



3 Dimensional Body Scanning Techniques and Applications for the Australian Apparel Industry



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National ISS Institute Overseas Fellowship

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Department of Education, Employment
and Workplace Relations
Commonwealth Government

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Executive Summary

This International Specialised Skills Institute (ISS Institute) Fellowship was sponsored by the Department of Education, Employment and Workplace Relations (DEEWR). It provided the opportunity to undertake an overseas study program in three dimensional (3D) body scanning technologies and their applications for apparel development, and to investigate the role these technologies play in facilitating innovation.

In addition, the study provided an opportunity to gain a comprehensive understanding of three major anthropometric survey projects undertaken by 3D scanning techniques, SizeUK, SizeUSA and the French Sizing Survey - Campagne Nationale de Mensuration, and to observe how body scanning is being used as a research and training tool. Knowledge was also gained in the interface of scanning technologies, CAD applications and traditional pattern development techniques.

Currently for the apparel industry in Australia there is no reliable data or current size standards to accurately define the anthropometric size and shape of our population. In recent years there have been requests from sections of the apparel industry and consumers to provide relevant size reference material. The latest bid by the Sizing Consortium of Australia Landmark Evaluation (SCALE) to harness Federal Government funding for a large scale 3D body scanning survey has not yet achieved support.

For TCF technical designers, the lack of reliable anthropometric data on which to base their skills development and work practices is of constant concern. The foundations to their technical frameworks for body size definitions are uncertain. Anthropometric changes to the physical size of our population because of aging and or the so called 'obesity crisis' have lead to an ad-hoc approach to size determination. 3D Body Scanning as demonstrated by projects such as SizeUK, SizeUSA and the French Sizing Survey have provided data and a new approach to the specification of body size.

Further to this, changes to the industry from a manufacturing base to a merchandise or brand model have fundamentally changed the supply relationship and created skills shortages in clothing pre-production skills. This has been identified by the TCF IAB in the TCF&L Industry Report, 2007/2008.

As the industry operates on shorter lead times from concept to market, it is more reliant on virtual supply tools. 3D body scanning technologies offer a new approach to creating, producing and marketing, "...products based on cutting-edge technical knowledge",¹ and highlighted as vital to the success of TCF companies by Senator Kim Carr, in a speech to Australian TCF Technology Network annual Creativity Workshop in August 2007.

As a way to fast track the adoption of these technologies and to bridge the knowledge gap it is advised that the industry invest in subscriptions to existing databases eg: SizeUSA and WEAR. It is recommended that the Australian TCF Technology Network become a SizeUSA sponsor, and form a strategic relationship with US apparel research company [TC]².

This would provide a resource to establish skills and knowledge in anthropometric database applications for both local and export markets. It will illustrate the purpose and application of such data to assist with implementation of either an Australian large scale survey, or mini surveys for individual companies. In addition it offers the ability to test and validate database tools for the Australian TCF Industry.

The opportunity to visit Cornell University's Centre for Body Scanning Research highlighted the importance of the 3D body scanning as an R & D resource, and creates new approaches into creating, producing and marketing. Key areas of interest for global research are: the virtual supply chain, mass customisation and automatic pattern extraction methods. Thus it is recommended that RMIT University establish a Centre for Body Scanning Research under the umbrella of the Specialist Skills Centre and enter this international research field with applied research.

Executive Summary

A number of modules in the new clothing training packages LMT07 TCF, recently submitted to DEEWR, and expected to be endorsed for release to the industry in September/October 2007, identify key learning areas relating to and requiring knowledge and skills in 3D body scanning technologies.

Universities visited during the study – Cornell University, The University of the Arts - London, and Hochschule Niederrhein University, currently incorporate body scanning within their curriculum structures.

The importance of the interface between traditional trade skills and technology was confirmed by training in the Grafis CAD system. As this system is based on a block construction methodology it provides a digital approach to the traditional craft skill of pattern tailoring, at an affordable price. It is feasible for this system to be linked to body scanning platforms to create automatic pattern outputs from 3D data. It is potentially an area of research that could provide the automated link to mass customised apparel.

The opportunity to undertake this study has provided insights and knowledge into the value that this emerging technology of 3D body scanning can play in redefining the way we create, produce and distribute products. It is envisaged that this knowledge be imparted via a series of industry seminars and workshop demonstrating 3D body scanning and applications.

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Abbreviations and Acronyms

3D	Three Dimensional
CAD	Computer Aided Design
CAESAR	Civilian American and European Surface Anthropometry Resource
DEEWR	Department of Education, Employment and Workplace Relations
DEST	Department of Education, Science and Training
FTAA	Fashion Technicians Association Australia
IFTH	Institut Français du Textile et de l'Habillement
ISSI	International Specialised Skills Institute
R-T-W	Ready to wear
SCALE	Sizing Consortium of Australia Landmark Evaluation
SIAL	Spatial Information Architecture Laboratory
SIP	Strategic Investment Program (TCF)
[TC] ²	The Textile/Clothing Technology Corporation
TCF	Textiles Clothing and Footwear Industries
TCFL	Textiles Clothing and Footwear and Leather Industries
TFIA	Council of Textile and Fashion Industries of Australia Limited
WEAR	World Engineering Anthropometry Resource

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Kate Kennedy would like to thank the following individuals and organisations who gave generously of their time and their expertise to assist, advise and guide her throughout the Fellowship program.

Awarding Body - International Specialised Skills Institute (ISS Institute)

We know that Australia's economic future is reliant upon high level skills and knowledge, underpinned by design and innovation.

The International Specialised Skills Institute Inc (ISS Institute) is an independent, national organisation, which has a record of nearly twenty years of working with Australian industry and commerce to gain best-in-the-world skills and experience in traditional and leading-edge technology, design, innovation and management. The Institute has worked extensively with Government and non-Government organisations, firms, industry bodies, professional associations and education and training institutions.

The Patron in Chief is Sir James Gobbo AC, CVO. The ISS Institute Board of Management is Chaired by Noel Waite AO. The Board comprises Franco Fiorentini, John Iacovangelo, Lady Primrose Potter AC and David Wittner.

Through its CEO, Carolynne Bourne AM, the ISS Institute identifies and researches skill deficiencies and then meets the deficiency needs through its *Overseas Skill Acquisition Plan (Fellowship Program)*, its education and training activities, professional development events and consultancy services.

Under the Overseas Skill Acquisition Plan (Fellowship Program) Australians travel overseas or international experts travel to Australia. Participants then pass on what they have learnt through reports, education and training activities such as workshops, conferences, lectures, forums, seminars and events, therein ensuring that for each Fellowship undertaken many benefit.

As an outcome of its work, ISS Institute has gained a deep understanding of the nature and scope of a number of issues. Four clearly defined economic forces have emerged out of our nearly twenty years of research. The drivers have arisen out of research that has been induced rather than deduced and innovative, practical solutions created - it is about thinking and working differently.

A Global Perspective. 'Skills Deficiencies' + 'Skills Shortages'

Skill deficiencies address future needs. Skill shortages replicate the past and are focused on immediate needs.

Skill deficiency is where a demand for labour has not been recognised and where accredited courses are not available through Australian higher education institutions. This demand is met where skills and knowledge are acquired on-the-job, gleaned from published material, or from working and/or study overseas. This is the focus of the work of ISS Institute.

There may be individuals or firms that have these capabilities. However, individuals in the main do not share their capabilities, but rather keep the IP to themselves; and over time they retire and pass way. Firms likewise come and go. If Australia is to create, build and sustain Industries, knowledge/skills/understandings must be accessible trans-generationally through nationally accredited courses and not be reliant on individuals.

Our international competitors have these capabilities as well as the education and training infrastructure to underpin them.

Addressing skill shortages, however, is merely delivering more of what we already know and can do to meet current market demands. Australia needs to address the **dual** challenge – skill deficiencies and skill shortages.

Acknowledgments

Identifying and closing skills deficiencies is vital to long-term economic prospects in order to sustain sectors that are at risk of disappearing, not being developed or leaving our shores to be taken up by our competitors. The only prudent option is to achieve a high skill, high value-added economy in order to build a significant future in the local and international marketplace.

The Trades

The ISS Institute views the trades as the backbone of our economy. Yet, they are often unseen and, in the main, have no direct voice as to issues which are in their domain of expertise. The trades are equal, but different to professions.

The ISS Institute has the way forward through its 'Master Artisan Framework for Excellence. A New Model for Skilling the Trades', December 2004. The Federal Government, DEEWR commissioned ISS Institute to write an Australian Master Artisan School, Feasibility Plan.

In 2006, ISS Institute Inc. set up a new ISS advisory body, the **Trades Advisory Council**. Members are Ivan Deveson AO; Martin Ferguson AM, MP, Federal Labor Member for Batman; Geoff Masters, CEO, Australian Council of Educational Research; Simon McKeon, Executive Chairman, Macquarie Bank, Melbourne Office; Richard Pratt, Chairman, Visy Industries and Julius Roe, National President Australian Manufacturing Workers' Union.

Think and Work in an Holistic Approach along the Supply Chain - Collaboration and Communication

Our experience has shown that most perceive that lack of skills is the principal factor related to quality and productivity. We believe that attitudes are often the constraint to turning ideas into product and a successful business; the ability to think laterally, to work and communicate across disciplines and industry sectors, to be able to take risks and think outside the familiar, to share – to turn competitors into partners.

Australia needs to change to thinking and working holistically along the entire Supply Chain; to collaborate and communicate across industries and occupations - designers with master artisans, trades men and women, Government agencies, manufacturers, engineers, farmers, retailers, suppliers to name a few in the Chain.

'Design' has to be seen as more than 'Art' discipline – it is a fundamental economic and business tool for the 21st Century

Design is crucial to the economic future of our nation. Australia needs to understand and learn the value of design, the benefits of good design and for it to become part of everyday language, decision making and choice.

Design is as important to the child exploring the possibilities of the world, as it is to the architect developing new concepts, and as it is to the electrician placing power points or the furniture designer working with a cabinet-maker and manufacturer. As such, design is vested in every member of our community and touches every aspect of our lives.

Our holistic approach takes us to working across occupations and industry sectors and building bridges along the way. The result has been highly effective in the creation of new business, the development of existing business and the return of lost skills and knowledge to our workforce, thus creating jobs - whereby individuals gain; industry and business gain; the Australian community gains economically, educationally and culturally.

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This Fellowship has been sponsored by Department of Education, Employment and Workplace Relations (DEEWR).

The Australian Government's Department of Education, Employment and Workplace Relations provides national leadership and works in collaboration with the States and Territories, industry, other agencies and the community in support of the Government's objectives. The department implements government policies and programs to provide education and training opportunities for all Australians, to increase employment participation and to ensure fair and productive workplaces. Education, training and workforce participation are central to our goal of building a productive and socially inclusive nation, one which values diversity and provides opportunities for all Australians to build rewarding social and economic lives. Their support of this Fellowship is greatly appreciated.

Fellowship Supporters

The Fellowship was made possible by the valued support of the following TCF organisations:

Council of Textile and Fashion Industries of Australia Limited (TFIA)

Andrew Edgar, Chairperson and Ashley Van Krieken, Executive Director

The Fashion Technicians Association Australia (FTAA)

Jo Kellock, President

RMIT University

Keith Cowlshaw, Head of School, Fashion and Textiles, Brunswick Campus

The TCF Technology Network

Peter Kreitals, Network Manager

Yakka Pty Ltd

Nicki Rowse, Senior Product Manager

In addition, the support of Industry Training and Employment Services Pty Ltd (ITES) is acknowledged in providing the additional funding required to undertake the Fellowship and associated activities.

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About the Fellow

Name: Kate Kennedy

Employment: Apparel Consultant - Outcomes Plus

Qualifications

- B.Ed. (Adult and Further Education) (1988) SA College of Advanced Education
- Dip in Teaching (TAFE) (1985) Brisbane College of Advanced Education
- Cert. in Dress Design (1979) Queensland College of Art
- Masters Fashion –Textile Technology (RMIT) in progress

Memberships

- Technical Committee member Fashion Technicians Association of Australia (FTAA)
- Committee member Standard Australia C92 CS-092 Sizing Systems for Clothing
- Clothing Industry Representative - Victorian TCF Industry Training Board - Victorian TCF Industry Training Board 1992/6
- Chairperson - VIC TCF ITB Clothing Advisory Committee.
- Chairperson of the TCF Resource Centre (1993/5)
- Member of the General Manufacturing Industry Training Accreditation Board.

Over a career of more than thirty years Kate Kennedy has gained a breadth of experience, qualifications and assumed substantial responsibility in business, manufacturing and technology, education and training, and the creative arts. These areas have been integrated throughout her career in an holistic approach and demonstrated through applications in design and innovation. She has specialised in product design, development and technical management in the preproduction supply chain for the apparel industry.

Kennedy first joined the workforce in the Banking Industry as a bank clerk with The Commercial Bank of Australia Ltd. Later pursuing her creative talents she studied Dress Design at the Queensland College of Art, where she was awarded the 1st year Dress Design Student Award in 1977.

Her career in the Apparel Industry has encompassed theatrical costuming, the design and manufacture of her own swimwear label, teaching fashion and design at a technical and tertiary level.

Kennedy's specialist skills in Computer Aided Design applications for apparel, initiated her move to Melbourne in 1989 to establish an apparel CAD system for Fletcher Jones. This technology proved to be an invaluable conceptual tool for virtual range presentations and has facilitated her expertise in the corporate apparel design and development. As Design Manager at Dowd Corporation, she managed the design team responsible for development of the work wear requirements of many of Australia's major corporations. This specialisation has been continued as a Product Consultant for the last ten years with Yakka Pty Ltd. Her corporate uniform client portfolio includes:

Telstra, Australia Post, Dept of Defence, NAB, ANZ, CML, Big W, NSW Health, NSW RailCorp, KFC, and Pizza Hut, and the 2000 and 2004 Australian Paralympic teams.

In addition to her professional career Kennedy was an industry appointment to the TCF Victorian Industry Training Board and contributed advice and policy direction to the Victorian Government on training needs for the apparel sector from 1992 to 1996.

About the Fellow

Kennedy is currently completing her Masters of Textiles (Technology) by research at RMIT University, and is consulting in apparel design and preproduction applications.

Away from this, Kennedy pursues her interests in creative textiles by weaving organza with metallic mesh in an assemblage that draws inspirations from pixels, watercolour and chaos theory. Her eclectic approach to art is assisted by a partner who provides a devoted level of IT and domestic help-desk support. In addition, Kennedy is an active member of her local community, and has been a volunteer arts editor for a community newspaper, and member of her son's primary school education board.

Aims of the Fellowship Program

The purpose of the Fellowship was to undertake an overseas study program in three dimensional (3D) body scanning technologies and their applications for pattern construction techniques for apparel.

The study provided the opportunity to gain a comprehensive understanding of how 3D body scanning is used to create anthropometric databases as is currently required by the Australian TCF Industry.

The aim of this study is to obtain first hand experience of initiatives undertaken in 3D body scanning technologies and their applications for constructing patterns for apparel.

Specific Areas of Study and Development

- 1) To investigate 3D body scanning technologies to measure body dimensions and shape.
 - To investigate the SizeUSA² model of anthropometric database development.
 - To investigate the use of SizeUSA data for apparel applications by SizeUSA consortium members.
 - To investigate the status of other anthropometric databases as developed by SizeUK and The French National Measurement Campaign and identify and meet with key stakeholders.
 - To develop advanced skills in CAD pattern construction techniques in Grafis apparel software.
- 2) To investigate the techniques in applying electric data capturing tools to the Grafis pattern construction methodology.

The Australian Context

The issue of ill fitting women's apparel in Australia is mainly attributed to the 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: Sizing coding scheme for women's clothing;³ is a voluntary code and is considered to be out of date and is not used by most outer wear apparel producers in Australia. It is based on methodologically questionable self-reported survey data obtained by The Women's Weekly in 1969. The unreliability of this survey has been confirmed by Standards Australia in the minutes of CS-092-F0000: Sizing Forum:

"In 1969 the Australian Women's Weekly did a national survey of size. The public cheated and the information wasn't accurate. The impression was given that they had much smaller bodies than [in] reality".⁴

However as little reliable data exists to determine the size and shape of our population, it is possible to examine recent anthropometric survey data from a growing body in international sources ie: SizeUSA, SizeUK and the French National Measurement Campaign to inform and validate a sizing strategy for the Australian market.

Given the ongoing criticism of AS1344-1997,⁵ Standards Australia initiated industry forums in 2003 to discuss the process for an update and have clearly stated their position 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".⁶

This has led to the formation of the Sizing Consortium of Australia Landmark Evaluation (SCALE)⁷. SCALE stakeholders include the Council of Textile and Fashion Industries of Australia Limited (TFIA), the Fashion Technicians Association Australia (FTAA) and the Victorian Government. SCALE is currently seeking industry and Government funding to conduct a survey by *"3D scanning to measure a cross-section of Australians"*⁸. The project also hopes to capitalise on a growing international body of work of anthropometric 3D body scanning surveys.

At this stage, the SCALE project is in question as it appears the lobby for Federal Government funding has not been successful⁹. This is not the first time that a consortium of industry members has sought to update AS1344-1997. To date none have been successful.

For TCF technical designers and apparel technicians, the lack of reliable anthropometric data on which to base their skills development and work practices is of constant concern. The foundations to the technical frameworks for body size definitions are uncertain. Anthropometric changes to the physical size of our population because of aging and/or the so called 'obesity crisis' have led to an ad-hoc approach to size determination. Further to this, the apparel industry lacks a research culture for conducting and trialing new technologies and their applications in the workplace.

Changes to the industry from a manufacturing base to a merchandise or brand model have fundamentally changed the supply chain model. As the industry operates on shorter lead times from concept to market, it is more reliant on virtual supply tools. With competition from:

"...emerging economies in the production of low value-added products and services"

The Australian Context

The future of the Australian apparel industry's:

....*"comparative advantage will lie in driving innovation, achieving ongoing productivity improvements and producing high value-add, knowledge-based goods and services"*.¹⁰

By investigating the international body of work in body scanning applications for apparel development, this Fellowship provided the opportunity to gain knowledge in how these technologies can assist with skill development and encourage innovation.

SWOT Analysis

A SWOT analysis provides a useful avenue for exploring three dimensional body scanning technologies. Exploring strengths, weaknesses, opportunities and threats provides an effective means of 'mapping' the current situation and identifying opportunities for future developments.

Strengths

- Flexible work force
- Existing knowledge base
- Demand for knowledge for Apparel Technicians
- Demand for change from consumers
- Industry Networks in place – eg Fashion Technicians Association
- Global networks with key players in scanning technologies
- Creates better fitting product

Weaknesses

- Industry reluctance to change
- Confusion over the ideal body type vs the real shapes
- Coding system based on non representative size
- Lack of local R & D
- Lack of capital investment to purchase scanning equipment
- Seen as a women-only subject

Opportunities

- Defines new markets and opportunities
- Defines existing markets better
- Facilitates new supply chain model
- Promotes sustainability
- To develop scanning project specific to the needs of the Australian market
- To create a size policy framework rather than size standards prescribe anthropometric data

Threats

- Reduced lead time for apparel development
- Consumer confusion over size definitions
- Shows real body types rather than ideal
- Obesity crisis requires constant updating of data
- Traditional view of the role of size standards that can no longer keep up with changes to body types and shapes

Identifying and Defining the Gap/s

Definition – Skill Deficiencies

Based on ISS Institute's initial market research in 1990, an important category emerged, that of 'skill deficiency'. As established previously, skill deficiency is where a demand for labour has not been recognised and where accredited courses are not available through Australian higher education institutions. This demand is met where skills and knowledge are acquired on-the job, gleaned from published material, or from working and/or study overseas. This is the key area targeted by ISS Institute.

Other ISS definitions are:

- Skill shortage is when there is an unmet and recognised demand for labour.
- Innovation creating and meeting new needs with new technical and design styles.
- Design is problem solving, from concept to production through to recycling. Design involves every aspect from the way the receptionist answers the phone, when invoices are sent out, where a machine sits on the factory floor, what trees are grown in the forest suitable for furniture or flooring, to whether the product is orange or blue, round or square, flat packed for export, displayed in a retail outlet and the market research to target customers' needs and wants - creating products or services.

Identifying and Defining the Gap/s

This Fellowship focused on how to apply body scanning technologies to develop better fitting apparel for the Australian Clothing industry by:

- Learning body scanning protocols and practices for both individual body scanning applications and anthropometric surveys.
- Learning how body measurements are extracted from 3D body scans.
- Learning how to work with databases to develop grade profiles of measurement data to define target markets.
- Reviewing how body scanning technologies are used as a research and educational tool.

Why it Needs to be Addressed

Skills shortages in the apparel preproduction areas have been clearly identified by the TCF IAB in the TCF&L Industry Report, 2007:

*“Clothing pre-production skills – patternmaking, cutting, merchandising and quality control, fitting, interpreting patterns, instructing and advising off-shore makers, supply chain savvy, IT literacy and short run sampling”.*¹¹

As 3D body scanning is an emerging technology in measurement techniques for apparel design and development for both the mass market and made to measure applications, it provides an opportunity to develop new approaches to training, skills formation and work practices for all areas defined as deficient.

Given that there is no reliable standard definition of body size for men, women and children in Australia, the use of resources and strategies to assist with defining size specific to market profiles is paramount. Body size must be identified as an aspect of market demographics. This is a new way of thinking about size for the Australian industry and training institutions.

The new clothing training package LMT07 TCF, recently completed and submitted to DEEWR, is expected to be endorsed for release to the industry in September/October 2007. This guarantees that there will be an approved curriculum framework to support training initiatives developed from the knowledge and experience gained in this Fellowship.

Identifying and Defining the Gap/s

The specific modules where curriculum content directly relates to this Fellowship profile are:

LMTFD4018B - Use and apply sizing systems appropriate for fashion design

LMTFD5003B - Analyse fit model

LMTFD5014B - Construct complex blocks for fashion garments

LMTFD4008B - Construct stock size block for garment to meet size and fit specifications

LMTFD5015B - Develop patterns for complex fashion garments

LMTFD4013B - Grade 2D patterns

LMTFD5016B - Grade shaped patterns

LMTFD5019B - Analyse individual fit and make pattern alterations

LMTFD6007B - Implement specialised patternmaking technologies

LMTFD4015B - Create pattern from block to meet customer specifications

LMTFD4020A - Use electronic fashion design tools

The International Experience

The structure of this study tour was based on a blend of formal training sessions, visits to education and training institutions, and meetings with industry bodies who have undertaken large scale anthropometric surveys by 3D body scanning.

The WEAR Conference - Adelaide February 2007

The WEAR Conference¹² provided an opportunity to meet with leading international anthropometric researchers and discuss the WEAR anthropometric database. WEAR is a central web portal working towards unifying access to 145 anthropometric databases through collaboration between people from ten countries in six continents. It includes the National Size and Shape Survey of Australia, of 1,320 women measured at 'The Needlework Craft and Quilt Fair' by SHARP Dummies, and the Wood Jones Chair of Anatomy, at the University of Adelaide.

It also will include access to the first large scale body scanning project of a civilian population, conceived and managed by Dr Kathleen Robinette, Civilian American and European Surface Anthropometry Resource (CAESAR) from April 1998 to early 2000. It is an anthropometric database of approximately 2,400 North American male and female subjects, aged 18-65 and 2,000 European subjects.

The WEAR conference took place in Adelaide on the 6th of February 2007. Papers presented at the conference covered areas of research from WEAR database applications and provided a pre-study opportunity for the overseas study. While this project is in its early stages, it is worth considering WEAR as an anthropometric database resource of the Australian Industry. Membership is to be offered via a partner or user subscription basis. The Beta system is expected to be available in 2009.

The conference also provided an opportunity to meet Professor Régis Mollard and arrange a visit to his laboratory at University Rene Descartes in Paris during the overseas study. Professor Mollard is responsible for trialing WEAR data and quality control.

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Links

Information on WEAR database can be found at <http://ovrt.nist.gov/projects/wear/>

WEAR Attachments (see CD)

Information on CAESAR database: [caesarbrochure.pdf](#)

Paper by Robinette, K. Daanen, H. Lessons Learnt from CAESAR: A 3D-Anthropometric Survey: **R.2 Caesar lessons learnt.pdf**

Paper by Veitch, D. Robinette, K. World Engineering Anthropometry Resource: **wear paper.pdf**

PDF copy of a Powerpoint overview of WEAR: **wear_overview_tools.pdf**

The International Experience

SizeUK - University College London

This was an informal meeting to discuss the SizeUK anthropometric survey project with Professor Phillip Trevelen, the SizeUK project instigator and Project Manager, Jennifer Bougourd from the University of the Arts London, London College of Fashion. It also provided an opportunity to discuss scenarios for a similar project for Australia. As this project was completed in 2002, and was the first large scale anthropometric survey to be conducted by 3D body scanning, it gave insight how it is being used by UK apparel companies.

This meeting specifically provided information on areas of data privacy. The data collected in this project is controlled by the British Data Protection Act (DPA). A secure storage location was established via a registered company. The data is thus stored and owned by Bodymetrics Pty Ltd.

The survey took place between July 2001 and February 2002 over 1.5 million measurements were taken from more than 11,000 people across the UK using [TC]² body scanners. SizeUK database Information includes:

- Personal details on each subject (excluding name & address)
- 11,000 subjects – 50% women and 50% men
- 140 measurements per subject
- 130 electronic
- 8-10 manual
- 1,540,000 measurements in total
- 22,000 scans – 2 per subject
- Market Research Information – 40 clothing, shopping and lifestyle sets of information.¹³

Jennifer Bougourd reported that Size UK subscribers: Arcadia, BHS, Debenhams, Freemans, Grattan, GUS, House of Fraser, John Lewis, Littlewoods, Marks and Spencer, Monsoon, N Brown, Oasis, Redcats, Rohan, Speedo and Tesco, note the following benefits from their membership:

- being able to view and define size and shapes for the total market and to map size definitions according to market distributions
- provides a new way of thinking about the body and shape
- offers links to automatic pattern extraction software for the future

Bougourd acknowledged that automatic pattern extraction was still a little way off.

The stated aim of SizeUK was to capture data to 'harmonise European sizing'. It does not intend to develop a new British Size Standard, as the size standardisation role has been taken on by the European standards committee CEN/TC 248/WG 10, which in 1996 started the process of developing a new system for labelling clothing size. The European standard (EN 13402) 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"*.

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 (3D) body scanning surveys undertaken in some EU countries since the late 1990's. EN 13402 is intended as a size policy framework rather than a technical manual of anthropometric measurements.

The International Experience

At this stage SizeUK size distributions are still based on the traditional ad-hoc sizing definitions of, 8, 10, 12, 14, etc. Size data from SizeUK appears to have tweaked shape definitions around these accepted market definitions, so to not alienate consumers from these groupings.

It appears that the role of the size standard as previously mandated by Standards Bodies is no longer relevant. This is an important issue for the Australian Industry.

Links

SizeUK website <http://www.size.org/>

University of the Arts London, London College of Fashion, SizeUK project site
<http://www.fashion.arts.ac.uk/sizeuk.htm>

Bodymetrics Site Visit to Selfridges - London

The SizeUK project partners Bodymetrics have established a made-to-measure bespoke body scanning service in department stores Selfridges and Harrods in London with [TC]² body scanners. The tour included a visit to the Selfridges site to see Jeans scanning pod and discuss the service structure with the sales assistant. Customers are scanned and then select and customise their jeans from style and denims options. The cost is approximately £250. The jeans are produced offshore and take approximately 4 weeks to produce. They currently scan approximately five customers per day.

Links

Bodymetrics website <http://www.bodymetrics.com>

SizeUK Attachments (see CD)

Paper on UK National Sizing Survey: [SIZEUKInformationDoc.pdf](#)

Paper by Trevelan, P. UK National Sizing Survey Using 3D Body Scanning: [T.3 UK national_sizing_survey.pdf](#)



The International Experience



IFTH Institut Français du Textile et de l'Habillement - Paris

This meeting was an invaluable chance to meet directly with the two key personnel of the French Sizing Survey - Campagne Nationale de Mensuration 2003-2004, Patrick Robinet the Project Manager, and Valérie Cailliez, the IFTH Communication Manager. The meeting took place as an informal discussion at the IFTH Paris office.

Robinet presented a Powerpoint presentation on the project. During the meeting the opportunity took place to discuss project logistics and industry applications of the data.

This meeting provided an opportunity to obtain knowledge that was of direct relevance for an Australian project of this type. The main points were:

- IFTH own and control the anthropometric data collected by scan of 11,562 men, women and children, all of whom volunteered to be scanned.
- Access to the raw data has not been made available.
- IFTH have produced anthropometric measurement tables, which are available for purchase.
- IFTH provide fee for service research in size definitions for specific markets upon request.
- The project cost is in the vicinity of three million Euros. Revenue for sales has been around 10-15% of this cost at this stage.
- IFTH are not planning to update the current French standard as EN 13402 is intended to be the policy guideline.
- Processing time for each person was 10 minutes, which included 9 landmarks, 10 manual measurements and 2 scans, standing and seated.

Ms Cailliez emphasised the importance of having the support of the press/media as they were an integral part in recruitment. The French citizens who volunteered as scanning subjects wore their own underwear. The project did not provide scanning underwear or offer incentive payment to the volunteers.



The International Experience

Robinet has been working on this project for 10 years and identified the following as essential to ensuring best practice:

- Right sample of the population
- Establish a good measurement protocol at the beginning
- Good choice for measurement site (to maximize productivity)
- Be careful, validation of raw data is essential (50% of the data had to be manually validated after the scan)

From a preliminary overview of the anthropometric kits, it appears that the data contained in the male and female kits is not particularly relevant to the Australian market because of specific size segmentation aligned to the current French apparel size designations. The children's data would be of use for the Australian industry and training institutions. Size designations are based on height.

Links

Details of *IFTH Institut Français du Textile et de l'Habillement* measurement campaign is available on this website (French) <http://www.iftth.org/mensuration>

Details of *IFTH Institut Français du Textile et de l'Habillement* services are available from <http://www.iftth.org/institut-textile/homeEN.html>

IFTH Attachments (see CD)

Examples of Standard Men's Women's and Children's Anthropometric Reference Kits:

CNM01_ven.pdf

CNM02_ven.pdf

CNM04_ven.pdf

CNM06_ven.pdf

Information sheet on tall persons reported in the French Measurement Campaign: **French-Measurement-Campaign-tall persons.pdf**

Powerpoint presentation of French Measurement Campaign: **FRENCHSIZINGSURVEY PRESENTATION.ppt**

Press Release of French Measurement Campaign – Summary information: **PKFMC2006.pdf**

Press Release of French Measurement Campaign – Survey Results: **PressKFMC2006.pdf**

Press Release of French Measurement Campaign – Power Point: **presspresFMC2006.ppt**

IFTH Scan Images Attachments (see CD)

Images and videos of scanning protocols

difference_morpho.avi

image2.jpg

image4.jpg

image5.jpg

image6.jpg

image7.jpg

image8.jpg

ReportageM6.avi

The International Experience

IFTH Children Attachments (see CD)

Photographs – Children's body type by age

8 years old boys Vue 1.jpg

8 years old boys Vue 2.jpg

12 years old girls Vue 1.jpg

12 years old girls Vue 2.jpg

IFTH Men Attachments (see CD)

Photographs – Men's body type by definition

AVERAGE BODY TYPE.jpg

AVERAGE MEN Vue 1. jpg

AVERAGE MEN Vue 2. jpg

SMALL BODY TYPE.jpg

TALL BODY TYPE.jpg

VERY TALL BODY TYPE.jpg

IFTH Women Attachments (see CD)

Photographs – Women's body type by definition

AVERAGE VUE 1.jpg

AVERAGE VUE 2.jpg

HEAVY – T38 Vue 1.jpg

HEAVY – T38 Vue 2.jpg

HEAVY – T40 Vue 1.jpg

HEAVY – T40 Vue 2.jpg

NORMAL – T38 Vue 1.jpg

NORMAL – T38 Vue 2. jpg

NORMAL – T40 Vue 1. jpg

NORMAL – T40 Vue 2. jpg

THIN – T38 Vue 1.jpg

THIN – T38 Vue 2.jpg

THIN – T40 Vue 1.jpg

THIN – T40 Vue 2.jpg

The International Experience



[TC]²: The Textile/Clothing Technology Corporation, Cary, North Carolina USA

Based in Cary, North Carolina, this apparel technology research and education organisation is funded by the United States Department of Commerce and by private firms in the soft goods industry. In 2002 [TC]² conducted the SizeUSA anthropometric survey of 11,000 US women and men. This visit provided the opportunity to gain first hand experience in body scanning and measurement extraction methods. The two day seminar with [TC]² provided technical training in body scanning techniques and applications, specifically in the NX12 3D body extraction software. It also gave the opportunity to meet with:

- Dr Mike Fralix, President of [TC]²
- Dr David Bruner, Vice President of Technology Development
- Jim Lovejoy, Director – Industry Program
- Kim Munro, Product Development Manager.

This was a formal training program that took place over two days.

DAY ONE

Intro to Body Scanning Technology

The preliminary session conducted by Dr David Bruner, provided an overview of the [TC]² white light scanning hardware. Information was given on how the NX12 scanner operates and how they were used and installed in retail locations for the SizeUSA project. The [TC]² body scanners utilise white light technology, which simulates the triangulation of laser beams, but at a lower cost. According to Dr Bruner, [TC]² has been the volume leader in body scanner shipments for the last two years.

The NX12 white light scanner uses 12 camera heads for scanning. This system has been superseded by the NX16, which uses 16 camera heads. Dr David Bruner explained that the system is easier to calibrate than the NX12 and it has a smaller footprint. NX16 is the latest generation [TC]² scanner. This new, smaller scanner captures 600,000 to 1 million data points of a user's image and then compiles those points into a three-dimensional representation of the body.

The opportunity was provided for individual body scans to be taken.

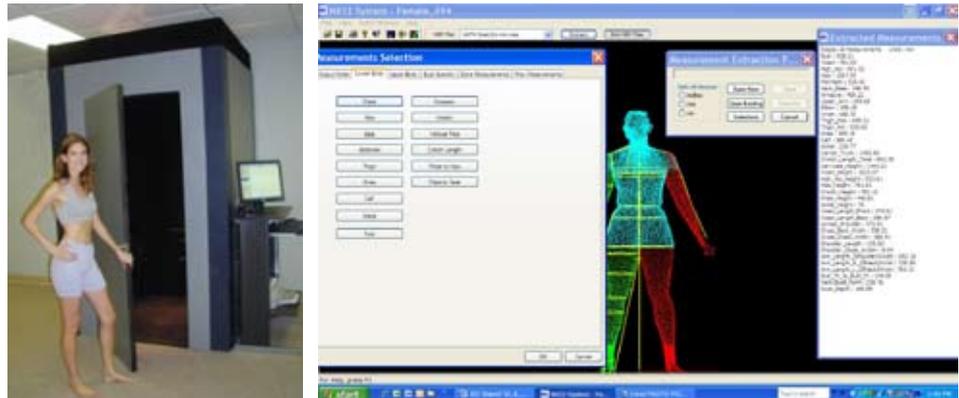
Building and Editing Measurement Extraction Profiles

During this session, how to build and create measurement profiles according to specific measurement extraction was explained. This included:

- file formats (.mep, .bin)
- order outputs
- measurement definitions
- extracted measurement outputs

As this was computer-based learning, the knowledge gained provided insight into measurement variables, in particular relating to measurements for waist extraction. Waists can be defined according to requirements: eg: anthropometric definitions of the waist or wearer's preference.

The International Experience



Extracting Measurement Outputs, Batch Processing and Custom Extraction for Shape Analysis

The [TC]² measurement extraction software clearly provides a very powerful and flexible tool in defining measurements for pattern construction, garment size selection and body size and shape identification. There is however some question over the measurement accuracy extracted by this software. It was highlighted by David Bruner that as data points are attributed as a data cloud on the external surface of the body, measurements are larger than by manual measurement. This is a factor for consideration for the use of body scanning for anthropometric database development, and for relying on measurements for pattern construction, or apparel size selection.

DAY TWO

SizeUSA Survey Overview

Jim Lovejoy, the project manager for SizeUSA presented an overview of the SizeUSA anthropometric survey of 11,000 men and women undertaken in a retail environment. The SizeUSA study used a final data sample size of 10,000 men and women selected from major cities across the United States. The SizeUSA study mirrored the statistical profile conducted by the Center for Disease Control in one of their National Health and Nutrition Examination Surveys.¹⁴ The SizeUSA project was initially funded by the annual grant supplied to [TC]² by the US Government. Access to the data is gained by a sponsored membership. The current buying rate is US\$20,000 for data. 3D images have recently been made available for purchase in 2007.



The International Experience

The data collection process and survey protocols were:

- Pre-screening – to identify correct client profiles. The over 65 age group was difficult to attract.
- Manually enter scan ID via barcode.
- Participants fill in questionnaire
- Scan (no land marking and scanning underwear provided)
- Attendant measures height and weight

As emphasised in the French and UK surveys, the maintaining of correct protocols and data management is vital.

SizeUSA Scan Data Overview

Size USA data would be of use for the Australian apparel industry as a database reference for US export markets. It would also be possible to validate this data against Australian population profiles so it could be used for size definitions for the Australian consumer.

3D Product Development

Kim Munro presented how data could be directly applied for the purpose of pattern development, with examples of grading applications according to SizeUSA size definitions. Size definitions are detailed in the [TC]² attachment *Size USA Overview.ppt*. The quest for automatic pattern generation is a priority area for research and development, as it is viewed that this area is the link to the mass-customisation production model. [TC]² continue to peruse this area. As yet it is not at a commercial product stage.

Links

[TC]² website <http://www.tc2.com/>

SizeUSA website <http://www.sizeusa.com>

[TC]² Attachments (see CD)

Agenda for [TC]² training session: **3D Body_Body_Scanning_for_Sizing_Agenda.doc**

Powerpoint presentation of SizeUSA: **SizeUSA Overview-50.ppt**



The International Experience



Cornell University, College of Human Ecology

Dept. of Fiber Science & Apparel Design 324 Martha Van Rensselaer Ithaca, NY 14853-4401

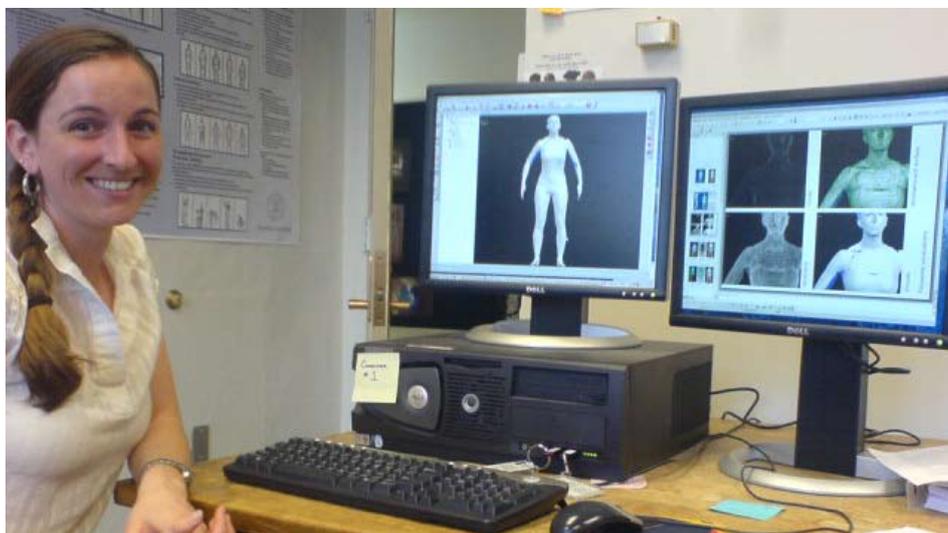
This visit provided an opportunity to discuss 3D body scanning research projects from an academic perspective and to investigate how the body scanner is used as a research and educational tool for apparel design and development. This involved a two day visit to the Department of Fiber Science and Apparel Design Body Scan Research Group to meet with Professor Susan Ashdown and Lindsay Lyman-Clarke, and to view the Apparel Design Faculty. Professor Susan Ashdown is a world leader in the area of body scanning research. She is widely published in the area and her research is aimed at:

- Immediate use to the apparel industry
- Focus on target market R-T-W sizing
- Analysis of misfit by comparing unclothed and clothed scans
- Research use of multidimensional measures

The Body Scanning Research Group has the resources of two scanners. A Human Solutions laser scanner and a [TC]² white light scanner. The Human Solutions laser scanner is the preferred scanning research tool as it does a better job of scanning clothed and moving bodies. A major focus for their research is to define fit definitions and the spaces between the body and clothing by merging clothed and unclothed scans to measure differences. The scanner is as a fit assessment tool. Students are free to use the scanner to access their garments.

Cornell University is also a member of the SizeUSA consortium. When asked for recommendations on scanning protocols for conducting an anthropometric survey, Ashdown stressed the following:

- The [TC]² NX16 scanner has an advantage as it is portable
- Train operators to add landmarks (shoulder/back of neck)
- Take manual measurements (crotch height, shoulder height, underarm height)
- Establish good demographics
- Check for good quality scans



The International Experience



Hip and thigh scan cross section

Ashdown stressed that the biggest benefit from scanning technology is it allows industry to see and identify their target markets. In addition to these discussions with Professor Ashdown the following activities were undertaken:

- A department tour with graduate student(s)
- A tour of the Cornell historical costume collection
- A presentation: *What Size am I: Decoding Women's Clothing Size* (a lecture presented by the Fellow)
- A meeting with Prof. Van Dyke Lewis to discuss his work in fashion theory and culture
- An opportunity to attend a department class-FSAD 266: Product Development taught by Prof. Susan Ashdown
- A meeting with Department Chair Professor Ann Lemley



The International Experience

Visiting Cornell demonstrated the value of the body scanner as a research and teaching tool for apparel students at a graduate or postgraduate level. It also provided the opportunity to view and discuss the technical and practical protocols of body scanning technologies.

Links

The following links are to the Cornell University site on of body scanning, sizing systems, and the Cornell costume collection database.

<http://www.bodyscan.human.cornell.edu/scene0037.html>

<http://www.sizingsystems.human.cornell.edu/references.html>

<http://www.human.cornell.edu/che/fsad/cctc.cfm?CFID=13726121&CFTOKEN=77349525>

Cornell Attachments (see CD)

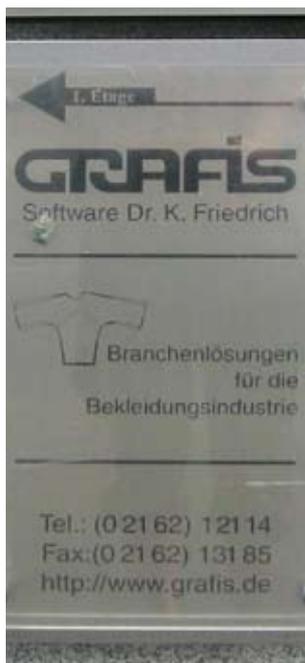
Poster presentation on Approved Apparel Sizing: Fit and Anthropometric Scan Data: **2007-02-15 NTC Poster FINAL.pdf**

Powerpoint presentation on the history of body measurement techniques and body scanning research: **2007 Science Caberet Presentation.ppt**

The agenda for the two day program at Cornell: **Agenda for Kate Kennedy and Jo Kellock (2).doc**

Index of sizing reference material: **M.4 sizing systems references.doc**

Powerpoint presentation of scanner images and rendering options: **Scanner output images.ppt**



Grafis – Computer Aided Design, Viersen - Germany

During the five day training session a basic knowledge of the Grafis Computer Aided Design Pattern was acquired. The Grafis system, unlike other apparel CAD systems, is based on a construction method. This training session took place over a five day period at the Grafis office in Viersen in Germany. Grafis is a family business, managed by Dr Kerstin Friedrich and Dr Volka Friedrich. Training was conducted on a one to one basis by a Grafis trainer Julia Gondecki.

The course content covered the following topics:

- The Grafis construction system
- Rules for working with Grafis blocks
- Grafis grading
- Pattern outputs

The opportunity to have hands on training in the Grafis system demonstrated how the system can be used to enhance pattern making skills. It is a very powerful CAD tool, and is unique in that it specialises in block development and facilitates very productive work practices for pattern development for the mass customisation model. Pattern files can also be exported to Gerber and Lectra systems. The other major advantage of the Grafis system is that at a cost of €2,000 it is extremely affordable for SME operators. It can be installed on a notebook computer and educational versions are available as free downloads. The Grafis system is also used for textiles and apparel training at University level.

The International Experience

Links

Grafis website <http://www.grafis.de/eng/index.htm>

Grafis Attachments (see CD)

Educational version of Grafis CD: **Graphis Demonstration software CD**



Hochschule Niederrhein, Niederrhein University of Applied Sciences

Department of Textile and Clothing Technology, Monchengladback, Germany

The visit to Hochschule Niederrhein University was specifically arranged by Grafis to see how Grafis is taught within a higher education environment. It also provided an opportunity to see German textile and apparel training facilities. This was a one day site visit, conducted by the Deputy Head of the Department of Textile and Clothing Technology, Ulrich Bauer. Bauer arranged for a meeting with Eva Hillers, the originator of the Optimass block construction method that has been programmed into the Grafis system. Hillers lectures in CAD systems and pattern technology at Hochschule Niederrhein. The Optimass manual measurement system was also demonstrated and the University has a Human Solutions body scanner.

Hochschule Niederrhein was established in 1851 as a specialist textile training institution. Ulrich Bauer provided an overview of the University's apparel and textile courses and facilities.

- German language Bachelor course 'Textile and Clothing Technology'
- German language Bachelor course 'Design Engineer'
- German language Master course 'Textile Products'
- English language Bachelor course 'Textile and Clothing Management'
- English language Master course 'Textile and Clothing Management'
- German language Diploma course 'Textile and Clothing Technology'
- German language Diploma course 'Design Engineer'

The International Experience



Fees for these courses for German and International students are €500 per semester. The University teaches four apparel CAD systems, Grafis Lectra, Gerber and Assist. Students are required to learn at least two systems.

The department staffing profile is based on 45 teaching staff and 32 technicians. Teaching staff deliver lectures and technicians maintain equipment and assist with individual student's practical projects. The equipment and machinery was state of the art, and the high standard of student work demonstrated on a variety of machinery was attributed to the support of the technical staff.

Visiting Hochschule Niederrhein University provided a practical example of the importance of the link between traditional trade skills and technology.

Links

Hochschule Niederrhein University website
<http://www.hs-niederrhein.de/fb07+M5ab988697c2.html>



Knowledge Transfer: Applying the Outcomes

As the use of body scanning and anthropometric data provides a new approach to body size definitions for apparel development, the most appropriate format to disseminate information to the apparel industry would be via a lecture/workshop. This would provide an overview on practical applications of this technology eg: body shape analysis, automatic size extraction, and database manipulations. The workshop could be conducted with a [TC]² scanner or Human Solutions laser scanner to demonstrate these applications if available.

It is important that this workshop provide hands on demonstration on how body scanning can be applied for the industry, eg pattern development and size profiles. This will also assist with knowledge development for the learning resources required for the development of the LMT07 TCF modules:

LMTFD4018B - Use and apply sizing systems appropriate for fashion design

LMTFD5003B - Analyse fit model

LMTFD5014B - Construct complex blocks for fashion garments

LMTFD4008B - Construct stock size block for garment to meet size and fit specifications

LMTFD5015B - Develop patterns for complex fashion garments

LMTFD4013B - Grade 2D patterns

LMTFD5016B - Grade shaped patterns

LMTFD5019B - Analyse individual fit and make pattern alterations

LMTFD6007B - Implement specialised patternmaking technologies

LMTFD4015B - Create pattern from block to meet customer specifications

LMTFD4020A - Use electronic fashion design tools

The workshop/lecture would be of benefit to Technical Teachers, Fashion Technicians, Apparel Designers and Product Developers. The SIAL 3D Gallery would be a suitable venue.

As a research tool, the analysis of body scan data facilitates a way of identifying body shape and size rather than just size and the traditional view of size. The traditional view of women's size as defined for outerwear in AS1344-1997¹⁵ is premised on whole body garments, predominantly the dress. Size is represented by the relationship of the three girth measurements for bust, waist and hip and thus determines shape. The prescribed shape for the average figure identified in AS1344 from this bust, waist and hip trilogy represents an hourglass and is dependent on a fixed relationship between these three body parts. This mode as defined in a number of size standards including the US standard ASTM D 5585, is monomodal and has a restricted capacity to represent the complexities of the female form and the fashion system.

Analysis of the body via body scanning technologies will assist with research to investigate whether dividing the body into the two separate zones, (one defined by the hip and the other defined by the bust) provides a more comprehensive technical framework to represent the variables of women's size for mass market apparel. This area of research is currently being undertaken through a post graduate Masters research project.

If we view women's bodies in separate zones and exclude the waist as a primary focus for size definition, we can construct regions that, within themselves, provide the opportunity to build more variables; ie: lower body with curved hips, or lower body with straight hips, and upper body, with bust definitions based on cup size of A, B, C etc. The combination of these two zones and their variables within provides the opportunity for a customised approach for the development and selection of mass market apparel, and creates the potential for a dialogue and democratic approach to women's size and shape. This new multimodal

Knowledge Transfer: Applying the Outcomes

format will thus lead a new approach to apparel sizing. Publication of this data via a formal thesis also presents opportunities to submit papers to academic conferences such as International Foundation of Fashion Technology Institutes (IFFTI). Academic publications will result. The FTAA's monthly seminar series will provide an ongoing venue for discussion, dissemination and critique of this research.

Further research opportunities exist via the Australian Research Council's (ARC) Linkage Projects scheme. This scheme supports collaborative research and development projects between higher education organisations and other organisations.¹⁶ Proposals for funding under Linkage Projects must involve a collaborating organisation from outside the higher education sector. A potential research area could investigate the correlation between the SizeUSA database and the Australian population. This research could be undertaken via RMIT University and industry partners.

Recommendations

Body scanning technologies provide a new and comprehensive way to define body size. From an international perspective it appears that size standards as previously mandated by standard bodies are no longer relevant. Major body scanning projects such as SizeUSA, SizeUK, and the French Sizing Survey - Campagne Nationale de Mensuration, are not seeking to establish standards. They are however a measurement tool for building anthropometric databases that can be mined and manipulated according to market definitions. Size is therefore an important aspect in defining market profiles. This approach is supported by the complexities of changing body shapes associated with aging populations and the so called 'obesity epidemic'.

These are important issues for the Australian Industry, as no such resource exists for TCFL industries. The failure of Project SCALE to attract funding support at this stage ensures that a comprehensive anthropometric database of the Australian population is not likely to be developed by the TCFL industry in the near future.

Industry Networks

As an immediate solution to this knowledge gap it is recommended that the industry buy subscriptions to existing databases eg: SizeUSA and WEAR. This would provide a resource to demonstrate anthropometric database applications and help develop size profiles for both local and global apparel markets.

[TC]² provide a unique research and development role for the US apparel industry and are at the forefront of scanning technologies and applications for the apparel industry. It is recommended that the Australian TCF Technology Network become a SizeUSA sponsor. The data would provide a useful resource for the apparel industry, and offer opportunities to conduct workshops and consultancies in fit mapping apparel size definitions. A package including the SizeUSA database, a search tool and 3D data is currently available for \$35,000.00. This resource could be accessed by FTAA members.

In conjunction with this, a subscription to the developing WEAR anthropometric database would also provide a useful resource for the industry and training institutions in a similar way.

Recommendation

Australian TCF Technology Network purchase subscriptions to existing databases eg: Size USA and WEAR, to facilitate skills development in anthropometric database applications via seminars/workshops and fee for service applications.

Education and Training

The Fellow is to be available to meet with the Industry Skills Council to provide advice as to existing and new training packages in the skills deficiencies areas targeted through this Fellowship.

Visiting Cornell University showed the value of the body scanner as a research and teaching tool for apparel students at a graduate and postgraduate level. The advantage of body scanning is in providing a tool to conduct complex analysis of size and shape. It is therefore recommended to assist with emerging approaches to size definitions, that a Centre for Body Scanning Research (CBSR) be established within a higher education institution such as RMIT University in Melbourne. This would provide the resource to develop new approaches to skills development in pattern/block construction by focusing on automatic measurement techniques and mass customisation.

Recommendations

Recommendation

A series of recommendations have been identified:

- Establish a Centre for Body Scanning Research to conduct research in body to garment fit profiles as a fit assessment tool.
- To participate in this area of research at an international academic level.
- That CBSR purchase a copy of the children's data produced in the anthropometric kits from the French Sizing Survey - Campagne Nationale de Mensuration 2003-2004 as a reference resource.
- That educational versions of the Grafis software be trialed for block construction education at CBSR.
- That the CBSR apply for ARC Linkage Project funds to investigate the correlation between the SizeUSA database and the Australian population.

Government

Recommendation

That funding support is given by the Federal Government via the Strategic Investment Program (SIP) to the SCALE consortium proposal for a large scale anthropometric survey of the Australian population by 3D body scanning.

Community

Recommendation

The Australian population is encouraged to participate in an anthropometric survey via the media and community organisations.

ISS Institute Inc

As the ISS Institute operations are directed towards bringing skills and knowledge to Australian industries, education and government and, in turn, the community in general, their assistance will be vital in trialing this leading-edge technology to assist traditional skills development for apparel design and development. The ISS Institute role in facilitating new ways of thinking, new ways of working so as to create innovative products and services for local and global markets will be of the utmost benefit. Its presence also supports the opportunity to maintain links with overseas contacts and networks developed by this study tour.

ISS Institute Inc Attachments (see CD)

Powerpoint presentation given at the Australian TCF Technology Network Conference May 2007: **technet 0_S findings show 2.ppt**

References

- ¹ *Innovation thread key to fibre future*, The Age, Business News 24/8/07, p10
- ² <http://www.sizeusa.com/>
- ³ AS 1344-1997: *Size coding scheme for women's clothing – (Underwear, outerwear and foundation garments)*. Standards Australia.
- ⁴ Standards Australia, CS-092-F0000: *Sizing Forum Minutes: Sizing Systems for Clothing*, December, 3rd 2003. <https://committees.standards.org.au/COMMITTEES/CS-092/F0000/CS-092-CIRC.HTM> (member login retrieved 15/10/06)
- ⁵ *Solving the Sizing Dilemma*, Ragtrader, 6th March 1999, p10.
- ⁶ Standards Australia, CS-092-M0001: *Minutes of Meeting MTG-001: Sizing Systems for Clothing*, 13 August 2003. (member login retrieved 15/10/06)
- ⁷ Murphy, M, *Shape up on sizes, fashion industry urged* <http://www.smh.com.au/news/National/Shape-up-on-sizes-fashion-industry-urged/2005/03/28/1111862325387.html>, March 29, 2005, (retrieved 10/10/06)
- ⁸ Ibid.
- ⁹ Smart, B., *It's numbers up for Aus Sizing*, Ragtrader, 7th September 2007, p1.
- ¹⁰ Rudd, K., Swan, W., Smith S., Wong, P., *Skilling Australia for the Future*, Election 07 Policy Document.
- ¹¹ *Textile, Clothing, Footwear and Leather Industry Report, 2007*, Office of Training and Tertiary Education, Department of Innovation, Industry and Regional Development- Victoria, p11.
- ¹² Book of Abstracts: WEAR Conference Adelaide February 2007, Human Factors and Ergonomics Society of Australia Inc. Baulkham Hills, NSW 2153.
- ¹³ <http://www.sizeuk.org/>
- ¹⁴ <http://www.sizeusa.com/>
- ¹⁵ AS 1344-1997 loc. cit.
- ¹⁶ http://www.arc.gov.au/ncgp/lp/lp_default.htm