible to digitally transpose this model. The size model can be represented by nomogram or in a digital format, and can be developed to suit men’s and children’s size profiles according to anthropometric definitions.
Three shape categories combined to represent the size model. This chart has been created as a working artefact to demonstrate how size categories can be mapped and selected.

Instructions
1. Take measurements for your chest, waist and hip.
2. Rotate the centre disk so that your chest measurement is aligned to the hip measurement. Note the size code and colour for your hip.
3. Place the pivoting ruler on that measurement.
4. Find your waist measurement along the swinging ruler. Your size should match the hip size code and colour.
5.4.2 **Somatic topography – viewing relationships**

This investigation has been undertaken by constructing topographical maps from transverse body slices images for bust, waist and hip captured from three dimensional body scan data.

The maps have been classified according to ratio profiles established in the shape model. It is intended to provide a conceptual plan for representation of body shape and size, and facilitates the transition from two dimensional geometry into three dimensional object. The approach links the virtual to the physical and has instructed the creation of full scale body models using traditional pattern construction formulas. It has potential applications for seamless knitting garment development and three dimensional pattern development.

From the preliminary experiments in creating somatic maps it was envisaged that it would be possible to use this approach as Berlei had done, to validate the shape model postulated in this exegesis:

*After the first 200 sets of measurements were completed, research as to means of classification was entered upon. It was required to divide those measurements into a series of groups so that each group would be comprised of individuals of similar shape, and of shape dissimilar to the members of any other group* (Pratt, 1930a, p. 2).

![Anthropometrical survey graphs 1926 (P3654 Berlei Ltd archive)](image)

This experiment, while limited by available three dimensional data, is showing valid constructs but can only be viewed as a methodology trial. Ideally scan data and measurement data should be drawn from the same database.
Using 53 body scans provided by the TC² Company (a separate data set to the RAW database), hip and waist ratios, and hip and chest ratios have been mapped to the RAW bivariate charts to identify shape and size categories. Shape and size was determined by the Linear Fit Index (LFI) protocol established previously. It has been possible to identify a group of scans within the 1.05L (hip) range, across all shape categories for this exercise. As the model for the shape hierarchy is based on the hip as the primary control point i.e. the starting point, it is possible to observe the commonality and/or difference in shape from a geometric perspective, and to consider how these factors would translate into garment fit. This can be observed from overlaying shape categories.

Shape and size locations for somatic maps circled with black dots represent the overlay of 53 TC² data from body scans
Female_011

Waist 76.49
Hip 105.62
Chest 89.84

WHR 0.72
CHR 0.85

Triangle shape somatic map
Female

Waist 80.66
Hip 107.22
Chest 100.60
WHR 0.75
CHR 0.94

Trapezoid shape somatic map
Female
Waist 88.53
Hip 107.54
Chest 104.68
WHR 0.82
CHR 0.97

Rectangle shape somatic map
<table>
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<th></th>
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<td>76.04</td>
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<td>101.40</td>
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<tr>
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<td>0.74</td>
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</tr>
<tr>
<td>CHR</td>
<td>0.99</td>
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</table>

Trapezoid/rectangle somatic map
Comparative reference charts: triangle, trapezoid, rectangle shapes
The reference map informed the construction of full scale three dimensional body models. Transverse views (bottom diagram) give information on measurements and positions for body circumferences for example, hip, waist and chest, while body lengths and angles are instructed by the level map (top diagram).
5.4.3 **Prototype body models**

The impetus to create full scale body models was motivated by the need to build a tangible working model to investigate and explain body shape variables. This experiment was initiated at an early stage in this research directly as a consequence of information gained from undertaking the ISS Institute overseas study fellowship in *3 Dimensional Body Scanning Techniques and Applications for the Australian Apparel Industry*. It became apparent that body scanning offered a new view of the body, particularly from the transverse plane. However the subsequent discovery that Berlei had in fact used a similar technique to classify body types from 1927 not only confirmed the validity of this approach but also verified the technical competence of Berlei’s research.

Body scanning technologies have informed this research on approaches to data collection for both two dimensional measurement and three dimensional body data. The conversion of two dimensional body measurement data is fundamental to the development of apparel trade skills however, how to apply three dimensional data is a new resource for apparel design and development. These models therefore are a translation of the visual record of individual body shape and posture in a working model. The ability to build a body according to need opens the design domain beyond the stereotyped body model.

Instructed by traditional block construction techniques the exercise in building three dimensional body models has facilitated the understanding of the conversion of two dimensional planes to three dimensional objects. The models are a way for practitioners to easily build body forms in any shape and size while concurrently developing body block patterns.

![Example two dimensional block pattern construction derived from three dimensional body model](image-url)
The following models were created in a format compliant with the body as separates construct to illustrate the shape matrix schema i.e. lower body primary shape and upper body secondary shape, which combine to form the tertiary shape. Upper and lower body parts can be interchanged in a mix and match format to illustrate all shapes represented in the shape schema. As artifacts they demonstrate the both similarities and differences in body shape.
6  CONCLUSION

This work has been presented as a study in two parts covering both theoretical and practical investigations. This project has been informed by hands on working knowledge. The theoretical research has demonstrated the unexpected complexity of debates around sizing and the importance of being informed on all variable and potential issues. Linking sizing and body types to obesity and eating disorders has been shown to generate its own contemporary mythology.

The theoretical investigation into the comparative and historical analysis of women’s apparel size standards has revealed the arbitrary nature of size. Methodological confusion exists due to the difference in performance requirements associated with the constructed and the unconstructed body. It has also questioned if generic standards can ever be a statistically correct anthropometric reference, or whether they should simply provide a consumer policy framework, supported by localised size specifications developed according to market demographics. Relevant anthropometric data is vital to an informed approach.

Fundamental to the practical research is the quandary: can a size designation system that describes body size and shape be considered acceptable for mass market apparel or does the fashion paradigm of the ideal exclude disclosure of the real body? The Lagerfeld view that fashion is all to do with ‘dreams and illusions’ and ‘no one wants to see round women’ claims the paradigm to be exclusive of anthropometric diversity. However not all parties can afford this elitist view. For those in the industry who operate beyond the realm of fashion and require an honest perspective to satisfy their market demands, understanding the correct anthropometric profiles of their constituents is vital to success.

This understanding was demonstrated by Berlei in 1926, by commissioning pioneering research to determine the anthropometric profile of the Australian woman, the like of which in terms of scope and methodology has not been undertaken in Australia since.

Berlei’s product and marketing success was based on being able to create product to fit various body types. The significance of the Berlei research from 1926 is such that it influenced many aspects of apparel size standardisation in Australia. Ironically the beginning of the demise of the foundation garment coincided with the adoption of Australia’s first outerwear apparel standard in 1970, which mandated wearing a foundation garment to achieve the prescribed ‘average’ size. Adopted at a time of a burgeoning youth market, the social mores of the era commanded a disregard of the girdle as a necessary item. This disjunction was the first undoing of the measurement conditions specified in AS1344.

When first introduced however, the apparently high level of compliance with AS1344 was partly due to the adoption of the metric system in Australia. It provided a plausible framework for the young fashion consumer of the time. Such is the nature of the relationship between this consumer and the market that, as they have aged, clothing size has adapted to suit the needs. Thus a struggle for ownership or the ‘what size am I?’ dilemma has resulted. The ensuing size turf war, mainly attributed to the practice of ‘vanity sizing’, is more likely a consequence of the limited framework and the antiquated Misses code.

The second stage of this research has been to demonstrate a new functional model for size representation by reframing the historical view. Size standards that prescribe anthropometric size
and shape cannot keep up as the boundaries of what they are meant to define keep changing. In a complex market that needs to accommodate children, youth, adults, a redefined middle age, and the elderly, a ‘one profile fits all’ is inadequate.

The Berlei survey of 1926 and shape classification model has provided the greatest resource into how to approach this exercise. Having undertaken extensive anthropometric research, their analysis, based on sound mathematical principles, still stands as a legitimate methodology. The opportunity to review the Berlei body classification system via a technical analysis has revealed an alternate view to that proposed by Sue Best in her 1991 feminist critique *Foundations of Femininity: Berlei Corsets and the (Un)making of the Modern Body*. While Berlei body typologies from 1926 exposed the full range of female shape diversity, Best’s notion that this reinforced women’s ‘need’ for the corset by creating ‘confusion about what the body should be’ (1991, p. 1) is based on an analysis of Berlei marketing material and is devoid of a technical critique. As the integrity of the Berlei research translated directly into Berlei product that was successfully marketed internationally from 1927, it remains as an outstanding example of trade innovation based on identifying a diverse, rather than limited range of body types.

By adding a split to the existing monomodal paradigm, a greater range of representation can be achieved via the interchange of upper and lower body regions in a separate or combined format. The process of investigating and validating this research has demonstrated the range of shape and size diversity required to satisfy the anthropometric profiles of the applied population. That in itself has been shown to quickly escalate to a complex level. One size fits all is not possible. Being able to quantify shape and size by measurement based on ratios allows for the development of interpretative tools to convert individual shape measurements into a customer focused format, as Berlei did with the Figure Type Indicator in the late 1920s. This research has shown that it has the potential to transcend a proscriptive definition of size and provide a multimodal framework to reflect changing population profiles. It offers an achievable logical means of rethinking sizing to capture a broader cross-section of the community without massive technological or conceptual changes.
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Photographic References

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## ACRONYMS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>ABS</td>
<td>Australian Bureau of Statistics</td>
</tr>
<tr>
<td>ADAPT</td>
<td>The Australian Defence Anthropometric Personnel Testing</td>
</tr>
<tr>
<td>ADF</td>
<td>Australian Defence Force</td>
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<tr>
<td>CHR</td>
<td>Chest to Hip Ratio</td>
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<td>Department of Education, Employment and Workplace Relations</td>
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<td>Fashion Technicians Association of Australia</td>
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<td>ISS Institute</td>
<td>International Specialised Skills Institute</td>
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<td>Real Australian Woman</td>
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<td>Stock keeping unit</td>
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<td>Textile Clothing and Footwear</td>
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<td>TFIA</td>
<td>Council of Textile and Fashion Industries of Australia</td>
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<td>WHR</td>
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9 APPENDIX

9.1 ISS Institute Report: 3 Dimensional Body Scanning Techniques and Applications for the Australian Apparel Industry