UNIVERSITÉ DE MONTRÉAL

PROPOSITION D'UN MODÈLE D'ÉTIQUETAGE FONDÉ SUR L'ESTIMATION DES FORMES PAR ANALOGIE DES TAILLES

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Cette thèse intitulée :

PROPOSITION D'UN MODÈLE D'ÉTIQUETAGE FONDÉ SUR L'ESTIMATION DES FORMES PAR ANALOGIE DES TAILLES

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To my dear husband Alain Trahan

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RÉSUMÉ

Des recherches ont montré que les consommatrices de vêtements prêt-à-porter ne sont pas satisfaites de l'étiquetage et qu'elles ont de la difficulté à trouver la bonne taille en lisant les chiffres et lettres apposés sur l'étiquette. Une étude approfondie de la question nous a permis de mettre au point une nouvelle méthode d'étiquetage universelle pour les femmes.

L'objectif de la présente thèse était d'abord d'étudier différents aspects de l'étiquetage par tailles dans l'industrie du prêt-à-porter et de démontrer que les problèmes qui lui sont liés sont en partie dus à la désuétude des standards mais aussi à ce que les manufacturiers n'ont pas adhéré à ces standards qui plus est, utilisent le même système d'étiquetage. Or, cet étiquetage se veut une information appréciée, voire un outil assistant les consommatrices dans le choix du vêtement leur seyant le mieux parce que bien ajusté.

Notre thèse est présentée par articles. Nous décrivons d'abord la problématique et exposons la recension des écrits. Six articles publiés ou a être publiés sont ensuite insérés les uns après les autres, chacun ayant sa propre problématique, sa revue de la littérature ainsi que ses résultats.

La première partie décrit la problématique et expose une recension des écrits sur l'évolution des standards et de l'étiquetage par tailles dans l'industrie. Fondée sur l'évolution historique du prêt-à-porter, elle tient compte de l'importance des canons de beauté et des événements importants survenus depuis son apparition. Nous voyons que la production de masse a amené un besoin de standards, la façon dont les donneurs d'ordres se sont approprié ces standards, ainsi que ce sur quoi ils se basent pour étiqueter les vêtements.

La deuxième partie est une recension des écrits basée sur la satisfaction ou l'insatisfaction des femmes quant à l'ajustement[1] des vêtements prêt-à-porter. Elle inclut aussi ce qui a été proposé comme solution de rechange à l'étiquetage actuel.

Nous présentons ensuite la méthodologie qui a servi tant à mesurer et à analyser des pantalons que pour analyser des mesures anthropométriques. Les résultats des analyses ont permis de développer un modèle de gradation et d'étiquetage. Ce modèle universel est présenté à la suite de nos résultats et validé de manière directe et indirecte.

Le premier article a servi de base à nos recherches. Il montre la faiblesse de l'étiquetage par taille. Le deuxième recense des écrits sur les événements qui ont marqué l'étiquetage par taille dans l'industrie et fait une étude plus approfondie de notre premier article. Le troisième article reprend les éléments du premier, mais de façon plus étoffée. Nous avons fait cette étude en deux temps : par un test pilote sur plus de 200 pantalons et ensuite sur un large éventail de plus de 800 pantalons mesurés. Le quatrième article est une revue de la littérature axée sur les études anthropométriques ayant servi l'industrie du prêt-à-porter. Il présente les méthodes proposées pour définir les tailles, les points de mesures les plus importants et les chartes de mesures qui en découlent. Le cinquième article analyse des mesures obtenues de la dernière étude anthropométrique nationale américaine portant sur 6 310 femmes et plus de 200 variables sociodémographiques et corporelles. Le dernier article propose un nouvel étiquetage. Puisque nous avons montré que les femmes ont différents profils de silhouettes et différentes tailles, nous validons d'abord que les manufacturiers couvrent l'ensemble des femmes. Ayant montré que les mesures de hauteurs et de circonférences ne sont pas corrélées, nous formulons et validons certaines hypothèses liées à ce nouveau modèle d'étiquetage universel que nous proposons.

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[1] Nous utiliserons ajustement au cours du texte, en référence à "fit" en anglais.

Nous validons de manière directe et indirecte que le nouvel étiquetage que nous proposons est plus intéressant pour les consommatrices, qu'il les guide mieux vers un vêtement qui leur soit mieux ajusté et qu'il est définitivement meilleur que l'étiquetage actuel.

Que notre nouvel étiquetage soit retenu ou non, nous concluons en affirmant que l'étiquetage par tailles doit être absolument revu car l'actuel ne remplit pas sa fonction initiale qui est de guider les consommatrices vers un vêtement leur seyant le mieux.

Notre travail ouvre la voie à plusieurs problèmes de tailles dans le prêt-à-porter. Il peut être généralisé aux vêtements pour hommes et pour enfants. Il ouvre aussi les portes à une nouvelle façon de penser au « mass-customization » sans oublier l'aspect lié au marketing tel que le « *Vanity sizing* ».

ABSTRACT

Many studies have shown that women have difficulties finding the right size garment with the current size labeling system, used for women's clothing. In-depth studies of this size labeling system allowed us to propose a new and universal size label.

The objective of this thesis was to study different aspects of the actual size labeling system, and to demonstrate that the weaknesses in women's ready-to-wear size standardization charts originate not only in the obsolescence of the anthropometric data base but more importantly in the manufacturer's non-adherence to the suggested standard sizes although they use the same labeling system. Not only do size labels affixed to garments not provide information on body measurements which they purport to identify, but size labels do not even give complementary information that could be used by consumers to help them in finding the garment that fit them properly.

This thesis presents the problem with the actual size labels, a literature review and six journal papers. These six papers published or to be published are presented separately one after the other with their own problem statement, literature review and results.

The first part presents the actual sizing situation and a literature review showing the evolution of standard sizing and size labeling in the ready-to-wear garment industry. It illustrates chronologically the most important contributions of the twentieth century, their impact on today's size system including the birth of the pattern, the impact of mail order sales, call for standards, national surveys' objectives and applications and key measurement points retained for the ready-to-wear industry. It demonstrates the need for standards in mass-production along with garment manufacturers' non-adherence to said standards. It also highlights ready-to-wear fitting studies showing dissatisfaction. The literature review focused on the production end of the garment industry and does not address the marketing imperatives affecting the size labeling decision.

Methodology used for two studies (pants measurements and anthropometric measurements) is only briefly described since it is detailed in each journal paper. One has to note that the results of our analyses had permit to develop a universal size labeling model. This universal model was directly and indirectly validated.

The first paper served to demonstrate the weakness of the current size labeling system. We formulated and validated three hypotheses. Results demonstrate that order initiators do not adhere to standard sizes charts, they do apply the same measurements throughout their product lines and that manufacturers are incapable or unwilling to produce garments that meet the order initiators' specifications. The second paper presents literature review about the apparel industry sizing system. The third paper is an in-depth study of pants measurements and size labeling. This third paper presents the methodology in pre-testing 200 pants and measuring a random sample (whole selection) of 800 items. Four hypotheses were tested. Mathematical extrapolations were conducted to ensure comparability between different product styles. Proximity analyses between measurements within order initiators' lines of products and between order initiators were used to identify targeted market body shape. Results show that identical size labeled pants (i.e.: 6, 8, 10...) measurements vary from order initiators and that tolerances are too generous. Order initiators do not adhere to the Canadian General Standards Board size standards and suppliers do not respect order initiators' specifications. Results also demonstrate that order initiators show consistency within their product lines. The fourth and fifth papers focus on women's body measurements and shape. We demonstrate that size standards and labels do not properly serve their original purpose. In order to do so we present in the fourth paper the important anthropometric surveys conducted in the twentieth century and the academic discussions on the determination of standards from such data. The fifth paper shows that the initial size standardization criteria conveyed better information for the consumer. We also demonstrate that the new body measurement technologies (i.e. body scanning) do not solve the size standardization

quandary; and that the solution requires a labelling system that better reflects the main factors in human body size: measurements and shape.

The findings of this research point to the necessity, in order for size labels to provide adequate information to the consumer, to look at different avenues such as developing a new label conveying information differently. The last paper presents our proposition of the new universal size label. We directly and indirectly validated that our new size labeling system is more appropriate than the current labeling system and would better serve consumers.

We conclude that the actual size labeling system needs to be reviewed since it does not help the consumer in finding the right size garment.

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LISTE DES SIGLES ET ABRÉVIATIONS

3-D ou 3D	Trois dimensions
14 et plus	Gradation de vêtement équivalent à des tailles de quatorze et plus
55 ans et plus	Individus âgés de 55 ans et plus
%	Pourcentage
AFNOR	Association française de normalisation
ASTM	*American Society for Testing and Materials*
BMABGGPC	B*ody measurements of American boys and girls for garment and pattern construction*
BS	*Brithish Standards*
BSI	*Brithish Standards Institution*
CAD	*Computer Aide Desing*
CAN	Canada
CEASAR	*Civilisation Europeen American Surface Anthropometrie Ressource*
CETIH	Centre d'Études Techniques des Industries de l'Habillement
CGSB	*Canadian General Standard Board*
cm	Centimètre

CS 151	*Commercial Standard* 151
CS 215-58 *in1958*	*Commercial Standard* 215 *Sizing of Women's Paterns and Apparel*
HEC	Hautes Etudes Commerciales
ISO	*International Standard Organisation*
kg	Kilogramme
L	*Large* (grand)
Lbs	Livres
M	*Medium* (moyen)
ONGC	Office des normes générales du Canada
p.	page
P	Petite
Pi	Pied
Po	Pouce
PS 42-70	*Voluntary Product Standard (*Produits standard de 1942 révisé en 1970)
S	*Small* (petit)
S&S	Style and size
SSL	*Standard size labels*

T	*Tall* (grand)
$[TC]^2$	*Textiles and Clothing Technology Corporation*
US	*United States* (États-Unis)
USA	*United States of America* (États-Unis d'Amérique)
USDCOTS	*United States Department of Commerce Office of Technical Services*
USDCNBS	*United States Department of Commerce National Bureau of Standards*
W	*Women*
WMGPC	*Women's Measurements for Garment and Pattern Construction*
XL	*Extra Large* (très grand)

INTRODUCTION

L'objet de la présente thèse était d'étudier différents aspects liés à l'étiquetage par tailles dans l'industrie du prêt-à-porter et de démontrer que les problèmes étaient en partie dus à la désuétude des standards mais aussi à ce que les manufacturiers n'ont pas adhéré à ces standards. Ce travail nous a permis de proposer un nouvel étiquetage par tailles universel car nous sommes convaincus que le besoin s'en fait sentir. Non seulement trouvons-nous des tailles « 00 » mais le problème de l'étiquetage par tailles faisait l'objet dernièrement des informations internationales et l'objet de l'émission de télévision américaine « *Life with Bonnie* ».

Cette thèse ajoute à notre recherche de maîtrise (2003) dans laquelle nous avions validé que la cliente doit obligatoirement essayer un vêtement prêt-à-porter avant de l'acheter, parce qu'elle n'en connaît ni le *look* (la tenue, le port) ni l'ajustement. Selon Eckman *et al.,* (1990), la consommatrice suit un processus lorsqu'elle achète un vêtement. Elle franchit d'abord la phase d'intérêt où un vêtement est sélectionné pour ses caractéristiques esthétiques : couleur, patron, style et tissu. Elle franchit ensuite l'essayage, deuxième étape du processus avant d'accepter ou de rejeter le vêtement selon que l'ajustement lui convienne ou non.

L'étiquetage des vêtements par tailles est une « information complémentaire appréciée des consommateurs »[2]. Chun-Yoon et Jasper (1996) disent que c'est un outil assistant les consommatrices dans le choix du vêtement leur seyant le mieux parce qu'il est bien ajusté. Des recherches ont démontré que les consommatrices ne sont par ailleurs pas satisfaites de l'étiquetage actuel (Schofield et LaBat, 2005). Les femmes ont peine à trouver la bonne taille à la lecture des chiffres ou des lettres de l'étiquette, peut-être parce que l'étiquetage ne fait aucunement référence aux mesures corporelles.

[2] La Fédération- Département Grande Diffusion, mars 1999, Canada.

Un système de tailles standards pour femmes est pourtant né après une grande enquête anthropométrique menée aux États-Unis à la fin des années 30 et au début des années 40. Il avait entre autres pour objectif de répondre aux besoins des manufacturiers et des consommateurs du prêt-à-porter. Ce système standard repris au Canada par l'Office des normes générales du Canada (ONGC) spécifie que chaque « code de taille »[3] correspond à des mensurations précises du corps et non à des mesures spécifiques du vêtement et que « *les tailles sont identifiées à l'aide de chiffres qui sont autant que possible, conformes aux pratiques commerciales actuelles* »[4] (ONGC).

L'étiquetage actuel n'indique en rien aux femmes le type d'ajustement, précisent Price et Zamkoff (1996). Know, Paek et Arzeni (1991) affirment, eux, qu'un mauvais ajustement est l'une des principales raisons des retours des achats à distance.

Un document du *United States Department of Agriculture*, soulignait il y a plus d'un demi-siècle, que 40% des retours était dû aux tailles. Nos observations (Faust, 2003) ont démontré que plus de 50% des femmes apportent en cabine d'essayage au moins deux vêtements similaires de tailles différentes et que les retours de commandes à distance sont du même ordre c'est-a-dire entre 40% et 50%. Melzer et Moffitt (1997) mentionnent que le résultat est prévisible puisque la méthode de gradation utilisée est celle du percentile et que la gradation est ensuite faite de manière linéaire (Ashdown, 1998). La méthode du percentile est intéressante lorsqu'il n'y a qu'une seule variable ou encore un seul point de mesure précisent-ils. Toutefois, au fur et à mesure que le nombre de variables augmente, le nombre d'individus est réduit. Zehnere *et al.,* (1992) l'ont montré et Whitestone et Robinette (1997) reprennent leur démonstration de l'inefficacité de la méthode de gradation lorsque des variables sont ajoutées.

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[3] Code de taille, expression utilisée par l'Office des normes générales du Canada pour désigner une taille de vêtement. Réf. CAN2-49.211-M84.
CAN/CGSB-49.203-M87, page 1, 2ième paragraphe.

Certains (Anderson *et al.* 2000) soulignent qu'il ne s'agit pas seulement d'un manque d'information sur les mesures, mais aussi sur les préférences d'ajustement (ajusté, semi-ajusté ou ample). Des femmes préfèrent un port ajusté alors que d'autres se sentent plus à l'aise dans une tenue ample. Connell et Presley (2005) écrivaient :

> "*Understanding the fit preferences of female consumers could help apparel companies to produce and meet demands for comfortable and well fitting clothes for women*"[5].

De deux choses l'une : 1- ou l'information sur les mesures (les formes sous-jacentes définies par le code de tailles) ne fait pas référence à des mesures corporelles ou à celles attendues, sans compter qu'elle ne donne pas d'indication sur les styles (ajusté à ample) ; 2- ou les consommatrices ignorent à quoi correspondent les codes de tailles (junior, jeunes filles ou dames) et les chiffres pairs ou impairs (de 5 à 19 ou de 6 à 24) proposés par l'ONGC (comme mesures corporelles et des vêtements). Sans compter qu'elles ne connaissent probablement pas leurs propres mesures et silhouette.

Nous détaillons donc ici l'origine du système des tailles, analysons les mesures de plus de 1 000 pantalons d'un donneur d'ordres canadien ainsi que les mesures du dernier sondage anthropométrique mené aux États-Unis sur plus de 6 000 femmes. Nous nous interrogeons ensuite sur la pertinence de l'information sur l'étiquetage par tailles et sur la perception que les consommatrices en ont. Nous proposons enfin un nouvel étiquetage par tailles et validons directement et indirectement que notre nouveau modèle (universel) est plus adéquat.

Nous croyons qu'en modifiant la façon de présenter l'information dimensionnelle du vêtement, nous améliorerons les échanges commerciaux même dans cette période de globalisation et contribuerons à diminuer les retours et à réduire la frustration des femmes

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[5] Connell, L.J., et Presley, A.B., (2005), *Clothing fit preferences of young female adult consumers*, p.61, 4ième paragraphe. International Journal of Clothing Science and Technology, Vol. 17, No.1 pp. 52-64

lors de l'achat. Nous sommes convaincus que notre proposition dotera l'industrie du prêt-à-porter d'un système d'identification des tailles plus représentatif des besoins.

Le présent travail est présenté sous forme de thèse par articles. Dans un premier temps, nous décrivons la problématique et exposons une revue complète de la recension des écrits. Ensuite, six articles publiés ou à être publiés sont insérés les uns après les autres. Le premier a sa propre recension des écrits portant sur un thème spécifique, sa propre problématique ainsi que ses résultats. Les cinq autres articles sont découpés en part I to part V, exposant la revue de la littérature, la méthodologie et les résultats.

La première partie de cette thèse comme mentionné, décrit la problématique et expose une recension des écrits sur l'évolution des standards et l'étiquetage par tailles dans l'industrie du prêt-à-porter. Celle-ci est fondée sur l'évolution historique du prêt-à-porter qui tient compte de l'importance accordée aux canons de beauté et des grands événements survenus depuis l'avènement du prêt-à-porter : naissance du patron ; introduction et impact des ventes par catalogues ; besoin de standards ; études anthropométriques, leurs applications et points de mesures retenus par l'industrie du prêt-à-porter. Il s'agit d'une réflexion de type macro-industrielle.

Nous constatons que la production de masse a amené un besoin de standards et la façon dont les donneurs d'ordres se sont appropriés ces standards. Et nous nous demandons sur quoi ils se basent aujourd'hui pour étiqueter les tailles des vêtements. C'est une réflexion de type « micro-industrielle ».

Il s'ensuit une recension des écrits basée sur la satisfaction qui comprend ce qui a été proposé comme solution de rechange à l'étiquetage actuel.

Notons que la recension des écrits (Maitrise, 2003) a aussi fait ressortir les variables essentielles suivantes liées à l'essayage : esthétique, aspect social, besoin d'être conseillé, ainsi que l'ajustement. Bien que ces variables ne puissent être complètement dissociées, notre recherche s'intéressait davantage à l'ajustement qui fait référence aux tailles et aux

formes. Puisque nous ne pouvons dissocier ces trois variables, nous commençons par l'importance de l'apparence, en gardant à l'esprit que notre recherche est davantage dirigée sur l'ajustement physique.

Nous présentons ensuite sommairement (puisque décrit de façon détaillée dans les articles) la méthodologie qui a servi tant à la mesure et l'analyse des pantalons qu'à l'analyse des mesures anthropométriques qui nous a permis de développer un modèle de gradation et d'étiquetage universel. Les résultats de ces analyses de mesures nous ont permis de développer un modèle de gradation et d'étiquetage, lequel est présenté et validé de manière directe et indirecte à la suite de nos résultats. Une méthodologie est décrite et détaillée pour chacune des analyses et est présentée dans les articles correspondants.

Le premier article a servi de base à nos recherches. Il démontre la faiblesse de l'étiquetage par tailles. Dans cette partie de l'étude, nous avons formulé et étudié les trois hypothèses suivantes :

H_1 : Les spécifications de mesures des donneurs d'ordres suivent les mesures prescrites par l'Office des normes générales du Canada. ;

H_2 : Les donneurs d'ordres appliquent les mêmes mesures à toutes leurs lignes de vêtements ;

H_3 : Les manufacturiers respectent les spécifications demandées par les donneurs d'ordres.

Nos résultats démontrent que la première hypothèse doit être rejetée, que la seconde est vérifiée et que la troisième rejetée mais ne fait référence qu'à un petit groupe. Cet article, comme nous l'avons mentionné, servait de base puisque notre échantillon ne comptait que cinq donneurs d'ordres et que nous n'avons mesuré que dix pantalons pour chaque donneur d'ordres.

Le deuxième article est une revue des écrits axée sur les événements qui ont marqué l'étiquetage par tailles dans l'industrie du prêt-à-porter. Il relate certains événements spécifiques qui ont guidé l'industrie du prêt-à-porter.

Le troisième article analyse les faits soulignés dans la revue de la littérature et une validation d'hypothèses. Les quatre hypothèses que nous avions à valider se lisent ainsi :

H_1 : Les pantalons étiquetés d'une même taille ont les mêmes mesures ;

H_2 : Les manufacturiers respectent les spécifications des donneurs d'ordres ;

H_3 : La tolérance accordée aux mesures est telle qu'il est possible de distinguer les grandeurs ;

H_4 : Les manufacturiers ont adhéré aux standards nationaux.

Nous avons fait cette étude en deux temps. D'abord à l'aide d'un test pilote sur plus de 200 pantalons et ensuite sur un large éventail de plus de 800 pantalons mesurés. Nos résultats montrent que toutes ces hypothèses étaient à rejeter. Les pantalons étiquetés d'une même grandeur peuvent avoir des mesures différentes; les manufacturiers ne respectant pas les spécifications de mesures proposées par les donneurs d'ordres; la tolérance acceptée est aussi trop généreuse et ne permet pas de distinguer deux tailles; et enfin, les manufacturiers ne suivent pas les mesures proposées par l'Office des normes générales du Canada, voire produisent pour une silhouette type, nonobstant la grandeur.

Le quatrième article et le cinquième sont orientés sur les mesures anthropométriques. Le quatrième article couvre la littérature axée sur les études anthropométriques qui ont servi l'industrie du prêt-à-porter. Pour chacune, nous présentons l'objectif, l'échantillon, la méthode proposée pour définir les tailles, les points de mesures les plus importants et les chartes de mesures qui en découlent. Dans ce même article, nous présentons aussi trois méthodes de mesure et de gradation proposées depuis par certains académiciens. Enfin, dans le cinquième article, nous présentons une analyse des données issues de la dernière

campagne nationale de mensuration faite aux États-Unis. Nous démontrons que les femmes peuvent être regroupées en fonction de leurs mesures corporelles et silhouettes. Encore une fois, nous validons nos propos à l'aide d'hypothèses. Les voici :

H_1 : Les technologies telles que le "3-dimensional body scanner (3D)" procurent un grand nombre de mesures en très peu de temps, par contre plusieurs sont redondantes et doivent être éliminées.

H_2 : Certaines mesures obtenues par l'utilisation du 3D ne sont pas fiables et doivent être retirées.

H_3 : Les mesures de hauteur, de poids et de circonférence ne sont pas corrélées.

H_4 : Il est possible de regrouper les femmes selon les deux mesures que sont la taille et les hanches.

H_5 : Même si les femmes peuvent être regroupées en trois silhouettes, le nombre de classes pour couvrir l'entière population serait trop grand pour que cela soit fonctionnel.

Dans le dernier article nous proposons un nouvel étiquetage. Puisque nous avons démontré que les femmes avaient différents profils de silhouettes et différentes tailles, nous validons d'abord que les manufacturiers couvrent l'ensemble des femmes :

H_1 : Les manufacturiers produisent de façon à couvrir l'ensemble de la population et utilisent le même système de grandeur.

Puisque nous avons démontré que les mesures de hauteurs et de circonférences ne sont pas corrélées, nous formulons l'hypothèse que la mesure de l'entre-jambe devrait être indiquée sur l'étiquette des pantalons :

H_2 : La longueur de l'entre-jambe est une information essentielle à mettre sur l'étiquette des pantalons

Enfin, nous validons les deux dernières hypothèses suivantes :

H_3 : Les femmes choisissent toujours un certain style de pantalons en fonction de leurs mesures et de leur silhouette ;

H_4: Les femmes recherchent toujours le même genre d'ajustement pour leurs pantalons.

Nous validons de manière directe et indirecte que ce nouvel étiquetage est plus intéressant pour la consommatrice et qu'il la guide mieux vers un vêtement qui lui soit le mieux ajusté et qui le soit définitivement mieux que l'étiquetage actuel.

Nous concluons que l'étiquetage par tailles doit être revu et en proposons un nouvel universel. Nous validons notre première idée que l'étiquetage actuel ne remplit pas sa fonction initiale qui est de guider les consommatrices vers un vêtement leur seyant le mieux et nous validons de manière directe et indirecte que le nouvel étiquetage par tailles que nous proposons est non seulement universel mais aussi plus approprié.

Cette thèse ouvre la voie à plusieurs pistes de recherches dans le domaine du prêt-à-porter. Elle peut être généralisée aux vêtements pour hommes et pour enfants. Elle ouvre les portes à une nouvelle façon de penser au « *mass-customization* », sans oublier tout l'aspect relié au marketing tel que le « *Vanity sizing* ».

CHAPITRE 1 : REVUE CRITIQUE DE LA LITTÉRATURE

> « De la nécessité de se couvrir on est parvenu à la grâce du vêtement sous des formes différentes, à la distinction des peuples, et parmi chacun, à celles des différents états et conditions, ce qui a donné lieu à la parure et à la magnificence » écrivait Garceau en 1769.[6]

Outre la pudeur et le besoin de protection, les femmes se vêtent pour la parure (Leroi-Gourhan, 1973). Lennon (1992) a démontré que les femmes ont le souci de bien paraître[7]. Elles sont peu à croire qu'elles ont un corps correspondant aux critères de beauté de leur époque ou de leur contrée et elles cherchent à se rapprocher des canons de la beauté afin d'être plus ravissantes, affirment Fan, Yu et Hunter (2004). Ils soulignent que la plupart se servent des vêtements pour mettre en valeur certains aspects attrayants de leur corps ou pour en camoufler d'autres. Il semble que se soit d'autant plus vrai lorsqu'elles gagnent en âge (Goldsberry *et al.*, 1996).

La femme a profité de la mode pour se rapprocher de l'idéal féminin. Alors que l'idéal de beauté demeure la rondeur, synonyme de fertilité dans certains pays arabes (Fan dans Fan, Yu et Hunter, ch.1, 2004), notre *modern western culture* a favorisé d'autres types de silhouettes. Au début du dix-neuvième siècle, la silhouette idéale est corsetée en forme de sablier (Stoppard et Younger-Lewis, 1995 Reader's Digest, p. 17 et Fan, Yu et Hunter, 2004). Pour accentuer leur taille de guêpe, les femmes enfilaient des gaines ou des corsets à baleines, recourant certaines fois à la chirurgie pour se faire enlever une ou plusieurs côtes (Stoppard et Younger-Lewis, 1995 Reader's Digest, p. 17). Dans les années 1920, la femme émancipée est mince et sans taille; les années 1950 présentent la vénus Marilyn Monroe, archétype du corps en sablier.[8] Le XXe siècle a produit à lui seul une vaste gamme de silhouettes *idéalement* belles. Mais les canons de beauté ne privilégient à la fois qu'une seule silhouette *idéalement* belle.

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[6] Garsault, 1769, lu dans Mode et vêtements, 1995, p. 73.
[7] Le regard de l'autre : une variable essentielle à l'acceptation et au rejet d'un vêtement, Anderson et al, 2001, selon la recension des écrits lors du mémoire de maîtrise.
[8] L'évolution de la silhouette féminine, dans Être femme un guide de vie, p.18.

La silhouette féminine idéale d'aujourd'hui est relativement mince, un peu musclée (Fan, Yu et Hunter, 2004) et représente la pleine forme physique. La forme idéale évolue mais les critères des canons de beauté sont toujours liés à la santé ou la prospérité (Amadieu, 2002). À noter que le New York Time Style Magazine Printemps 2007 publie un article dont le titre est « Fat is February Issue » et où l'on y présente le dernier « top model » de Jean-Paul Gaultier « *the decidedly full-figured Velvet d'Amour, who weighs in at nearly 300 pounds.* »[9] et où l'on peut lire « *Diversity is what's important* ».

Alors que la silhouette des femmes américaines semble s'épanouir vers le bas du corps et la fait ressembler de plus en plus à une «poire», forme communément appelée en **A**, la silhouette de base sous-jacente à l'étiquetage par tailles de l'industrie du prêt-à-porter féminin demeure celle en sablier communément appelée en **X**. Selon LaBat et DeLong (1990), il est si important pour la femme de correspondre à un idéal de beauté, que celles-ci ont tendance à se blâmer elles-mêmes quand un vêtement ne leur va pas au lieu de s'en prendre aux manufacturiers, voire de simplement s'accepter comme elles sont: différentes des mesures du vêtement convoité.

La recension des écrits nous apprend aussi que les femmes satisfaites de leur corps (comme un tout) ou d'une partie de leur corps (le haut ou le bas, pris distinctement), tendent à privilégier des vêtements de style ajusté. À l'inverse, les moins satisfaites de leur corps ou d'une de ses parties tendent à favoriser des vêtements plus amples (Anderson *et al.*, 2000).

Cette recension des écrits se décomposera en parties. Dans la première, un retour dans le temps permettra de mieux comprendre le système de gradation et d'étiquetage ainsi que l'information contenue sur une étiquette de prêt-à-porter. Il s'agira d'une vision historique. La partie suivante montrera la relation entre les données anthropométriques et l'étiquette des tailles, en passant par les chartes de tailles et leur gradation. Comment les donneurs d'ordres s'y prennent-ils pour déterminer leurs standards?

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[9] Armand Limnander, The New York Time Style Magazine, Women's Fashion Spring 2007, p. 124.

1.1 La gradation, les chartes de mesures et l'étiquette de la taille vus sous un œil macro-industriel

Nous présentons, dans cette section, la gradation, les chartes de mesures et l'étiquetage par tailles présentés suivant l'évolution du prêt-à-porter.

Selon Schofield et LaBat (2005), peu d'écrits ont été publiés sur l'origine du système de gradation, des chartes de mesures et de l'étiquette de taille. L'évolution dans le temps du prêt-à-porter permet de mieux comprendre la gradation, les chartes de mesures et l'étiquetage par tailles ainsi que l'ajustement qui en résulte. C'est pourquoi nous allons présenter les travaux de recherche sur le prêt-à-porter suivant les périodes successives, du XIXème au XXIème siècle.

1.1.1 Avant le XXème siècle: l'arrivée du prêt-à-porter et la commercialisation des patrons

> « Il n'y aura qu'une seule mesure de vin dans tout la Royaume, et une seule de bière, et une mesure de grain à savoir la pinte de Londres, et une longueur de drap teint, de drap de bure de couleur brunâtre et de couleur grisâtre, à savoir deux aunes entre les lisières. Il en sera de même pour les poids comme des mesures ».[10]

Lorsque les vêtements étaient faits sur mesure, chacun était taillé et confectionné pour qui le portait. L'ajustement était personnalisé à l'individu (Workman, 1991). C'était essentiellement une production que Pine (1990) qualifierait d'artisanale et personnalisée.

Selon Kindwell (1979, lu dans Schofield et LaBat, 2005) les premiers patrons gradués pour femmes repérés aux États-Unis datent des années 1820-1840. La mesure du buste servait de référence et les autres mesures étaient proportionnelles à celle-ci. À cette époque et même avant, les Européens considéraient le buste comme principal point de

[10] Jean Sans Terre, Roi d'Angleterre, signa La Grande Charte (l'écrit le plus ancien traitant de la normalisation démontrant le besoin de normes). Notes de cours Patrick Isaac et lu dans le mètre du monde, livre sur le système décimal.

mesure (Workman, 1991). En 1860, le buste demeure le point de mesure pour les patrons du haut du corps et la taille devient le point de mesure pour les patrons des vêtements couvrant le bas du corps en l'occurrence les jupes. Le vêtement était ensuite ajusté par la couturière lors de la confection.

Le succès dépendait de l'habileté de la couturière à ajuster le vêtement (Schofield et LaBat 2005). Il s'agissait d'une production dite personnalisée. Burns et Bryant (1997), spécifient qu'Ebenezer Butterick en 1863 et James McCall en 1870 furent les premiers à commercialiser les patrons gradués.

La commercialisation des patrons a rapidement été suivie par le « prêt-à-porter », pour hommes[11]. Le prêt-à-porter pour femmes n'est apparu que plus tard (Burns et Bryant, 1997). Les capes et manteaux furent les premiers vêtements prêt-à-porter acceptés pour les femmes, probablement parce que leur ajustement n'était pas très important. Corsets et autres dessous connaissaient aussi un certain succès, probablement parce que portés sous d'autres vêtements, à l'abri des regards des tiers. Toujours selon Burns et Bryant (1997), il faudra attendre le début du XXème siècle pour l'arrivée des jupes « prêt-à-porter ».

La popularité des « *separates for women* » (une blouse et jupe), créées par Gibson (entre 1890 et 1950) et portées par les jeunes filles, donna le réel coup d'envoi du prêt-à-porter féminin (Burns et Bryant, 1997).

Schofield et LaBat (2005) soulignent que ces vêtements étaient gradués avec les mesures du buste et de la taille, et que les deux mesures faisaient référence aux mesures du vêtement et non du corps. Selon Bryk (1988) lu dans Schofield et LaBat (2005), le *Ladies Standard Magazine* de 1894 spécifiât, en plus du buste et de la taille, les hanches comme troisième point de mesure important.

[11] Les prisonniers, les marins et les esclaves furent probablement les premiers à se vêtir de ce que l'on peut appeler prêt-à-porter (Burns et Bryant, 1997).

1.1.2 Début du XXème siècle: les tailles sont établies en fonction de l'âge

La gradation, les chartes de mesures et l'étiquetage par tailles furent aussi marqués par la production de vêtements de masse. Au début du XXème siècle, le sur-mesure et la production artisanale étaient tranquillement laissés pour compte, remplacés par une production en série (Burns et Bryant, 1997). Un *« system for developing sizes »* était nécessaire car les vêtements n'étaient plus produits à l'unité. Workman (1991) explique que l'échantillon de base était gradué à 36, étant censé convenir à une femme ayant 36 pouces de tour de buste. La gradation du buste allait en augmentant ou en diminuant la mesure par bonds de deux pouces. Le *Sears, Roebuck and Co.1902 Catalogue* offrait en 1902 une gamme de tailles de 32 à 42 pouces (Workman, 1991). Une mesure de buste de 32 pouces devait seoir à une jeune femme de 14 ans, une de 34 pouces, à une jeune femme de 16 ans et une mesure de 36 pouces seyait à une jeune femme de 18 ans *(Sears, Roebuck and Co. 1902 Catalogue* No. 112., 1902). Le catalogue mentionnait aussi de spécifier s'il s'agissait d'une jeune femme, car la construction du vêtement n'était pas la même et, par conséquent, l'ajustement ne devait pas être le même (Workman, 1991). Plus important, *Sears, Roebuck and Co. 1902 Catalogue* présentait pour la première fois en 1902 des robes graduées d'une codification faisant à la fois référence au buste et à l'âge (Fan, Yu et Hunter, 2004).

Cooklin (1990), lu dans Schofield et LaBat (2005), avance qu'il s'agissait de vêtements très simples, une *"cheap interpretation"* de la mode et que les femmes de l'époque achetant un vêtement savaient qu'elles devraient retoucher celui-ci pour qu'il leur aille convenablement. La gradation demeurait proportionnelle et linéaire d'une taille à l'autre et était encore établie seulement en fonction du buste pour les vêtements couvant le haut du corps et de la taille pour ceux du bas du corps.

1.1.3 De la Première à la Seconde Guerre Mondiale: les manufacturiers fonctionnent au mieux de leurs connaissances

Durant la Première Guerre, plusieurs maisons de mode françaises et anglaises ont fermé leurs portes. Quand les Européens ont repris les échanges commerciaux en mode, ils vendaient des patrons aux Américains qui les confectionnaient en masse (Burns et Bryant, 1997) et se dotaient d'un paradigme de production qui influençait déjà plusieurs types d'industries (Pine, 1990).

Les quatre décennies suivantes furent réellement marquées par l'avènement du prêt-à-porter. « Dans les villes, les grands magasins comme *Dupuis Frères*, *Eaton* ou *Simpson* introduisent le prêt-à-porter et modifient les habitudes d'achat de la population. Des millions de leurs catalogues sont distribués dans tout le Canada. »[12] Selon Pine (1990), les manufacturiers offraient plusieurs items, pourvu que vous vous satisfassiez des tailles standards qu'ils avaient définies. Une certaine homogénéité dans le choix des tailles offertes se dessinait.

Faisant au mieux de leurs connaissances, les manufacturiers ont développé des gradations et des tailles sans avoir d'informations précises, car aucune information scientifique ne les guidait pour graduer ou étiqueter (O'Brien et Shelton, 1941). Selon Schofield et LaBat (2005), tout un chacun répétait la façon de faire de ses prédécesseurs. Le buste, la taille et les hanches semblaient être les mesures de base. Cela assurait une certaine homogénéité des points de mesure, mais les manufacturiers n'avaient pas tous les mêmes standards pour une taille donnée (Workman, 1991). Faute de normes, ils appliquaient leur propre gradation (Gould-Decauville *et al.*, 1998) et les acheteuses de ces vêtements faisaient les retouches nécessaires (Cooklin ,1990, lu dans Schofield et LaBat 2005).

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[12] Bernier, Dourignon et Saint-Martin (2003), Géographie, histoire et éducation à la recherche de la citoyenneté; Sur la piste. Éditions du Renouveau pédagogique inc., Bibliothèque nationale du Québec et Bibliothèque nationale du Canada, 175 pages, p. 77.

1.1.4 Durant la Seconde Guerre 1939-41: "*Women's Measurements for Garment and Pattern Construction*" (WMGPC)

Selon, O'Brien et Shelton (1941) le consommateur s'y retrouve difficilement et la disparité des tailles entraîne des retours de marchandises évalués à plus de 40% pour les ventes à distance. O'Brien et Shelton (1941) mentionnent qu'à cette époque, il n'était pas rare que le coût d'un vêtement après retouches soit augmenté jusqu'à 25% de son prix initial et que beaucoup de pertes d'argent étaient causées par un ajustement inadéquat.

La production de masse, la variété des mesures, la popularité du catalogue et ces retours fréquents ont créé un besoin pour un système de tailles standards (Fan, Yu et Hunter, 2004). Plusieurs ont en effet souligné à cette période l'importance de standards faits à partir de mesures anthropométriques afin que tous parlent le même langage (O'Brien et Shelton, 1941).

À la suite de cette demande de standards, l'enquête[10] intitulée « *Women's Measurements for Garment and Pattern Construction (WMGPC)* » a eu lieu. Cette dernière a été faite aux États-Unis de juillet 1939 à juin 1940. Les résultats furent publiés par le *United States Department of Agriculture Washington, Government Printing Office* en 1941.

Selon plusieurs (O'Brien et Shelton, 1941, Goldsberry, Shim et Reich, 1996, Chun-Yoon et Jasper, 1996, Burns et Bryant, 1997, Ashdown, 1998, Workman et Lentz, 2000, Fan, Yu et Hunter, 2004, Shorfield et LaBat, 2005), ces mesures anthropométriques devaient pour la première fois standardiser les tailles, au plus grand bénéfice de l'industrie du vêtement. L'étude, écrivent O'Brien et Shelton (1941), avait pour objectif d'obtenir des mesures au bénéfice du prêt-à-porter pour femmes en permettant de construire des chartes de tailles.

Le rapport décrit l'objectif de l'enquête « *in order to provide measurements which could be used for improving the fit of women's garments and patterns* »[13] et présente les informations sur l'organisation de l'enquête :

- l'aspect démographique des femmes mesurées (14 698 femmes américaines de race blanche âgées de plus de 18 ans recrutées dans huit états américains) ;
- la procédure utilisée pour prendre les mesures (chacune d'elles fut pesée et mesurée aux mêmes 58 points de mesure) ;
- le calendrier ;
- le questionnaire ;
- l'évaluation de l'échantillon (10 042 retenues, soit un échantillon final représentant 0,025% de la population féminine américaine (Winks, 1997) ;
- les raisons et le nombre de données rejetées, liés aux femmes mesurées ;
- la distribution des mesures obtenues ;
- les corrélations issues de ces mesures (aucune corrélation entre les mesures verticales et horizontales. Certaines corrélations entre les mesures verticales entre elles, d'autres entre la stature et le poids) ;
- la façon d'utiliser les données afin qu'elles soient transposées à la création de chartes de mesures (divisées entre autre par tailles: *short, regular et long*).

1.1.5 De 1945 à 1970: le besoin de standards pour guider l'industrie du prêt-à-porter

L'Association de vente par la poste recommandait en 1945 un standard commercial pour l'industrie du vêtement, le *Commercial Standard* (*CS151*). Il a fallu attendre 1958 avant de se procurer le « *Body Measurements for the Sizing of Women's Paterns and Apparel* », appelé le *CS215-58* sans compter qu'il était inscrit dès les premières pages « *The adoption and use of a Commercial Standard is voluntary* ».

[13] WMGPC (1941), page 1, paragraphe 1.

Le but du *CS215-58*, s'énonçait comme suit:

> *"The purpose is to provide standard classification, size designations, and body measurements for consistent sizing of women's ready-to-wear apparel (Misses', Women's, Juniors', etc.) for the guidance of those engaged in producing, or preparing specifications for, patterns and ready-to-wear garments. The measurements given in this standard are body, not garment, measurements."*[14]

Le deuxième but était:

> *"... to provide the consumer with a means of identifying her body type and size from the wide range of body types covered, and enable her to be fitted properly by the same size regardless of the price, type of apparel, or manufacturer of the garment."*[15]

Le rapport (*CS215-58*) contient les étendus « *scopes* » (quatre classifications de femmes *Misses'*, *Women's*, *Half-sizes* et *Junior)*, et neuf groupes (les tailles *Tall*, *Regular* et *Short* avec, dans chacun des trois groupes une sous-classification *Bust-hip*, *Slender*, *Average* et *Full*). En termes de classification, ce rapport est différent des regroupements qu'O'Brien et Shelton (1941) avaient proposés. Il contient néanmoins les différentes applications possibles, les définitions des points de mesures, les méthodes et les chartes de mesures ainsi que le pourcentage de chaque classe.

Plusieurs auteurs estiment que de nombreux industriels ont compris que ces données pourraient leur être bénéfiques et ont demandé ce rapport. Ils croyaient pouvoir utiliser ces données pour graduer leurs vêtements et habiller un maximum de personnes avec un minimum de tailles (Goldsberry, Shim et Reich, 1996, Chun-Yoon et Jasper, 1996, Burns et Bryant, 1997, Ashdown, 1998, Workman et Lentz, 2000, Fan, Yu et Hunter, 2004, Shorfield et LaBat, 2005).

Entre le début des années 50 et le milieu des années 60, plusieurs pays ont développé des standards de tailles et publié des rapports sur le sujet:

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[14] Commercal Standard CS215-58, page 1, 1st paragraphe, point 1.1.
[15] Commercal Standard CS215-58, page 1, 2nd paragraphe, point 1.2

- 1947, le *BS 1345* du *The British Standard Institution*;
- 1950, l'enquête du *British Board of Trade* stipulant que 126 tailles seraient nécessaires pour couvrir la population féminine;
- 1954, le *DS923* de la *Denmark Standards Association*;
- 1955-59, une étude anthropométrique de la *Polish Academy of Science;*
- 1957, rapport *United Kingdom* sur des mesures anthropométriques de personnel militaire;
- 1957-65, au tour de l'USSR;
- etc. (Fan, Yu et hunter, 2004).

En 1968 certains ont cru que pour faciliter les standards commerciaux de pays en pays, il valait mieux avoir recours à des standards. Des représentants membres de l'*International Organisation for Standardisation* (*ISO)* de dix-sept pays se sont réunis à Genève et ont mis sur pied un comité technique *TC133* nommé *Sizing Systems and Designations for Clothes*, un «impératif» pour les échanges commerciaux international (Fan, Yu et Hunter, 2004).

1.1.6 De 1970 à la fin du XXème siècle: nouveaux standards et standards révisés

Le « *Voluntary Product Standard* » (*PS 42-70*) fut publié en 1970 pour réviser le *CS215-58* et implanté pour commercialiser des gradations de patrons variant dorénavant de pouce en pouce pour les mesures de circonférence des petites tailles et au pouce et demi pour les mesures des tailles moyennes et enfin par bonds de deux pouces pour les fortes tailles. La mesure de la hauteur elle variait au pouce et demi. On peut y lire:

> *"The objective of a Voluntary Product Standard is to establish requirements which are in accordance with the principal demands of the industry and, at the same time, are not contrary to the public interest".*[16]

[16] PS 42-70 (1970), page iv, paragraphe 1.

Depuis, plusieurs pays développent des standards:

- 1972, en Suisse ;
- 1973, *PC3137* et le *PC 3138*, en URSS ;
- 1974, *GB1335-81*, en Chine qui fut implanté en 1981 ;
- 1978-81, enquête anthropométrique au Japon, etc.

À la suite de prises de mesures sur 9 402 femmes en Allemagne, on a, en 1983 par exemple, établi à 57 le nombre de tailles nécessaires pour couvrir 80% de la population féminine.

Plus près de chez nous, le nouveau standard *ASTM D5586-95* développé à la suite de la remise en question de la pertinence des chartes de mesures de certains segments de marché tel que celui des femmes âgées de plus de 55 ans, fit couler beaucoup d'encre. Les mesures de 6 000 femmes américaines ont été prises (voir Figure 1.1). Des manufacturiers se sont rendu compte que les morphologies ne sont pas homogènes. Certains chercheurs (Shim et Bickle, 1993; Goldsberry *et al*, 1996; ainsi que Horne et Cambell, 1999) ont démontré que les femmes de 55 ans ont une morphologie différente de celle des mannequins d'industrie représentant les canons de la beauté qui sont souvent utilisés pour essayer des vêtements. Ces auteurs révèlent que le nombre de femmes de cette tranche d'âge augmente et qu'il serait opportun de leur porter une attention particulière.

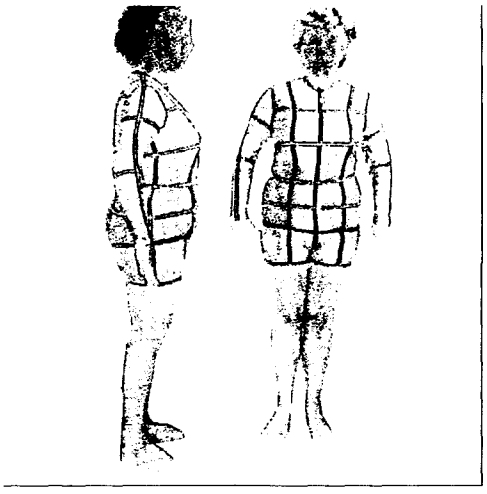

Figure 1.1 : Costume de mesures[17]

1.1.7 La fin du XXème siècle: les manufacturiers n'ont pas adhéré aux standards

> « En supposant que l'on fixât à l'une des mesures usuelles, pour y ramener toutes les autres, et que l'on prit des précautions pour en conserver fidèlement l'étalon, les avantages de l'uniformité se trouveraient bornés au territoire particulier de la France. La mesure préférée n'aurait aucune prépondérance sur les mesures en usage chez les autres peuples... »[18]

Schofield et Labat (2005) concluent que les manufacturiers ne furent pas aussi nombreux qu'anticipé à se servir des standards proposés et préfèrent encore utiliser leurs propres chartes de tailles. Contrairement aux philosophes de la révolution française, qui eux désiraient l'universalité d'un système de mesures, les manufacturiers d'aujourd'hui perpétuent le morcellement des systèmes de tailles. Certaines compagnies avaient d'ailleurs déjà leurs chartes de tailles qui correspondaient à une clientèle cible (Burns et Bryant, 1999). Qui plus est, selon Glock et Kunz (1995), les manufacturiers ont la responsabilité de définir leurs standards en fonction de leur clientèle cible.

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[17] Source: *"Women 55 Years and Older: Part I. Current Body Measurements As Contrasted to the PS 42-70 Data"*. Goldsberry *et al.*, (1996).

[18] Guedj, Denis, 2000, le mètre du monde, Éditions de Seuil, France, p. 33, 3ème paragraphe, 416 pages.

Workman et Lentz (2000), rappellent qu'adhérer aux standards développés était une décision volontaire et non imposée.

Il en résulte que l'idée d'habiller un maximum de personnes avec un minimum de tailles, pour faciliter les échanges commerciaux, comme initialement souhaité (avec les standards et ce nonobstant le prix), est remise en question (Ashdown, 1998). Comme le spécifie [TC^2]:

> "*How is that a 5'8'', 150lb. woman; a 5'6'', 135lb. woman and a 5'9'', 125lb. woman all claim to wear a size 8?*". [19]

On pourrait croire que des entreprises inscrivent délibérément une taille plus petite sur l'étiquette pour faire croire aux femmes qu'elles maintiennent leur silhouette d'antan en achetant des vêtements de la même taille qu'avant (industriellement appelé *Vanity sizing)*? Toujours est-il, Gould-Decauville *et al.*, (1998) spécifiaient à la fin du dernier siècle que de 30% à 40% des retours des ventes par correspondance sont dus à une mauvaise taille.

1.1.8 Changement de millénaire: utilisation des technologies et mise à jour des données anthropométriques

Plusieurs grandes entreprises du monde entier se sont regroupées (avec ou sans organismes gouvernementaux) avant la fin du XXème siècle et ont profité des nouvelles technologies pour mettre à jour des mesures anthropométriques et des standards: l'Asie, l'Europe et les États-Unis utilisèrent des cabines 3-D pour scanner les corps de milliers de volontaires de tous âges.

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[19] [TC]2. (2004). Size USA The US National Size Survey. Consulte le 18 mars 2004, http://www.tc.2.com/what/sizeusa/index.html

Notons :

- 1992 à 1994 au Japon ;
- 1999 à 2002 en Grande Bretagne (UK) ;
- dans les mêmes années, l'étude du *"Civilisation Europeen American Surface Anthropometrie Ressources"* (*CEASAR*);
- 2002-2003 aux États-Unis par la *Textile and Clothing Technology Corporation [TC]*^{2};

et toujours dans la même période en Europe sous la gouvernance d'Eurotaille où la phase de la collecte des mesures terminée, on pouvait lire:

> « ... nous entrons dans une nouvelle phase liée aux traitements statistiques afin de valoriser ce patrimoine et établir les nouveaux barèmes de taille mais aussi satisfaire les besoins de nombreux secteurs industriels et de biens de consommation afin qu'ils adaptent au mieux leurs produits à leur marché. Les premiers résultats sont prévus pour janvier 2006. »[20]

Rien ne semble toutefois avoir été écrit sur les résultats des mesures d'Eurotaille ou de *[TC]*^{2} dont nous avons obtenu copie des données anthropométriques et démographiques.

1.1.9 Les standards de l'Office des normes générales du Canada

Près de chez nous, depuis plusieurs décennies, l'Office des normes générales du Canada (ONGC) participe à la production de normes et publie des chartes de données copiées des standards américains :

> « Les principaux buts étaient entre autres d'encourager et de promouvoir la normalisation volontaire comme un moyen d'améliorer l'économie nationale, d'aider le consommateur et de faciliter le commerce car ces mesures représentent presque toute la population féminine adulte »[21].

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[20] Institut français textile-habillement, Synthèse Textile-Habillement No 10 Juillet 2005, page 6, Le journal des professionnels du textile et de l'habillement.
[21] OGNC, CAN/CGSB-49.203-M87, avant page, 2eme paragraphe

À notre étonnement, ces standards ont été développés à partir des mesures issues du *WMGPC* de 1939-1941. À cet effet il est écrit :

> « Les données sur les mesures qui ont servi de base au système des tailles de vêtements pour dames ont été prises il y a quelques années sur environ 10 000 femmes américaines* âgées de 18 à 80 ans. »
>
> *Les mesures du corps destinées à la confection de vêtements et à l'établissement de patrons furent prises en 1939 et 1940 dans le cadre d'un projet subventionné par le gouvernement américain. La publication intitulée « *Miscellaneous Publication No. 454* » du Ministère de l'Agriculture des États-Unis renferme une description de ce projet.[22]

On peut aussi y lire que :

> « ...seules les tailles présentant le plus grand intérêt commercial ont été retenues. »[23]

1.1.10 **Miscellanées**

La standardisation des tailles des vêtements de prêt-à-porter a fait l'objet de nombreux textes scientifiques. Certains auteurs partent du corps humain et traitent des mesures anthropométriques. Rasband (1994) et Beazley (1996) expliquent comment les prendre et comment construire une charte de tailles. D'autres ont comparé les chartes entre elles ou opté pour établir une nouvelle façon de préparer les chartes standards (Ashdown, 1997, Campbell et Horne, 2001). D'autres encore se sont intéressés à la perception que les femmes ont de l'étiquetage par tailles (Lennon, 2002) et de l'information contenue sur ces étiquettes de taille (Chun-Yoon et Jasper, 1996). Certains prétendent enfin depuis quelques décennies que les chartes de mesures doivent être revues au moins tous les 10 ans parce que les silhouettes des femmes ne sont pas constantes dans le temps (Brunn, 1983 dans Workman et Lentz, 2000). Ils disent de plus qu'il est nécessaire de « réévaluer » la silhouette et ses mesures pour assurer le meilleur ajustement possible (Anderson, Brannon *et al.*, 1998).

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[22] ONGC : CAN/CGSB-49.201-92, p3, #7.1
[23] OGNC : CAN/CGSB-49.203-M87, p.1, par.#1.

Marks and Spencer de Grande-Bretagne se fait un point d'honneur de mesurer 6 000 consommateurs tous les 15 ans pour actualiser ses chartes de tailles (Tait, 1998, dans Workman et Lentz, 2000). Selon DesMarteau (2002), utiliser de nouvelles technologies est la tendance clé. Whitestone et Robinette (1997) abondent dans le même sens:

> *"If clothing and equipment designers can combine 3-D data collection technology with computer modeling and simulation software, anthropometry will leap into the 21st century."*[24]

Néanmoins, précisent-elles, le *3-D* peut être un outil de travail intéressant en autant que l'on ne se perde pas dans l'accumulation de mesures en grand nombre.

Cette première partie de la littérature dresse l'éventail des événements historiques depuis le commencement de la production de masse dans l'industrie du vêtement prêt-à-porter. C'est une perspective macro-industrielle des campagnes de mensuration, des standards, des chartes de tailles et de leur gradation.

Les pages qui suivent montrent la relation entre les données anthropométriques et l'étiquette des tailles, en passant par les chartes de tailles et leur gradation. Comment les donneurs d'ordres s'y prennent-ils pour déterminer leurs standards?

À partir de quelles données anthropométriques issues de sondages nationaux, de clientèle cible, de prototypes, de mannequins vivant déterminent-ils leurs standards? Comment font-ils pour acheminer leurs spécifications aux fabricants? Enfin, comment et sur quoi se fondent-ils pour chiffrer les informations inscrites sur l'étiquette des tailles? Une perspective que l'on qualifierait de micro- industrielle.

Nous verrons ensuite comment la clientèle évalue et apprécie le prêt-à-porter. Enfin, nous identifierons les propositions actuelles et les solutions de rechange à l'étiquetage par tailles.

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[24] Whitestone and Robinette from *Melzer and Kirk W. Moffitt (...)Head-Mounted Displays: Designing for the User, chapter 7,Ch8,* section 8,4 online: http://www.hec.afrl.af.mil/HECP/Card5.shtml

1.2 La « bonne » taille: un regard micro- industriel

> « La mode a deux visages: l'un est créateur, flamboyant, exhibitionniste, spectaculaire; l'autre est technique, rigoureux, précis, savant. Le premier a un côté artiste, tantôt fou, tantôt sage. Le second a un côté maître, toujours réservé, le plus souvent méconnu. »[25]

Le second visage de la mode, technique, rigoureux, précis et savant, mérite d'être connu davantage.

Depuis plusieurs années, certains auteurs ont écrit sur la façon de prendre les mesures corporelles et sur celle de préparer les chartes de gradation. Beazley a écrit et publié trois articles à la fin des années 90 pour guider les académiciens et les gens de l'industrie (Beazley, 1997-98-99). Ces articles décrivent les étapes à suivre depuis la prise des mesures jusqu'à l'étiquetage des vêtements par tailles. Le lecteur en appréciera le synopsis ci-dessous.

1.2.1 Des mesures anthropométriques à l'étiquette des tailles

Pour en arriver à étiqueter les vêtements par tailles, il faut d'abord déterminer ce qui caractérise la population à habiller et en prélever un échantillon; après quoi, les sujets de l'échantillon sont mesurés. Beazley (1997-98) détaille tous les outils nécessaires, identifie les points de mesures et explique la technique pour les prendre.

Les mesures anthropométriques prises sont enregistrées dans une banque de données informatisée. La connaissance des gens du milieu et des outils statistiques permettent de répartir par groupes les sujets dont les mesures sont similaires. L'auteur (Beazley, 1997) suggère de prendre les quatre points de mesure suivants: la hauteur du sujet ainsi que les tours du buste, de la taille et des hanches aux points de mesure les plus grands.

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[25] Poitras, L'art de la mode, dessin de patrons (1992), p. 7, 1er paragraphe, les éditions Le Griffon d'argile, Québec, 287 pages.

Dans un premier temps, elle explique comment diviser l'échantillon selon la hauteur. Elle énonce à priori qu'il y aura trois groupes de sujets comme certains standards nationaux le prévoient. Elle évalue ensuite la moyenne et l'écart-type des données de cette variable. Elle harmonise ses résultats en ne conservant que les valeurs à moins de deux écarts-types de la moyenne, ce qui comprend 95% de la population. Elle élimine ainsi les mesures extrêmes qui peuvent causer de la distorsion et elle obtient une distribution normale. Dans son exemple, la hauteur moyenne est de 165cm et l'étendue est de 30cm. Divisée par trois, l'étendue donne un intervalle de 10cm dans chacun des trois groupes *short, medium* et *tall*. L'auteure ajoute qu'il peut être intéressant de calculer le percentile pour chacun des trois groupes. Elle enrichit en mentionnant qu'il est facile, voire intéressant, de comparer ces résultats à ceux d'un échantillon national (voir Tableau 1.1 et 1.2).

Tableau 1.1 : "Comparison of height control measurements to establish size dimensions and intervals"[26]

1996 Survey of Students: Range 30cm: size intervals 10cm							
Size code		*Short*		*Medium*		*Tall*	
Range	*150*		*160*		*170*		*180*
Central size		*155*		*165*		*175*	
1988 CDT Dept: Range 30cm: size interval 4in. /10cm							
Size code		*Short*		*Medium*		*Tall*	
Range	*146*	*155, 5*		*164, 5*		*173, 5*	
Central size	*151*		*160*		*169*		
Recommended height sizes: Range 30cm							
Size code		*Short*		*Medium*		*Tall*	
Range	*150*	*155, 5*		*164, 5*		*173, 5*	
Central size	*151*		*160*		*169*		

La même méthode est appliquée pour séparer par groupes, les mesures des tours du buste ainsi que celles des tours de la taille et des hanches. Les mensurations ainsi obtenues sont comparées à celles des tailles commerciales. Il semblerait acceptable, selon les résultats, d'identifier un vêtement ayant 86cm de tour de buste par une taille de grandeur 12. Il faut ensuite établir pour cette taille commerciale de grandeur 12 à quoi correspond sa mesure du tour de taille et sa mesure du tour des hanches.

[26] Extrait de la "chart 5" présenté par Beazley (1997) p. 266

Elle développe ensuite la charte des tailles en augmentant et en diminuant de quelques cm à la fois les mesures aux points retenus par intervalles réguliers.

Tableau 1.2 : Table de mesures selon Beazley[27]

	Short 155 cm			*Medium 165 cm*			*Tall 175*		
"Size"	*8*	*10*	*12*	*8*	*10*	*12*	*8*	*10*	*12*
Buste (+4)	*78*	*82*	*86*	*78*	*82*	*86*	*78*	*82*	*86*
Taille (+4)	*60*	*64*	*68*	*60*	*64*	*68*	*60*	*64*	*68*
Hanches (+4)	*88*	*92*	*96*	*88*	*92*	*96*	*88*	*92*	*96*

Il est important de rappeler, selon Beazley (1997), que rares sont ceux qui utilisent les méthodes statistiques (comme celles-ci) pour développer leurs chartes de tailles. C'est pourquoi les manufacturiers, affirme-t-elle, préfèrent des intervalles réguliers et constants. Elle précise toutefois qu'un tel intervalle ne devrait pas dépasser quatre à cinq cm, car il serait disproportionné. Le nombre de tailles est déterminé pour être le plus utile à la fois aux manufacturiers, aux détaillants et aux consommateurs. Les vêtements dessinés sont transposés en patrons selon les mesures du standard à habiller. Le patron est ensuite gradué pour satisfaire les mesures de la charte de standard établi selon l'expérience et le jugement de la personne qui s'occupe de la gradation. Chaque manufacturier commence avec un *master-size pattern*[28]. Une fois l'échantillon terminé, il est ajusté sur un mannequin inerte ou sur un mannequin vivant.

Bien que cette méthode semble intéressante, Merzer and Moffitt (1997) la qualifie de « *the impossible dream* »[29]. Ils prétendent qu'une approche statistique semblable ait des lacunes. Ils s'élèvent d'abord contre l'utilisation de la moyenne. Ils reprennent l'exemple amusant de Damon, Stoudt et McFarland de 1966, qui expliquent que si l'ouverture d'une porte était établie en fonction de la hauteur moyenne de la population, elle serait trop

[27] Extrait du tableau "table 8" présenté par Beazley (1997) p. 275
[28] Price et Zamkoff, 1996 expression lue et traduite par l'auteur de ce document à la page 6, 2ème paragraphe.
[29] Melzer and Moffitt (1997)."The head-mounted display (HMD) provides the user, *Ch #7 Head-Mounted Displays: Designing for the User*."#7.2.1

basse pour 50% de cette population. Qui plus est, ajoutent-ils, aucune personne n'a des mesures moyennes en tous points, ce qui remet en question l'utilisation des percentiles. La méthode statistique des percentiles peut être utile lorsqu'il est question d'une seule variable :

> *"Percentiles are univariate (one variable) statistics that indicate the relative location of a value for a variable with respect to the distribution of values for more that variable."*[30]

À partir du moment où il y a plus d'une variable comme par exemple la taille, les hanches, les cuisses et de l'entrejambes, il est peu probable que toutes ces mesures prises sur une même personne puissent se situer dans le même percentile (Robinette and McConville, 1981). Zehner *et al.*, (1992) cités dans Melzer and Moffitt, 1997, ont démontré dans leur recherche que le pourcentage d'individus, de ceux qui sont initialement entre le 5ème et le 95ème percentile, décroît avec l'augmentation des variables (voir Figure 1.2).

HEAD LENGTH	*90% OF POPULATION*
HEAD BREADTH	*82% OF POPULATION*
PUPIL TO VERTEX	*78% OF POPULATION*
FACE BREADTH	*69% OF POPULATION*
FACE LENGTH	*63% OF POPULATION*
EAR TO VERTEX	*57% OF POPULATION*

Figure 1.2 : Pourcentage décroissant en fonction du nombre de variables[31]

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[30] Melzer.and Moffitt (1997)."The head-mounted display (HMD) provides the user, *Ch #7 Head-Mounted Displays: Designing for the User*." #7.2.1., page 3.

[31] Sources: "*Figure 1 show the actual percentage of people who are within the 5th and the 95th percentile range for up to six head and face measurements*." Whitestone et Robinette p. 3. Extrait de la *Figure 1*.

Contrairement à ce que mentionne Beazley (1997), Whitestone et Robinette (1997) croient que cette méthode statistique est largement utilisée justement parce qu'elle est relativement simple et à tout le moins beaucoup moins complexe que d'autres méthodes d'analyse de données. Elles croient aussi que cette méthode statistique donne l'impression d'accommoder un grand pourcentage de la population.

Scholfield et LaBat (2005) soulignent toutefois dans une étude récente que la gradation est apparue plus d'un demi-siècle avant la prise des mesures anthropométriques en 1939. Même s'il y a des façons de faire comme celles mentionnées plus haut, les manufacturiers développent leurs chartes de tailles selon leurs connaissances, nonobstant les sondages sur les mesures anthropométriques. Ils croient connaître leur clientèle mieux que qui que ce soit... et ce, depuis plus d'un siècle.

Scholfield et LaBat (2005) ont comparé les chartes de tailles et l'étendue des mesures de plus de 40 détaillants, compagnies de patrons, etc., de 1893 à 2000. Le nombre de tailles et l'étendue des mesures variaient considérablement de l'un à l'autre.

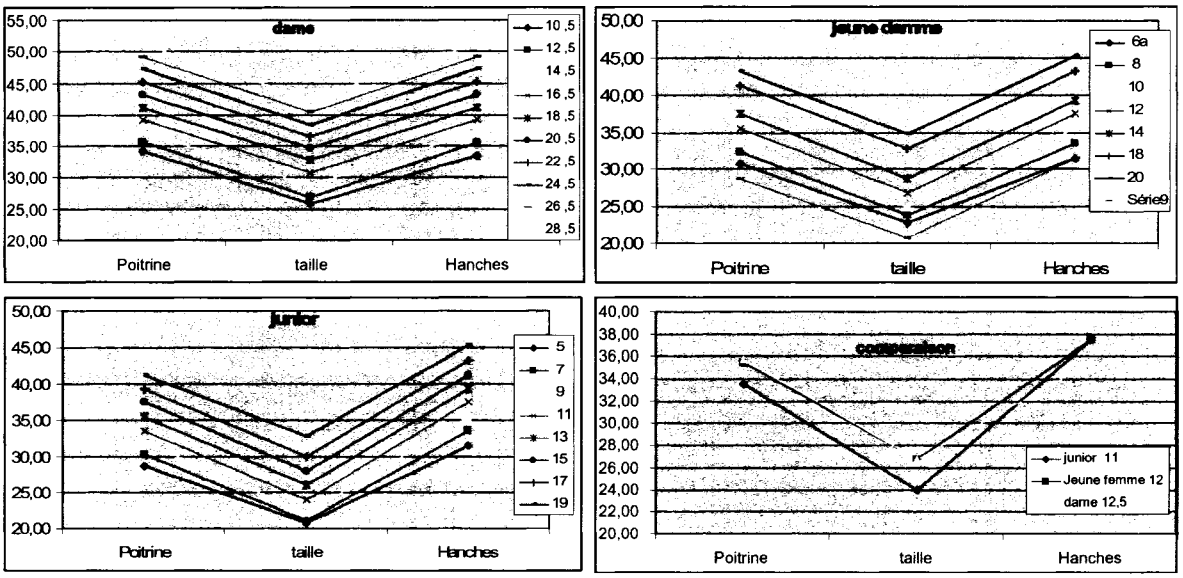
On peut lire en 1894, que le *Ladies Standard Magazine* proposait quatre tailles dont la mesure du buste variait de 29 à 33 pouces. En 1908, *Ladies Tailor Made* offrait 17 tailles dont la mesure de buste variait de 21 à 50 pouces. Le *Sears, Roebuck and Co. 1902 Catalogue*, offrait cinq tailles pour des mesures de buste qui variaient de 30 à 38 pouces. Le *Sears, catalogue* de l'an 2000, offrait enfin neuf tailles pour une valeur de buste de 31 à 43 pouces.

Voici quelques tableaux (Tableaux 1.3 à 1.9) non exhaustifs des tailles couramment offertes sur le marché du prêt-à-porter avec certains le buste (poitrine), la taille et les hanches comme points de mesures en référence ainsi que de quelques représentations graphiques.

Tableau 1.3 : Résumé des tailles (ONGC)

Tailles Office des normes générales du Canada		Circonférence			Hauteur taille taille courte		Hauteur taille taille longue	
		Poitrine	taille	Hanches	jambe courte	jambe longue	jambe courte	jambe longue
Junior	5	28 ¾	20 ¾	31 ½	37 ¾	40 ½	39	41 ¾
	7	30 ¼	21	33 ½	37 ¾	40 ½	39	41 ¾
	9	32	22	35 ½	37 ¾	40 ½	39	41 ¾
	11	33 ½	24	37 ½	37 ¾	40 ½	39	41 ¾
	13	35 ½	26	39 ¼	37 ¾	40 ½	39	41 ¾
	15	37 ½	28	41 ¼	37 ¾	40 ½	39	41 ¾
	17	39 ¼	30	43 ¼	37 ¾	40 ½	39	41 ¾
	19	41 ¼	32 ¾	45 ¼	37 ¾	40 ½	39	41 ¾
Jeune femme	6	30 ¾	22 ¾	31 ½	37 ¾	40 ½	39	41 ¾
	8	32 ¼	23 ¾	33 ½	37 ¾	40 ½	39	41 ¾
	10	33 ¾	24 ¾	35 ½	37 ¾	40 ½	39	41 ¾
	12	35 ½	26 ¾	37 ½	37 ¾	40 ½	39	41 ¾
	14	37 ½	28 ¾	39 ¼	37 ¾	40 ½	39	41 ¾
	16	39 ¼	30 ¾	41 ¼	37 ¾	40 ½	39	41 ¾
	18	41 ¼	32 ¾	43 ¼	37 ¾	40 ½	39	41 ¾
	20	43 ¼	34 ¾	45 ¼	37 ¾	40 ½	39	41 ¾
Dame	10 ½	34 ¼	25 ¾	33 ½	37 ¾	40 ½	39	41 ¾
	12 ½	35 ¾	26 ¾	35 ½	37 ¾	40 ½	39	41 ¾
	14 ½	37 ½	28 ¾	37 ½	37 ¾	40 ½	39	41 ¾
	16 ½	39 ¼	30 ¾	39 ¼	37 ¾	40 ½	39	41 ¾
	18 ½	41 ¼	32 ¾	41 ¼	37 ¾	40 ½	39	41 ¾
	20 ½	43 ¼	34 ¾	43 ¼	37 ¾	40 ½	39	41 ¾
	22 ½	45 ¼	36 ½	45 ¼	37 ¾	40 ½	39	41 ¾
	24 ½	47 ¼	38 ½	47 ¼	37 ¾	40 ½	39	41 ¾
	26 ½	49 ¼	40 ½	49 ¼	37 ¾	40 ½	39	41 ¾
	28 ½	51 ¼	42 ½	51 ¼	37 ¾	40 ½	39	41 ¾

Tableau 1.4 : Résumé (graphiques) des tailles (ONGC)



Le tableau suivant répertorie les tailles ainsi que les mesures correspondantes offertes dans un catalogue « *Sears* »[32]. Notons que la mesure corporelle qui sert de référence est en pouces.

[32] Afin de divulguer les renseignements tels qu'ils étaient, l'endroit indiqué pour prendre les mesures ainsi que la terminologie utilisée varient d'un tableau à l'autre et peuvent par conséquent sembler incohérents. Par exemple, Office des normes générales du Canada utilise «Poitrine, Taille et Hanches», le catalogue *Sears* utilise «Poitrine, Ceinture et Hanches», le catalogue *Trois Suisses* utilise «Poitrine, Taille et Bassin», etc.

Tableau 1.5 : Répertorie les tailles offertes dans le catalogue *Sears*

Tailles	*Standard 5'4"à 5' 7"*	*Petite < à 5'4"*	*Grande 5'7" à 5' 11"*	*Poitrine*	*Ceinture*	*Hanches*
TP	*4*	*4P*		*33*	*25 ½*	*36*
P	*6*	*6P*		*34*	*26*	*36 ½*
	8	*8P*	*8T*	*38*	*27*	*37 ½*
M	*10*	*10P*	*10T*	*36*	*28*	*38 ½*
	12	*12P*	*12T*	*37 ½*	*29 ½*	*40*
G	*14*	*14P*	*14T*	*39*	*31*	*41 ½*
	16	*16P*	*16T*	*41*	*33*	*43 ½*
TG	*18*	*18P*	*18T*	*43*	*35*	*45 ½*
1X	*18W*			*44*	*37*	*46*
	20W			*46*	*39*	*48*
2X	*22W*			*48*	*41 ½*	*50*
	24W			*50*	*44*	*52*
3X	*26W*			*52*	*46 ½*	*54*
	28W			*54*	*48 ½*	*56*
4X	*30W*			*56*	*50 ½*	*58*

Puisqu'il est aussi possible de se procurer par le catalogue *Sears* des vêtements de la firme française *Les Trois Suisses*, nous avons de plus préparé un tableau des tailles qu'elle offre. Dans ce cas, la référence corporelle est en centimètres.

Tableau 1.6 : Répertorie les tailles offertes dans le catalogue *Les Trois Suisses*

Taille	Poitrine	Taille	Bassin
34	78-82	56-60	84-99
36	82-86	60-64	88-92
38	86-90	64-68	92-96
40	90-94	68-72	96-100
42	94-98	72-76	100-104
44	98-102	76-80	104-108
46	102-106	80-84	108-112
48	106-112	84-90	112-116
50	112-118	90-96	116-122
52	118-124	96-102	122-128
54	124-130	102-110	128-134
56	130-136	110-118	134-140
58	136-142	118-126	140-146
60	142-148	126-134	146-152

Le portrait des tailles offertes peut sembler assez complexe. Néanmoins, nous présentons un tableau où nous avons répertorié les tailles que l'on retrouverait généralement aux États-Unis, selon certains auteurs comme Goldsberry *et al.* (1996) et Burns et Bryant (2002).

Tableau 1.7 : L'étiquetage des tailles offertes USA selon Goldsberry *et al.*, (1996)

	L'étiquetage des tailles offertes USA											
Junior	3	5	7	9	11	13	15	17				
Junior petite	3	5	7	9	11	13	15					
Misses petite			8	10	12	14	16	18				
Misses		6	8	10	12	14	16	18	20	22		
Women	34	36	38	40	42	44	46	48	50	52		
Misses Tall				10	12	14	16	18	20	22		
Half-size					12,5	14,5	16,5	18,5	20,5	22,5	24,5	26,5

Tableau 1.8 : L'étiquetage des tailles offertes aux USA selon Burns et Bryant (2002)

	L'étiquetage des tailles offertes aux USA												
Junior	1	3	5	7	9	11	13	15					
Missy		4	6	8	10	12	14	16	18				
Missy			S		M		L						
Women Large								16W	18W	20W	22W	24W	26W
Women Large								1X	2X		3X		4X
Plus sizes								1X	2X		3X		
Tall					10T	12T	14T	16T	18T				
Petite	2P	4P	6P	8P	10P	12P	14P	16P					

Voici un tableau résumé (

Tableau **1.9**) des tailles offertes selon Tailles Canada Standard, *Sears Canada inc.* et *Les Trois Suisse*, sans références corporelles.

Tableau 1.9 : Résumé des tailles offertes au Canada

Tailles Canada Standard			*Sears Canada inc.*				*Les Trois Suisses*
Junior	Jeune femmes	Dames	Petite	Standard	Grande	«Forte taille»	
			4P	4			*34*
5	6		6P	6			36
7	8		8P	8	8T		*38*
9	10	10 ½	10P	10	10T		*40*
11	12	12 ½	12P	12	12T		42
13	14	14 ½	14P	14	14T		44
15	16	16 ½	16P	16	16T		46
17	18	18 ½	18P	18	18T	18W	48
19	20	20 ½				20W	50
		22 ½				22W	52
		24 ½				24W	54
		26 ½				26W	56
		28 ½				28W	58
						30W	60

Dans chacun des cas, la silhouette en **X** est favorisée. Plusieurs auteurs (Price et Zamkoff, 1996; Auburn, Hamel et Salvas, 1992) affirment que les mesures corporelles devraient être analysées autrement pour qu'apparaissent de façon artificielle, en groupes tailles, des silhouettes sous-jacentes comme celles présentées dans la figure suivante (Figure 1.3).

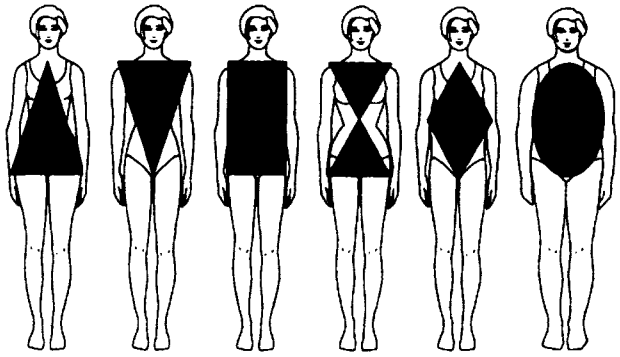


Figure 1.3 : Différentes formes de silhouettes féminines[33]

Les tailles sont importantes pour les agents commerciaux de l'industrie du vêtement, précisent Price et Zamkoff (1996) :

- les manufacturiers, pour produire des lignes de vêtements pouvant habiller le plus de personnes possible ;
- les distributeurs, pour qu'ils offrent une grande variété de tailles dans chaque style qui satisfasse une clientèle cible ;
- les consommateurs, pour qu'ils trouvent la taille leur seyant le mieux.

Whitestone et Robinette (1997) ajoutent que les vêtements devraient être essayés par une personne pendant au moins quinze minutes afin d'identifier les points d'inconfort où un ajustement est requis avant de commencer à les produire.

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[33] Source: *"Fabulous fit"*, Price et Zamkoff (1996)

Enfin, plusieurs spécialistes estiment que les progrès technologiques permettent de meilleurs résultats. Istook, DesMarteau et Robinette (1997) croient d'emblée que les industriels combinant l'utilisation de certaines technologies comme le *body scan*, le 3-D ou le *Computer Aided Design* (*CAD*), entreront dans le XXIème siècle avec un pas d'avance sur leurs compétiteurs. Le *body scan* réduit par exemple considérablement le temps de la prise des mesures (quelques secondes), sans compter son exactitude et sa précision. Grâce aux *body scanners*, les mesures sont aujourd'hui plus faciles à prélever et beaucoup plus justes ([TC]^2 2004). Les coûts peuvent être un frein à l'utilisation de telles technologies sans compter qu'il est important de ne pas se noyer dans le flot d'informations fourni par ces technologies.

Avant de présenter les solutions actuelles et les propositions de rechange à l'étiquetage par tailles, voyons comment la clientèle évalue et apprécie l'ajustement du prêt-à-porter.

1.3 La satisfaction du prêt-à-porter

Tous les efforts d'enquête et d'analyse pour développer les standards démontrent que certains groupes de l'industrie de la mode ont pris conscience qu'il fallait standardiser les tailles et leur étiquetage. On a surtout jusqu'ici tenté d'habiller la consommatrice de taille moyenne croyant à tort qu'on y arriverait avec un nombre restreint de tailles. On croyait que ces standards créeraient moins d'ambiguïté en identifiant mieux les tailles au bénéfice du consommateur. À l'avènement de la production de masse, on croyait satisfaire le marché dont on pensait les silhouettes homogènes.

Oldham Kind et Hathcote (2000) mentionnent que le consommateur est insatisfait du prêt-à-porter depuis vingt ans. S'il semble que les industriels du milieu fonctionnent avec leurs propres standards, qu'ils établissent souvent en fonction de l'idéal féminin de la société.

Dans notre société occidentale, l'idéal féminin est défini par une mesure des épaules égale à celle des hanches et une mesure de la taille de 9 à 12 pouces de moins que les deux précédentes (LaBat et Delong, 1990). Nonobstant les tailles, les industriels graduent de façon linéaire à partir de l'idéal féminin et cherchent à habiller une silhouette en forme de **X** (voir Figure 1.4)

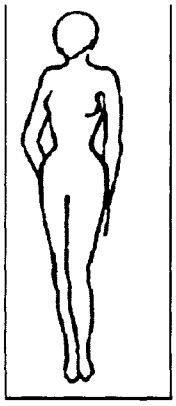

Figure 1.4 : Silhouette de femme en forme X[34]

Ces standards ont une telle influence sur les femmes, que bien qu'insatisfaites, elles ont tendance à se blâmer elles-mêmes lorsque le vêtement ne leur va pas, au lieu de blâmer les manufacturiers (LaBat et Delong, 1990). Qui plus est, il semble que lorsqu'elles magasinent, les femmes suivent certaines démarches (ou modèles) bien précises selon le type d'achat et consciemment ou inconsciemment, elles cherchent un vêtement qui leur fera ressembler à l'idéal féminin.

Différents modèles pour différents types d'achat : l'achat en magasin pour les vêtements intimes se fait d'une certaine manière selon Hart et Dewsnap (2001), l'achat par catalogue suit un modèle bien précis selon Gaal et Burns (2001) et l'achat de prêt-à-

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[34] Source: C'est moi, ma personnalité, mon style, Hamel et Salvas (1992)

porter en magasin se fait selon un autre modèle d'après Eckman et Kadolph (1990). Les grandes lignes du modèle d'Eckman et Kadolph (1990) pour l'achat en magasin ressemblent en beaucoup de points aux étapes vues lors de notre projet de maîtrise (Faust, 2003).

Même si Eckman et Kadolph (1990) mentionnent que leur recherche est légèrement biaisée en ne tenant compte que d'un certain type de magasin, elle est intéressante, car elle présente les critères que la consommatrice utilise pour évaluer un vêtement. Leur modèle d'achat en magasin décrit les étapes et les critères que la cliente suit pour évaluer un vêtement prêt-à-porter depuis l'instant où elle entre en magasin. Leurs nombreux critères décisionnels principalement définis en deux étapes sont les suivants :

- la première étape est dite d'intérêt et regroupe quatre variables esthétiques, soit :
    - la couleur;
    - le patron;
    - le style;
    - le tissu.
- la cliente intéressée, passe à la seconde étape, l'essayage, qui comprend deux variables esthétiques, soit :
    - le style;
    - l'apparence;
    - ainsi que l'étape de l'ajustement, une variable de performance ou de qualité.

Cette deuxième étape permet enfin d'évaluer l'harmonie du vêtement avec la silhouette. On sous-entend ici une détermination spécifique à plusieurs points de mesure, comme la taille. Cette étape est cruciale pour l'acceptation ou le rejet du vêtement. La décision finale du processus d'achat arrive en troisième lieu (voir Figure 1.5).

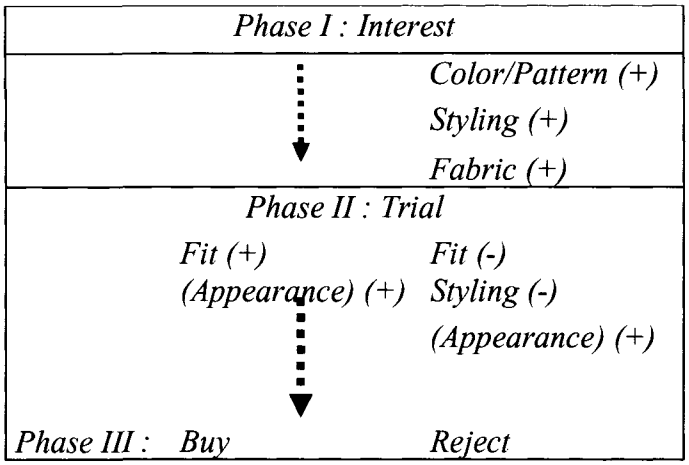

Figure 1.5 : Modèle d'achat en magasin[35]

La satisfaction est un construit multidimensionnel complexe largement étudié avec différentes théories tant dans l'industrie en général que dans le prêt-à-porter (Campbell et Horne, 2001).

Shim et Bickle (1993) définissent ainsi la satisfaction :

> *"a determination of whether the outcomes associated with the use of a product/service reached expected levels or standards of performance[36]"*
>
> *"an outcome of purchase and use from the buyer's evaluation of the rewards and costs of the purchase in relation to the anticipated consequences"*[37]

[35] Source : Model of in-store apparel purchase decision process, de Eckman et Kadolph (1990), p.20. Figure 1
[36] Conant, Brown et Mokwa, (1985)
[37] Churchill et Surprenant (1982)

Selon Swan & Combs (1976), repris dans l'étude de Campbell et Horne en 2001, ce construit multidimensionnel permet d'évaluer la satisfaction que procure un vêtement selon sa performance en provoquant une réaction émotionnelle des consommateurs ou grâce à son aspect physique (la théorie dite de Renoux (1973) signalée dans Oldham Kind et Hathcote (2000)). Otieno (2000), établie que la satisfaction ou l'insatisfaction résulte de l'évaluation des produits en fonction d'une norme ou d'un standard :

"*Normative expectations are what the costumer thinks the product ought to be in terms of specific elements such as size and colour*" (Stanforth and Lennon, 1998, cité dans Otieno, 2000)[38]. Quand les attentes d'un client sont satisfaites ou lorsque le vêtement va au-delà de ses attentes, il en est satisfait (Otieno, 2000).

La satisfaction entraîne des achats répétés, une certaine loyauté et une fidélisation à la marque (Oldham Kind et Hathcote, 2000) tandis que l'insatisfaction provoque des plaintes. Les insatisfaits achèteront ailleurs, formuleront des plaintes, exprimeront leur mécontentement à d'autres consommateurs, retourneront les vêtements Otieno (2000). Anderson *et al.*, (2001) disent qu'un bon ajustement est un critère important de satisfaction des femmes dans le choix de leurs vêtements et que la mauvaise taille est la raison première des retours. Le bon ajustement peut être difficile à trouver (McVey, 1984, cité dans Workman, 1991). Il faut essayer (Goldsberry *et al.*, 1996), voire porter le vêtement durant une période d'au moins quinze minutes (Withestone et Robinette, 1997).

Workman (1991), Lennon (1992), Goldsberry *et al.*, (1996), Chun-Yoon et Jasper (1996), Ashdown (1997), Horne *et al.*, (1999), Yoo, Khan et Rutherford-Black (1999), Otieno (2000), Oldham Kind et Hathcote (2000), Campbell et Horne (2001), Anderson *et al.*, (2001), Yertutan (2001), Schofield et LaBat (2005) estiment qu'avec les standards définis actuellement, beaucoup de segments sont négligés, voire laissés pour compte (Yoo, Khan et Rutherford-Black, 1999).

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[38] Otieno (2000), The role of Garment sizing in creation of consumer satisfaction: Indications from focus group responses, p. 326, paragraphe 3.

Voici quelques cas recensés dans la littérature où les auteurs mentionnent un ou des segments de marché insatisfaits de l'ajustement et des tailles du prêt-à-porter.

1.3.1 **55 ans et plus**

Goldsberry *et al.*, (1996) se sont intéressés à la satisfaction des femmes de 55 ans et plus à l'égard du prêt-à-porter et ont relevé que plusieurs auteurs avaient mentionné que l'ajustement provoquait l'insatisfaction des femmes âgées. Elles citent Smarthers et Horridge (1978-79) selon qui un bon ajustement est vital au bien-être psychologique d'un individu, ainsi que Shim et Bickle (1993) qui affirment qu'un bon ajustement est un défi pour les personnes plus âgées. En vieillissant, des changements corporels apparaissent. Ils commencent vers l'âge moyen et s'accentuent avec le temps (Hoffman, 1970, dans Goldsberry *et al.*, 1996). C'est le cas de : l'épaisseur de la taille, celle des hanches, un buste affaissé, un dos arrondi et une diminution de la taille (jusqu'à 2,2cm de hauteur en moins). Les femmes âgées se soucient plus que jamais de leur apparence et pour ce faire, elles se fient aux vêtements pour rehausser leur image (Fan, Yu et Hunter, 2004).

Un cinquième de la population américaine était âgée de 55 ans et plus quand l'étude fut menée (1996). Les auteurs ont donc consulté les données des mesures anthropométriques du *WMGPC* de 1941 et celles du *PS42-70* pour voir si elles en tenaient compte. Elles mentionnent que l'échantillon du *WMGPC* était biaisé car une forte proportion des femmes mesurées étaient jeunes et célibataires et que les plus âgées y sont moins bien représentées. Goldsberry *et al.*, (1996) ont été mandatés pour mesurer et enquêter auprès de ces femmes. Plus de 6 000 femmes (6 081) âgées de plus de 55 ans ont servi à l'étude. Les chercheuses voulaient savoir si les mesures des sujets différaient des standards nationaux ainsi qu'enquêter sur leur degré de satisfaction face au prêt-à-porter.

À quelques points près, l'échantillon était démographiquement similaire à celui de la population américaine présentée par le *U.S. Bureau of Census*, (1992b).

Leurs résultats ont montré qu'il y avait des différences de mesures corporelles. La majorité des *juniors* (68%) et 76% des *juniors petites* étaient naturellement regroupées dans les tailles 9 à 13. La majorité des *misses petite* (92%) et la majorité des *misses* (69%) étaient regroupées dans les tailles 12 à 18.

Une série de tests (t-test) a montré des différences significatives entre les mesures du *PS 42-70* et celles de l'étude qu'elles menaient. Globalement, les mesures étaient plus larges.

Leurs résultats ont également montré que 70% des répondantes étaient insatisfaites de l'ajustement. La majorité (73%) avoua avoir des problèmes avec la longueur des pantalons. Un grand pourcentage (87%) d'entre elles spécifia qu'ils étaient trop longs et 46%, que la fourche ne les satisfaisait pas. De ce même pourcentage d'insatisfaites, la majorité disait les pantalons trop étroits : 62% à la taille, 86% aux hautes hanches et 70% au point le plus fort des hanches.

L'étude a aussi mesuré l'insatisfaction en fonction des tranches d'âge. L'insatisfaction générale pour les vêtements du prêt-à-porter des 55 à 64 ans est de 72% ; celle des 65 à 74 ans, de 68% et ; celle des 75 ans et plus, de 64%. Enfin, deux femmes sur trois disent devoir retoucher les vêtements prêt-à-porter.

Les manufacturiers auraient avantage à tenir compte de ce segment de marché (femmes âgées). Les auteurs écrivent que plusieurs manufacturiers ont développé des chartes de tailles standards pour des segments de marché comme les *petites*, les *tall,* ainsi que pour les femmes enceintes. Elles ajoutent que les manufacturiers auraient avantage à tenir compte de ce segment de marché (les femmes de 55 ans et plus), un segment potentiellement intéressant, estiment les auteurs (Goldsberry *et al.*, 1996).

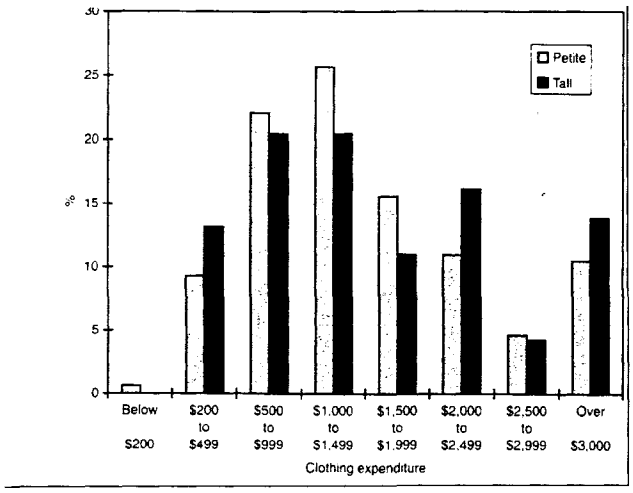

Figure 1.6 : Dépenses moyennes des *Petites* et *Tall* selon Yoo *et al.*, (1999)[39]

Au Canada, Horne Campbell et Scholz (1999) relèvent aussi que la littérature populaire fait souvent mention des caractéristiques propres aux femmes âgées et du manque d'ajustement des vêtements. Elles citent Blair (1953), Bartley et Warden (1962), Smarthers & Horridge (1978-79), Rosenblad-Wallin & Karlsson (1986), Goldsberry *et al.*, (1996) qui ont étudié les changements physiques des femmes âgées (taille plus épaisse, hanches plus larges, prise de poids,...) et les problèmes d'ajustement. Elles mentionnent qu'il est temps d'explorer le segment de marché des femmes plus âgées. Et pour justifier ce besoin de segmentation, elles reprennent la définition de segmentation suivante de Day (1990) :

> *"to identify the smallest set of groups which are: 1. identifiable so that they can be reached; 2. durable so that profit can be realised before the characteristics of the segments disappear; 3. measurable in terms of sales volume and rate of growth; 4 substantial to justify the allocation of resources to serve the segments; 5. sufficiently distinctive in their behaviour in the marketplace."*[40]

[39] Source: Yoo *et al.*, (1999), "*Yearly clothing expenditure of petite and tall women*". «Petite» et «Tall» dépensent, selon l'étude de Yoo *et al.*, (1999), pour la plupart entre 1000 $ et 1500 $ (la distribution variant de 200 $ à 3 000 $) américain par année pour leurs vêtements.

[40] Horne et al., (1999), Older females as a market segment for well-fitting clothing, JFMM, Vol. (3), p. 237, paragraphe 3.

Les Canadiennes de plus de 65 ans représentent 11,8% de la population et la proportion passera à 25% en 2036 (*Statistics Canada* 1995, in Horne et *al.*, 1999) et le volume des ventes est mesurable et considérable. Horne Campbell et Scholz (1999) spécifient que les critères de segmentation sont respectés, ajoutant que manufacturiers et détaillants auraient avantage à mieux connaître ce segment de marché particulier et lucratif. Ils doivent savoir par exemple qu'une femme âgée et petite n'a pas nécessairement les mêmes caractéristiques physiques qu'une jeune femme petite.

Ils doivent aussi savoir qu'il est faux de croire que lorsque les petites femmes âgées magasinent dans les *petites* elles sont satisfaites de l'ajustement. La raison de l'insatisfaction est probablement due au fait que les mannequins utilisés pour l'ajustement *petite* sont jeunes (Shim et Bickle, 1993).

En 1994, *l'American Society for Testing and Materials* (*ASTM*), publiait une charte des tailles standards avec les mesures corporelles de femmes de 55 ans et plus (*ASTM D5586*). C'était la première tentative pour répondre aux problèmes associés aux femmes de 55 ans et plus, disent Campbell et Horne (2001). Au-delà de 75% des mesures différaient de celles du *PS 42-70* (*Institute for Standards Research*, 1993, lu dans Campbell et Horne, 2001). En général, les mesures de la taille et des hanches étaient plus larges tandis que celles de la hauteur étaient moindres dans *ASTM D5586* que dans celles du *PS 42-70*.

Bien que ces changements fussent signalés, aucune étude n'avait encore été faite de la satisfaction des femmes pour les vêtements confectionnés à partir de ces nouvelles mesures.

Campbell et Horne (2001) ont évalué la satisfaction des femmes âgées de 55 ans et plus en appliquant la théorie de Swan & Combs (1976). Ils ont choisi de confectionner un pantalon pour évaluer la satisfaction des femmes quant à l'ajustement pour deux raisons. La première, parce que, selon Labat et DeLong (1990), la plus grande insatisfaction de l'ajustement est éprouvée avec le pantalon. L'étude de Shim et Bickle en 1993 sur la

satisfaction des achats par catalogues par les femmes de 55 ans et plus, démontrait la même chose. La deuxième raison est que c'est l'un des vêtements les plus achetés par les Canadiennes de plus de 65 ans. Les femmes choisies pour l'enquête étaient les *petites* à cause, entre autres, des résultats de Goldsberry *et al.*, (1996) cités plus haut. Ambigüe quant à la sélection de la taille, entre 14 ou 16, elles ont fait appel à différents manufacturiers pour statuer sur la taille la plus populaire. Cela donna une taille de 14 avec une largeur à la taille de 32 pouces.

Les pantalons ont été fabriqués à partir de cette base de taille de 32 pouces. Les premiers, en suivant les spécifications de *ASTM*, et les autres, suivant les spécifications de l'ONGC ; lesquelles mesures reposent sur celles du *PS 42-70*. Les participantes (n=20) ont porté les pantalons (*ASTM*) en moyenne 3,8 jours et les pantalons (ONGC) en moyenne 3,6 jours, durant une période de deux semaines.

Les résultats montrent sommairement que les femmes étaient plus satisfaites de l'ajustement des pantalons de l'*ASTM* que de celui de l'ONGC. Le pourcentage de satisfaction entre l'ajustement des pantalons de l'*ASTM* et ceux de l'ONGC sont : à la taille 80% vs 63,2% ; aux hanches, 80% vs 68,4% ; à la fourche 60% vs 38,9% et enfin ; 55% vs 63,2% pour la longueur de la jambe. Ces différences, spécifient les auteurs, ne sont pas statistiquement significatives, mais les résultats montrent une appréciation globale plus satisfaisante des mesures du *ASTM* que de celles de l'ONGC, exception faite de la longueur de la jambe.

1.3.2 **Petite et *Tall***

Le *WMGPC* de 1941 recommandait de diviser les groupes par hauteur (*short, regular* and, *long*). Cette distinction fut retenue dans le *PS42-70* mais n'a pas été grandement exploitée pour les *petites* avant la fin des années 70, voire 80. Elle est encore peu considérée aujourd'hui pour les *tall* (Yoo Khan et Rutherford-Black, 1999). Ces auteurs disent qu'on retrouve des "*petites*" dans les magasins à rayons et dans les ventes à distance par catalogue. On ne peut en dire autant des *tall*. Peu de magasins et de catalogues tiennent des vêtements *tall*. Autant les femmes de taille *petite* que celles de taille *tall* se disent insatisfaites du prêt-à-porter. Lors de leur étude, Yoo Khan et Rutherford-Black (1999) ont exploré ce qui était offert à ces deux groupes, ainsi que les raisons de l'insatisfaction des acheteuses.

Les auteurs rappellent que les standards des *petites* furent établis dans le rapport du *PS 42-70*. La hauteur des petites variaient entre 4'9'' et 5'2'' et les tailles variaient de 2P à 16P. Ces standards ont toutefois été ignorés par les manufacturiers qui ont établi les leurs en fonction de leur clientèle cible rappellent Yoo Khan et Rutherford-Black (1999). Un tableau comparatif des standards de hauteur pour les *petites* recueillis par des manufacturiers ou détaillants lors de leur étude démontre une certaine disparité entre les spécifications. D'abord, les auteurs soulignent les résultats de Pray (1987) qui allaient d'une hauteur de 4'10'' à 5'4''. Ils mentionnent aussi les standards de *Lands'End* qui vont de 4'11'' à 5'3'' et ceux de *Spiegel* qui sont définis en deçà de 5'4''. Si les *petites* étaient de 5'4'' et moins, 40% à 70% des femmes se classeraient dans les *petites* soulignent-ils. Les mêmes démarches de comparaison de hauteur ont été faites pour les *tall* dont les tailles varient de 10 à 22.

Dans chacun des cas (*petite* ou *tall*), les auteurs ont cherché à savoir dans quelle catégorie les femmes magasinent (*junior, misses, petite* ou *tall*) et quelles sont leurs insatisfactions.

Leurs résultats montrent que la majorité des *petites* (81,9%) magasinent dans les sections identifiées *petites* suivies par les sections *misses*.

Les grandes quant à elles, magasinent dans les *misses* (50,3%) ou les *tall* (39,2%). La majorité des petites magasinent dans la section *petite* car ce segment de marché est relativement bien servi par l'industrie. Il en est tout autrement pour les *tall*, raison pour laquelle elles ne magasinent pas autant (en pourcentage) dans la section *tall* (Yoo Khan et Rutherford-Black, 1999). Dans les deux cas, les deux tiers des répondantes avouent ne pas magasiner uniquement dans une seule catégorie *petite* ou *tall* et les auteurs concluent qu'elles ne sont pas entièrement satisfaites de ces catégories. Les insatisfactions sont d'abord les tailles offertes par catégorie soulignent les auteurs.

Les répondantes de la classe *petite* avaient des tailles variant de 2 à 18, tandis que celles de la classe *tall* avaient des tailles de 6 à 20. Au delà de 55 pourcent des *petites* portaient une taille 10 et plus. Selon leurs résultats, il semble plus difficile de trouver des vêtements pour celles qui sont petites et épanouies que pour celles qui sont petites et en même temps menues. Pietsch (1991) cité dans Odlham et Hathcote (2000), ajoute toutefois que les très petites (tailles 2 à 4) sont très insatisfaites de l'ajustement. À l'inverse les grandes femmes minces avaient plus de problèmes à trouver des vêtements que les grandes femmes « plus rondes ».

Par ailleurs, 67,2% des petites femmes disent être insatisfaites de la longueur des pantalons, 33% de la longueur de la fourche, 31,1% de la largeur de la taille. 80,6% des grandes disent être insatisfaites de la longueur des pantalons et 52,8% de la longueur de la fourche. Les petites femmes sont en moyenne insatisfaites de l'ajustement à 6,63 sur une échelle de sept (un étant très satisfaite et sept très insatisfaite) et les *tall* à 6,61 sur cette même échelle. Selon les auteurs, il y place à amélioration dans les deux cas pour augmenter la satisfaction.

1.3.3 Collégiennes, *petite, tall, half-size* et *average*

Oldham Kind et Hathcote (2000) continuent dans la même veine et s'interrogent sur le niveau de satisfaction des « *collégiennes* »[41] américaines. Ils mentionnent que si plusieurs entreprises (*Levi's, Maybelline*, et *Nike*) ont connu un tel succès, c'est probablement parce qu'elles ont su reconnaître ce segment de marché.

L'échantillon de leur étude comptait 358 « *collégiennes* » dont la moyenne d'âge était de 22 ans. Physiquement, elles ont un profil d'adulte avec des goûts de «jeune», mentionnent-ils. Les auteurs se sont intéressés aux trois dimensions suivantes de la théorie de Renoux (1973) pour évaluer leur satisfaction des vêtements prêt-à-porter: 1) nombre de magasins offrant des tailles spécifiques; 2) variété des tailles offertes, des couleurs, des prix, de l'ajustement, etc., et; 3) *consuming system* basé sur la satisfaction de l'ajustement quand le vêtement est porté.

Ils ont donc regroupé les répondantes en *petite, tall, half-size* et *average*, tel que défini par Diamond et Diamond en 1994. Les *petites* < 5'4'' étaient représentées à 37,7%; les *tall* > 5'8'' comptaient pour 20,9%; celles entre 5'4 ½'' qui ne faisaient pas partie du *half-size* était placées dans *l'average* et représentaient 31,6% de l'échantillon.

Leur étude démontre ainsi l'insatisfaction dans les trois tailles de l'échantillon:

1) Les fortes « *half-size* » disent être insatisfaites du nombre de magasins offrant des tailles spécialisées. Les auteurs sont surpris car ils estiment que plusieurs chaînes se spécialisent dans les grandes tailles. Ils concluent que les « *collégiennes* » n'ont peut-être pas le profil d'âge ou les mêmes goûts que la clientèle ciblée par ces chaînes.
2) Les « *half-size* », disent être insatisfaites de la variété des tailles offertes, des couleurs, des prix, de l'ajustement, etc..., ce qui, selon les auteurs, corrobore les résultats de l'étude de Chowdhary et Beale de 1988.

[41] Collégiale en terme américain

3) Les quatre groupes *petite*, *tall*, *half-size* et *average* disent être insatisfaits du *consuming system* ou ajustement du vêtement lorsque porté. Les *petite* et *tall* sont insatisfaites de la longueur des pantalons tandis que les *average* en sont relativement satisfaites. Les auteurs disent que ces résultats corroborent ceux de LaBat et DeLong (1990).

Chaque groupe était mécontent du *consuming system*, surtout de l'ajustement. Les *petite*, les *tall*, les *half-size* sont plus insatisfaites, ce qui est probablement normal, les standards étant conçus pour la moyenne (Oldham Kind et Hathcote, 2000). Les auteurs suggèrent aux manufacturiers et aux détaillants de réévaluer leur marché cible et leurs standards. Les *petite* sont nombreuses, représentant 37,7% de leur échantillon. Si leur échantillon est représentatif de la population, les manufacturiers auraient avantage à s'intéresser à ce segment de marché. Bref, comme LaBat et DeLong (1990), ils suggèrent une plus grande variété de tailles.

1.3.4 Tailles 14 et plus

Un autre segment de marché qui a suscité l'intérêt des académiciens, des manufacturiers et des détaillants est celui des tailles 14 et plus. Selon Stone, 1988 et Zetlin, 1988, (dans Lennon, 1992), un tiers des Américaines sont de taille 14 et plus. Tandis que selon Castro, 1987, Harris, 1988 (dans Lennon, 1992), il s'agit plutôt de 50%. Depuis que les manufacturiers et les détaillants reconnaissent ce segment, le nombre de manufacturiers spécialisés 14 et plus était passé de 250 en 1983 à plus de 1200 en 1988 (Stone 1988, cité dans Lennon, 1992).

L'augmentation des ventes de ce segment s'explique par celle du nombre des 14 ans et plus à cause des changements démographiques comme l'espérance de vie et un travail physiquement moins dur (Lennon, 1992). Les femmes doivent cesser de rechercher des images de beauté irréalistes et s'accepter telles qu'elles sont, croit Shan (1987), (cité dans Lennon, 1992).

Même si elles sont plus nombreuses, et que leur segment est très lucratif, les « 14 et plus » sont encore aujourd'hui, perçues d'une façon plus « négative » que les « minces » (Lennon, 1992).

Les résultats de recherche d'Otieno *et al.*, (2005) vont dans la même direction. Elles ont montré qu'en Grande-Bretagne, comme aux États-Unis, les femmes de tailles 16 et plus sont majoritairement insatisfaites des aspects suivants: de l'environnement et du visuel (là où sont présentés les vêtements de « forte taille »); du prix, car elles ont l'impression de payer plus cher; de la difficulté de trouver un vêtement « mode »; et de l'ajustement, tant de façon générale que pour des items plus prêts du corps comme le maillot de bain, la lingerie et les tenues de soirée. Selon elles, puisque les tailles « standards » sont normalement numérotées jusqu'à 14 seulement, les manufacturiers manquent une bonne occasion en passant à côté du segment de marché des grandes tailles.

1.3.5 **Les jeunes**

Une étude faite en Turquie (Yertutan, 2001) montre que la satisfaction des jeunes quant au prêt-à-porter n'est guerre plus réjouissante qu'ailleurs. Yertutan (2001) estime que les vêtements prêt-à-porter sont appréciés parce qu'ils ne sont pas très coûteux. Mais encore faut-il que l'ajustement soit satisfaisant. Lorsque des retouches sont nécessaires, tous sont perdants, mentionne-t-il.

Les filles sont généralement plus insatisfaites de l'ajustement des vêtements de prêt-à-porter que les garçons. L'étude montre que le pantalon semble être le plus problématique, tant chez les filles (74%) que chez les garçons (69%). Les points de mesures les plus difficiles à ajuster sont : longueur de la jambe (64% chez les filles et 56,8% chez les garçons); circonférence de la hanche (46,5% chez les filles et moins de 20% chez les garçons) et enfin; tour de taille (31,4% chez les filles et un peu plus de 10% chez les garçons).

Connell et Presley (2005) ont poussé plus loin leur étude avec les jeunes. Elles ont tenté de déterminer s'il y a une relation entre les formes de corps et la préférence d'ajustement (ce qu'elles appellent le « *body cathexis* ») avec les bénéfices recherchés grâce au prêt-à-porter. Leurs résultats démontrent que si les mesures étaient développées en tenant compte des préférences d'ajustement, cela aurait un effet bénéfique pour l'industrie du prêt-à-porter.

En conclusion sur l'insatisfaction, retenons sommairement que :

- selon LaBat et DeLong (1990), les femmes devraient cesser de se blâmer lorsque les vêtements ne leur font pas et plutôt blâmer les manufacturiers ;
- les femmes satisfaites de leur corps portent des vêtements plus ajustés alors que celles qui n'apprécient guère leur silhouette tendent à porter des vêtements moins ajustés (Anderson *et al.*, 2001) (voir Figure 1.7).

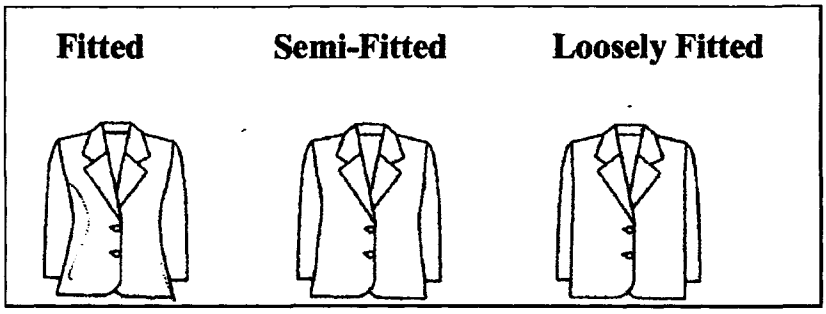

Figure 1.7 : Préférences d'ajustement[42]

La gradation et les chartes de tailles ont été définies. L'appréciation des vêtements du prêt-à-porter (de façon générale ou par segment de marché) est claire : les femmes en sont peu satisfaites. Qu'en est t-il de l'étiquetage par taille?

[42] Source: "*Understanding Fitting Preferences of Female Consumers: development an Expert System to Enhance Accurate Sizing Selection.*" Anderson (1998)

1.4 L'étiquette de vêtements par tailles

Les femmes font face à une panoplie de tailles car bien qu'il y ait des standards, les manufacturiers de prêt-à-porter développent leur propre charte de tailles qui diffère de celle de leurs concurrents. Alors que Workman (1991) croit qu'il est mieux que tous les manufacturiers n'aient pas les mêmes standards, car une même gradation ne servirait qu'une seule et même clientèle, d'autres sont d'avis contraire. "*Several attempts have been made at standardization, but the variety of sizes and body types in women's ready-to-wear has interfered with the development of standardized sizing.*" Certains soulèvent qu'il y a trop de tailles et d'autres croient qu'il devrait y en avoir plus.

Nous avons vu que le choix des mesures et celui de la taille étaient souvent faits au mieux des connaissances du donneur d'ordres et que plusieurs auteurs ont des doutes quant au bienfait de l'étiquetage par tailles. Voici quelques renseignements trouvés dans la littérature qui permettent de boucler la boucle sur l'étiquetage par tailles.

1.4.1 **Chronologie de l'étiquetage**

En 1902, le *Sears, Roebuck and Co.1902 Catalogue* des États-Unis faisait correspondre les mesures du tour du buste à l'âge (Workman, 1991). Plusieurs procédures ont depuis été développées pour obtenir des informations « scientifiques » afin de déterminer les tailles.

Parallèlement à ceci, les gens du marketing ont, au fil des ans, utilisé des chiffres de plus en plus petits pour déterminer la taille d'un vêtement dans le but de flatter la consommatrice (Workman et Lentz, 2000). Il en résulte qu'aujourd'hui, une même étiquette de taille peut avoir différentes mesures et vice versa (Otieno, 2000). Mesures pour mesures, une taille 16 en 1902 équivaut chez certains donneurs d'ordres de nos jours à une taille 8 (Workman, 1991). Il semble que les informations écrites sur l'étiquette de taille ne relève pas tant des procédures statistiques mentionnées auparavant, mais plutôt de stratégies du marketing (Beazley, 1997 ; Otieno, 2000). Plus les vêtements sont

dispendieux, diront certains, plus la taille devrait être petite. Mais, la consommatrice ne peut s'y retrouver, puisque la taille inscrite sur l'étiquette ne contient aucune information quant aux mesures (Workman et Lentz, 2000).

Une telle façon de faire ne sert guère. Au contraire, les clientes en sont frustrées (Goldsberry *et al.*, 1996). Sans compter que cela fait perdre du temps, tant au consommateur qu'au distributeur (Yoo, Khan et Rutherford-Black, 1999).

1.4.2 L'étiquetage par tailles ne joue pas son rôle initial

L'étiquetage des vêtements par tailles est une information complémentaire appréciée des consommateurs pour l'aider à choisir la bonne taille, écrivions-nous au début. Les citations suivantes permettent de croire que cet étiquetage aurait avantage à être revu :

> "*Petite / tall-sized clothing needs to improve labelling to help the customers in selecting correct size clothes in order to save time and minimise frustration: body dimensions need to be disclosed on the label.*"[43]

> "*We believe that a size-labelling system that would allow consumers to visually identify – within seconds – the size of a garment would facilitate the selection and purchase of garments.*"[44]

> "*A new coding system could be established to identify the garments specifically tailored for older women within each figure type. The industry also needs to standardized figure type categories which marketers and consumers could understand and use effectively.*"[45]

> "*In marketing the products, the new labelling code must be sensitively selected and marketed in a positive manner not to be demeaning in any way to the older female consumers.*"[46]

> "*More research needs to be done on the topic of anthropometric size labels... An anthropometric size label could accurately communicate to the consumer expend size options as well as an expend range of sizes.*"[47]

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[43] Yoo, Klan et Rutherford-Black, 1999, p. 231.
[44] Chun-Yoon et Jasper, 1996, p. 90.
[45] Goldsberry, Shim et Reich, 1996, p. 131.
[46] Goldsberry, Shim et Reich, 1996, p. 118.
[47] Workman et Lentz, 2000, p. 258.

> "*The coding scheme required manufacturers to indicate on the size label the main body measurements that the garment was intended to fit. The focus should be on obtaining good fit as opposed to wearing a particular size.*"[48]
>
> "*Marketers may need to focus on addressing such issues as size codes, information tags...*" (Otieno, 2000).

Il en résulte que l'étiquette n'indique à peu près rien qui puisse guider la femme quant à la taille proprement dite, néanmoins, il semble que les femmes soient sensibles aux attributs apposés sur l'étiquette. Certaines personnes vont jusqu'à percevoir les femmes de petites tailles comme plus compétentes que les *« larger-sized women »*.[49]

1.4.3 Situation actuelle et propositions de rechange

Lors de la première prise de mesures, O'Brien et Shelton (1941) mentionnaient qu'il y avait peu ou pas de corrélation entre la mesure de la circonférence et la mesure de la longueur (vertical et horizontal ou encore stature et poids). Quelques études subséquentes ont montré que certaines formes de corps de femmes sont identifiables (voir Figure 1.8).

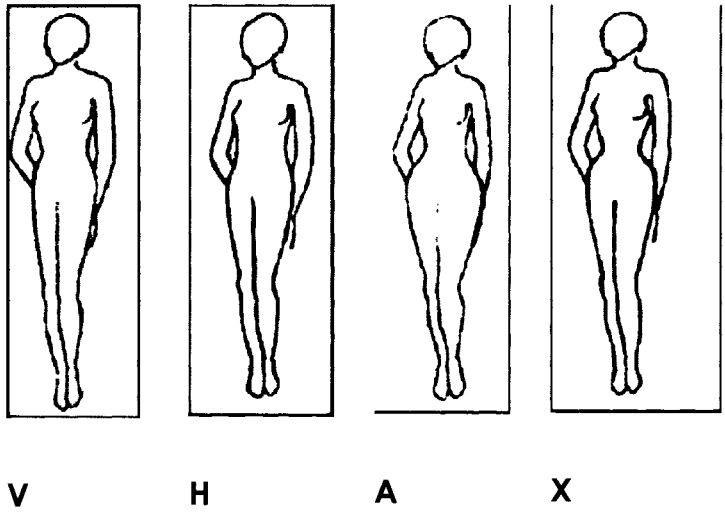

Figure 1.8 : Les formes de silhouettes de femmes V, H, A et X.[50]

[48] Workman,1991, p. 35.
[49] Rudd et Lennon, 2005, p.124.
[50] Source: *C'est moi, ma personnalité, mon style*, Hamel et Salvas (1992)

Selon certains, l'étiquetage de taille devrait avoir un pictogramme (ISO) indiquant des points de mesures en pouces ou en cm. Selon d'autres, l'étiquette devrait spécifier le type d'ajustement offert par le vêtement (Anderson, 1998). D'autres spécifient que les points de mesures devraient être identifiés et faire référence à des mesures corporelles comme c'est le cas de l'étiquetage des vêtements pour hommes (Goldsberry *et al.*, 1996). Ces derniers soulignent l'importance d'une étiquette pertinente et facile à lire. Chun-Yoon et Jasper (1996), rappellent que l'étiquetage d'entretien, lui, est facilement lisible « décodable » nonobstant la langue et qu'il devrait en être ainsi pour celui de l'étiquetage par taille.

ISO offre une multitude de codes pour classifier les normes internationales en vigueur reliées aux tailles (Guide pratique des tailles dans 36 pays).

Voici certains pictogrammes développés.

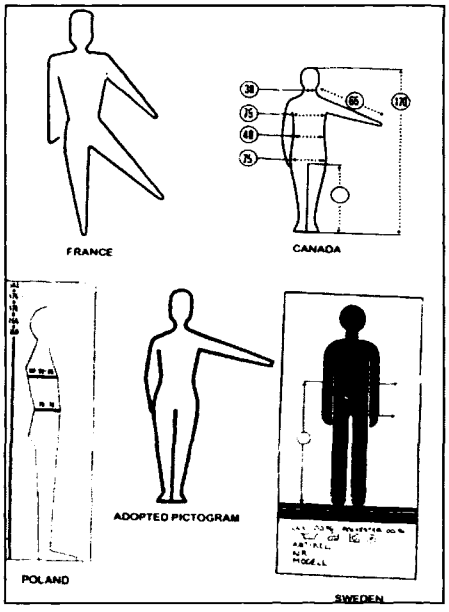

Figure 1.9 : Pictogrammes pour l'étiquetage par tailles[51]

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[51] Source: *Clothing Sizes International Standardization*, Winks (1997), p. 45

Un bon étiquetage de tailles devrait enfin permettre de mieux orienter le consommateur (Yoo-Khan et Rutherford-Black, 1999). Il faut faire attention à la terminologie utilisée pour présenter les tailles, car les femmes ont une perception négative et une tendance à juger sévèrement les autres femmes de tailles plus épanouies. Enfin, comme le rappel Ashdown (1998), les femmes ont l'habitude de trouver « leur » grandeur à l'aide des cinq ou six choix possibles. La consommatrice non initiée pourrait trouver l'étiquetage avec mensurations inutilement trop complexe (Ashdown, 1998).

Dans les pages qui suivent nous tenterons de trouver plus d'information sur l'étiquetage actuel (information pragmatique). Puisque cette thèse est une thèse par article nous reprendrons certains éléments mentionnés dans cette revue de la littérature et nous validerons en différentes étapes les points qui nous semblent importants relevés dans cette partie de la littérature.

CHAPITRE 2 : MÉTHODOLOGIE

De l'empirisme à l'exercice en bibliothèque, en passant par l'analyse de notre recension de la littérature dans les revues académique, nous retenons que la gradation des tailles des vêtements est une opération délicate et souvent aléatoire. Le résultat : l'étiquetage ne semble pas guider la cliente vers un vêtement lui seyant le mieux. Les documents consultés montrent que l'approche actuelle de gradation fixe *a priori* des normes et les transmet aux différents acteurs. Le strict respect de ces normes conduirait les fabricants à n'habiller que les personnes de taille et de silhouette « standards ».

Voilà probablement la raison pour laquelle les donneurs d'ordres n'ont, plus souvent qu'autrement, pas tenu compte de ces normes dans le passé et qu'ils ont gradué et étiqueté sans poursuivre d'autre objectif que de satisfaire leur propre clientèle, laissant la consommatrice se débrouiller dans un dédale de mesures différentes identifiées par les mêmes tailles. Cette situation relatée dans la littérature et que nous avons observée, nous confortait dans notre conviction de l'importance d'une recherche sur le sujet.

Notre recherche explore donc la voie de la gradation et de l'étiquetage. Notre objectif était de proposer un modèle structuré pour modifier, moderniser, voire métamorphoser, la manière d'établir la gradation (si cela s'avère possible) et l'étiquetage des tailles. Ce modèle est issu d'une approche itérative. Nous avons concentré notre recherche sur une population et un type de vêtement que sont les femmes nord-américaines et les pantalons les habillant. Voici la méthodologie de notre recherche :

1. décrire de façon détaillée la problématique retenue ;
2. énoncer l'objectif recherché et le but souhaité ;
3. développer et proposer un nouveau modèle de gradation (dans la mesure du possible) et d'étiquetage ;
4. valider le nouveau modèle proposé ;
5. conclure sur ce modèle et énoncer des pistes de recherches ultérieures.

2.1 Décrire de façon détaillée la problématique retenue

L'étiquetage de taille ne semble pas guider la cliente vers le vêtement lui seyant le mieux. La méthode de gradation et de l'étiquetage doit donc être repensée. L'étude en bibliothèque nous a en effet montré que la gradation et l'étiquetage des tailles des vêtements est une opération délicate dont le résultat ne semble pas guider adéquatement la cliente.

Nos lectures révèlent que les donneurs d'ordres ont décidé leur gradation très tôt. À cause de la disparité des tailles offertes, ils ont établi des standards pour aider tant à graduer qu'à faciliter les échanges commerciaux. Ces standards offraient, et offrent toujours, un choix limité de tailles. Certains donneurs d'ordres ont préféré leurs méthodes de gradation aux standards établis, cherchant à satisfaire leur clientèle cible. Notons que ces standards ont été élaborés il y a plus de 60 ans et que, selon plusieurs, ils sont désuets.

La recension des écrits montre que certains vêtements comme le pantalon féminin sont plus difficiles à ajuster. Nous avons donc validé notre modèle auprès d'une population féminine en utilisant le pantalon. Une abondante littérature (qu'elle provienne du domaine de la gradation ou celui de la satisfaction de la clientèle) précise par ailleurs les points de mesures critiques à la gradation du pantalon et, par conséquent, nous en avons tenu compte.

2.2 Énoncer l'objectif recherché et le but souhaité

Notre objectif étant d'améliorer la situation qui perdure, nous avons développé et proposé un nouveau modèle d'étiquetage qui donnera suffisamment d'information aux clientes pour qu'elles identifient rapidement le pantalon leur seyant le mieux. Nous avons pour cela mesuré et analysé une série de pantalons, que nous avons comparés aux standards, aux spécifications d'un donneur d'ordres, ainsi qu'à la grandeur respective identifiée sur l'étiquette ?

Nous avons ensuite tenu compte d'une population à habiller. En fonction des points considérés critiques nous pourrons voir quelle partie de la population est habillée et si cette population a raison de ne pas s'y retrouver. Il en résulte que l'étiquetage actuel des vêtements prêt-à-porter en sera modifié, voire métamorphosé.

Nous souhaitons que ce modèle serve autant à l'Office des normes générales du Canada (ONGC) qu'aux différents intervenants de l'industrie que sont les donneurs d'ordres (manufacturiers ou distributeurs) ou les institutions de mode. Le but final est de retrouver ce nouvel étiquetage dans le commerce pour améliorer les échanges commerciaux de l'industrie du prêt-à-porter.

2.3 Développer et proposer un nouveau modèle de gradation (si possible) et d'étiquetage

Nous tentons de développer un modèle de gradation (si possible) et d'étiquetage qui tienne compte des besoins et des caractéristiques propres à l'industrie du prêt-à-porter. Pour y arriver, nous avons adopté une démarche par étapes.

Nous avons analysé ce qui est disponible sur le marché du prêt-à-porter que nous décrivons comme l'*offre*. Nous avons segmenté cette *offre* en fonction des mesures obtenues des donneurs d'ordres, pour choisir les paramètres discriminants préalablement déterminés. Nous désignons cette segmentation comme *segmentation empirique*.

Nous avons en parallèle analysé les besoins d'une population à habiller (la *population*). Nous avons désigné cette segmentation comme *segmentation théorique*.

Nous avons ensuite comparé l'*offre* à la *population*, c'est-a-dire que nous avons juxtaposé l'*offre* à la *population* pour évaluer si l'*offre* couvre effectivement la *population*.

Les grandes étapes sont définies comme suit :

- Observer et analyser l'*offre* en tenant compte du choix des paramètres discriminants ;
- Caractériser et analyser la *population* à l'aide des paramètres discriminants ;
- Comparer l'*offre* à la *population*.

De manière plus détaillée voici l'approche de chacune des étapes (les deux premières étapes ci-haut mentionnées peuvent être franchies en parallèle).

2.3.1 Observer et analyser *l'offre* en tenant compte du choix des paramètres discriminants

La littérature nous apprend que malgré les méthodes de gradation proposées et les standards actuels, les manufacturiers en font un peu à leur tête. Par ailleurs, si la gradation était déterministe (un 8 est un 8 et détermine de manière univoque les paramètres taille, hanches et longueur), alors seule la partie standard ou moyenne de la population serait habillée. Il s'agissait donc dans un premier temps, d'analyser l'*offre* dans son ensemble, c.à.d. analyser ce que l'on retrouve sur le marché. Cette étape franchie, nous devions analyser la répartition en fonction des donneurs d'ordres (*segmentation empirique*).

Pour analyser l'*offre* dans son ensemble, nous avons fait un test pilote afin de développer une méthodologie fiable et efficace de prise de mesures de pantalons. Les objectifs étaient de : (1) développer et tester la méthode de prise de mesures et de nous assurer de sa facilité d'exécution ; (2) sélectionner les outils nécessaires à la prise des mesures et ; (3) vérifier, analyser et interpréter les premiers résultats.

Le test pilote compte un échantillon de convenance d'environ 200 pantalons dont les grandeurs varient de 4 à 18. Les quatre hypothèses suivantes devaient être validées :

(1) la classification par tailles des pantalons (6, 8, 10, ...) permet aux consommatrices de s'y retrouver, c'est-a-dire que les pantalons étiquetés d'une même taille ont les mêmes mesures,

H_1: Pants identically size labeled have identical measurements;

(2) pour s'assurer d'une certaine homogénéité des mesures et s'assurer d'un certain niveau de qualité, les donneurs d'ordres fournissent des mesures de spécification qui sont respectées par les manufacturiers ou fournisseurs,

H_2: Suppliers respect the order initiators' measurement specifications;

(3) les marges de tolérance accordées aux mesures de spécifications sont telles que la gradation demeure discriminante entre deux tailles,

H_3: Tolerances allowed by order initiators do not reduce the size discriminating ability of the sizing system;

(4) les manufacturiers ne respectent pas les standards nationaux, ils conçoivent et confectionnent des pantalons selon leurs propres standards qui se rapprochent le plus de ce qu'ils croient être leur clientèle cible,

H_4: Order initiators adhere to national standards.

Ce test pilote a permis d'affiner notre méthodologie « prise de mesures » et l'interpolation des mesures. Nous avons par exemple dû interpoler les mesures pour tenir compte des différences de hauteur de la bande de taille du pantalon (taille haute ou basse). Les hypothèses furent reprises ensuite pour des fins de validation sur l'ensemble de tous les (31) styles de pantalons offerts durant une saison chez l'un des plus grands distributeurs de vêtements au Canada, et ce, pour toutes les grandeurs. Au total plus de 800 pantalons ont été systématiquement mesurés. Les hypothèses se lisent ainsi :

H_1: *Pants identically size labeled have identical measurements* (nous avons aussi regardé la dispersion *"within – within", "within – between" et "between – between");*

H_2: *Suppliers respect the order initiators' measurement specifications;*

H_3: *Tolerances allowed by order initiators do not reduce the size discriminating ability of the sizing system;*

H_4: *Order initiators adhere to national standards.*

Une fois validées ou rejetées, nous avons regardé et analysé la *segmentation empirique*, c'est-à-dire comment l'*offre* est repartie en fonction des points de mesures (les variables considérées discriminantes). D'une part, nous savions que nous pouvions faire une segmentation par grandeur (des petits formats aux plus grands formats de pantalons pour femmes plus épanouies, communément représentés, peut-être à tort, par 6, 8, 10, 12, etc.).

D'autre part, nous tentions de voir s'il était possible de segmenter l'*offre* en différents profils correspondant à différentes silhouettes (correspondant aux femmes ayant des profils de silhouettes soit en **A**, **X**, **H** ou autres) en nous basant sur des analyses taille/hanches, par exemple.

2.3.2 Caractériser et analyser la *population* à l'aide des paramètres discriminants

Étudier la population équivaut à analyser quantitativement des mesures anthropométriques (prises dans ce cas-ci de manière automatisée avec un *3D body scan*). Nous devons étudier et mesurer plus exactement les dispersions des variables critiques (les points de mesures que la littérature considère discriminants) obtenues de la banque de données. Cela terminé, il faut segmenter cette banque et si possible établir une nouvelle gradation.

Une des difficultés est de déterminer les mesures à retenir puisque, pour une première fois, il s'agit de mesures obtenues de façon automatisée. La littérature nous apprend qu'avec le *3D body scanner* il est possible d'obtenir une multitude de mesures en quelques secondes sans aucun contact physique avec la personne mesurée. Le *3D body scanner* permet certes d'obtenir une multitude de données en quelques secondes, mais certaines sont peut-être redondantes. Qui plus est, puisqu'il s'agit d'une première et puisqu'il était mentionné dans la littérature que certaines données n'étaient peut-être pas aussi précises que souhaité, nous devions nous assurer de leur validité. Pour nous assurer que les mesures obtenues étaient valides et ne retenir que certaines plus critiques (*key body measurement points*) nous avons validé les hypothèses suivantes préliminaires à notre travail de recherche pour ce qui est du *3D body scanner* et de la banque de données :

Body scanning can provide a multitude of anthropometric data yet many of them are useless for the pants specifications, moreover:

H_1: *Numerous measurements obtained through body scanning technology are duplicates and therefore of limited use in the determination of size standards;*

H_2: *Numerous measurements obtained through body scanning technology reflect false or unreliable readings of the body;*

Nous avons ensuite formulé et validé une série d'hypothèses liées à notre recherche.

H_3: *Height, weight and circumference measurements are not correlated;*

H_4: *It is possible to classify the entire female population on two circumference measurements: hip and waist;*

H_5: *Although women can be classified on three basic silhouettes, the number of classes needed to cover the entire population is such that it can hardly lead to a functional size standardization system.*

Notre recherche faite de manière itérative nous a permis de cheminer et d'ajuster notre méthodologie initiale après non validation de certaines hypothèses préliminaires et en fonction des résultats des analyses de corrélation. Nous avons modifié notre approche parce que certaines variables étaient ou n'étaient pas corrélées entre elles (par exemple, lorsque nous démontrons que les mesures des hauteurs ne sont pas corrélées avec les mesures des circonférences) ce qui nous a forcés à analyser ces deux types de mesures séparément.

Une autre des difficultés est de segmenter un ensemble de points denses dans l'espace (les individus selon les paramètres discriminants sélectionnés) et d'en déterminer les frontières dans un espace continu. La figure suivante, par exemple, est tirée d'une première analyse et démontre clairement deux axes de gradation. Ces deux axes correspondent aux deux axes principaux du nuage de points dans l'espace (taille/hanches) :

- le premier axe correspond « au volume » des clientes, c'est-à-dire l'axe principal du nuage de points qui est l'axe que cherche aujourd'hui à discriminer la gradation en 6, 8, 10, etc., avec plus ou moins de succès ;

- le second axe, orthogonal au premier, correspond à la répartition « des masses ». Il sert à exprimer implicitement les gradations en profil sous-jacent (lettres **A, X, H,** communément utilisées pour designer le profil d'une silhouette féminine).

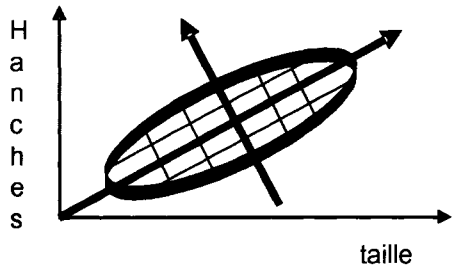

Figure 2.1 : Aperçu de la dispersion de la population en fonction des variables «taille, hanches»

Compte tenu la direction du nuage, une rotation des axes a permis de retrouver les deux directions principales de chaque sujet : (1) la quantité de matière (volume) et (2) la déviance **A**, **X** et **H**, ainsi que de déterminer (tel était notre objectif) une classification avec des classes les plus homogènes possible pour éviter les trop grandes différences voire une nouvelle méthode de gradation (si elle s'avère plus efficace). Nous avons donc retenu les deux méthodes de segmentations « segmentation théorique » suivantes en tenant compte à la fois des grandeurs et du profil des silhouettes (**A**, **X**, **H**) :

i) une segmentation basée sur une *équirépartition* (répartition d'effectifs égaux de notre échantillon) de la population, soit :

- un nombre égal d'individus dans chaque segment où les limites de mesures varient et où l'on satisfait avec des classes plus petites les segments de population les plus abondants, mais où les classes extrêmes (**A** et **H**) deviennent par contre plus hétérogènes ;

ii) une segmentation basée sur des répartitions de la densité (amplitude égale) de la population, soit :

- un nombre différent de femmes dans chaque classe, par exemple, une répartition *a priori* des ratios où 50% des clientes s'habilleraient entre les tailles 8 et 12 mais où les limites de mesures seraient identiques.

Cette analyse des données par groupement tente d'exploiter les variations de densité du nuage de points pour trouver des frontières « naturelles » entre les classes, voire établir une nouvelle gradation.

Les frontières externes et le nombre de segments à déterminer pour la *segmentation théorique* seront dans ces deux cas fonction des limites de la *segmentation empirique* c'est-a-dire : (1) des limites extrêmes allant des plus petites aux plus grandes ; (2) du nombre des grandeurs normalement offertes sur le marché et ; (3) des frontières de ces grandeurs que l'on retrouve habituellement sur le marché. Nous nous appuyons plus exactement sur les limites empiriques recueillies chez un grand donneur d'ordres canadien qui sont souvent très près de ce que l'on retrouve dans la littérature.

Quant aux profils sous-jacents (silhouettes **A**, **X** et **H**), dans les deux cas, nous avons déterminé le nombre de silhouettes *a priori*, non pas arbitrairement mais bien en fonction d'une logique s'appuyant sur notre expérience et sur les résultats obtenus lors de la segmentation empirique, ainsi que sur la littérature. S'il en avait résulté que les classes étaient clairement identifiables et qu'elles pouvaient être utilisées sans ambigüité par les donneurs d'ordre et les consommatrices, nous aurions défini une nouvelle gradation à partir de ces points de mesures jugés importants à l'étiquetage et aurions déterminé et fixé les frontières externes et limitatives de chaque segment (les différentes classes) ; ce qui aurait été équivalent à établir des nouveaux standards. Si au contraire, les résultats avaient démontré les limites discutables, cela nous aurait forcé à trouver une autre solution.

Encore une fois, puisque cette recherche fut menée de manière itérative, nous sommes en mesure et obligée d'admettre que le classement d'individus semblables entre eux serait toujours discutable, c'est-a-dire qu'il y aura toujours des individus mal vêtus en dépit des standards adoptés, peu importe la manière dont ils auraient été définis.

Enfin, avant de valider le modèle d'étiquetage, nous avons regardé si l'*offre* satisfaisait la *population* (notre échantillon). Pour ce faire nous avons juxtaposé les mesures de spécifications obtenues ou les mesures réelles des différents styles de pantalons mesurés (*offre segmentée de manière empirique*) sur les mesures des femmes (taille – hanche), c'est-a-dire le nuage de points de notre l'échantillon de quelque 6 000 femmes mesurées à l'aide du *3D body scanner* que nous appelons la *population,* sachant que tous ces pantalons étaient étiquetés avec une simple numérotation. Nous avons validé l'hypothèse suivante :

> H_1: *Order initiators measurement specifications cover the whole spectrum of size and shape although they are labeled with a same size code number.*

Si l'*offre* couvrait la *population*, nous serions confortée et pourrions affirmer qu'il est heureux que les manufacturiers ou donneurs d'ordres n'aient pas adhéré aux standards, car s'ils y avaient adhéré, seulement une partie de la population féminine se serait habillée. Il n'en demeure pas moins que le bât blesse car nous savons qu'ils utilisent une simple numérotation sur l'étiquette.

Cette hypothèse validée nous obligeait à repenser l'étiquetage en fonction seulement des points de mesures critiques retenus. Il en résulte, nous le constatons dans la partie analyse et résultats, que l'étiquette de pantalon devrait comprendre un pictogramme avec un pantalon où l'on identifierait certains points de mesures et les mesures de ces points.

2.4 Valider le nouveau modèle proposé

À ce stade, nous savons qu'une nouvelle gradation visant à proposer une nouvelle standardisation est peine perdue pour plusieurs raisons que voici : (1) le nuage de points est très dense et, par conséquent il y aura toujours des femmes dont les mesures seront à cheval sur la ligne de délimitation ; (2) le nombre de classes nécessaires serait ou trop nombreux ou aux limites trop distancées ; (3) les limites des classes calculées avec la rotation des axes rend l'utilisation trop complexe pour une utilisation générale, par conséquent, les manufacturiers n'adhéreront probablement pas, et enfin ; (4) les femmes dont les mesures sont aux extrémités des classes risquent d'être mal servies.

Nous avons par conséquent opté pour un nouvel étiquetage qui spécifie certains points de mesures du pantalon et les mesures comme telles de ces points. Pour démontrer que le nouvel étiquetage est plus adéquat que l'étiquette actuelle et qu'il permet aux femmes de sélectionner le pantalon qui leur convient et leur sied le mieux, nous devions valider certaines hypothèses.

La validation du nouveau modèle d'étiquette fut réalisée en deux temps.

Dans un premier temps nous devions utiliser une approche que nous qualifierons d'indirecte. Cette approche permet de valider l'importance de la mesure de l'entre-jambe, mesure de longueur. Nous devions étudier et comparer les retours de deux types de pantalons très similaires entre eux, exception faite de leur longueur d'entre-jambe. Nous pouvions démontrer ainsi que la mesure de longueur de l'entre-jambe est une variable critique et qu'elle est par conséquent un des points de mesure qui permet à la cliente de sélectionner le « bon » pantalon.

H_2: *Inseam is a critical measurement for selecting the right pants.*

Dans un deuxième temps, l'importance d'identifier et d'inclure la mesure des circonférences doit être validée selon une approche que nous qualifierons de directe.

Encore une fois de manière à s'assurer que notre façon de procéder était adéquate, nous avons d'abord fait un pré-test *in situ* et à distance. Les femmes devaient se mesurer et nous donner les mesures des deux pantalons qui offraient le meilleur ajustement. Ce pré-test fut suivi d'une étude plus approfondie pour notre validation. Nous mesurons donc, *in situ* la taille et les hanches d'un groupe d'une centaine de femmes. Ces femmes essaient un lot de dix pantalons de mesures différentes et de différents profils sous-jacents de silhouettes. Nous pouvons ainsi valider les hypothèses suivantes : (1) que les femmes portent habituellement des pantalons de mêmes mesures ; (2) que sans aller jusqu'au *body cathexis*, à savoir leur perception et satisfaction de leur corps, elles optent habituellement pour un même type d'ajustement (ajusté, semi-ajusté ou ample) de pantalon.

H_3: Women search and prefer pants with the same waist and hip measurements;

H_4: Women prefer to wear the same type of pants fit (fitted, semi-fitted or loose).

Nous avons profité de ce contact avec les femmes pour leur poser les quelques questions suivantes : (1) préfèrent-elles une étiquette avec ou sans pictogramme ; (2) avec ou sans points de mesures ; (3) avec ou sans mesures précises et ; (4) connaissent-elles leur mesures à ces points?

Ces hypothèses validées permettent d'avancer que le nouvel étiquetage serait plus approprié et permettra aux femmes de trouver le «bon» vêtement en lisant l'étiquette et, qui plus est, que cela améliorera les échanges commerciaux et diminuera les retours. Nous sommes conscients que si les femmes ne connaissent pas leurs mesures corporelles, un peu d'éducation reste à faire.

2.5 Conclure sur ce modèle et énoncer des pistes de recherches ultérieures

Pour conclure, nous savons, tel que mentionné précédemment, qu'une nouvelle standardisation serait utopique. Le processus d'utilisation de la gradation serait non seulement difficile mais constituerait en plus un retour à des standards.

Nous savons par ailleurs que les échanges commerciaux pourraient être grandement améliorés si l'étiquette était modifiée, voire universelle. Cela devrait dire que la cliente passerait moins de temps *in situ* à chercher le vêtement qui correspond le plus à ses désirs et qui lui sied le mieux, ainsi qu'à la cabine d'essayage. Les employés manipuleraient moins la marchandise *a posteriori* ; ce qui veut dire moins de dépenses pour replacer les vêtements sur le plancher et ceux-ci pourraient aider *a priori* les consommatrices. À distance, la nouvelle méthode d'étiquetage amènera une diminution des retours, et une augmentation de la satisfaction des clientes.

Nous savons enfin quels sont les points de mesures à spécifier sur l'étiquette et que lesdites mesures doivent être précisées. Maintenant, que nous avons eu un son de cloche des femmes sur leurs préférences de types d'étiquette, nous laissons le soin à d'autres chercheurs (en marketing par exemple) de peaufiner l'allure de la nouvelle étiquette : avec ou sans pictogramme, son genre, sa couleur en fonction des silhouettes, etc.

CHAPITRE 3 : VARIATIONS IN CANADIAN WOMEN'S READY-TO-WEAR STANDARD SIZES

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La recension des écrits présente une certaine insatisfaction quant à l'information fournie sur l'étiquette par tailles. Il semble que des vêtements étiquetés avec une même taille peuvent avoir différentes mesures. Nous nous sommes intéressés à ce problème. Nous avons dans un premier temps trouvé les mesures fournies par l'Office des normes générales du Canada. Nous avons ensuite contacté cinq grands donneurs d'ordres au Canada, lesquels nous ont donné les mesures « spécifications » pour certaines tailles spécifiques. Nous avons ensuite mesuré dix pantalons de chacun des cinq donneurs d'ordres et nous avons comparé ces mesures aux standards issues de l'Office des normes générales du Canada ainsi qu'aux spécifications obtenues. Cet article présente de façon détaillée la méthodologie utilisée et les résultats obtenus.

Ci-après le premier papier paru dans la revue *Journal of Fashion Marketing and Management*.

3.1 Abstract

This article demonstrates that the current weaknesses in women's ready-to-wear size standardization charts originate not only in the obsolescence of the database but more importantly in the non-adherence of garment manufacturers to the suggested standard sizes. It fills an important void in the existing literature as, although a number of authors have stated that garment manufacturers do not respect the standard sizes proposed by different national organizations or governmental agencies, the authors could not identify one research demonstrating this fact. It questions the pertinence of investing heavily in the modernization of standard sizes charts if the industry and the governments are not ready to impose adherence by order initiators.

Key Words: Garment, apparel, fashion, size, standardization, label

3.2 Introduction

Dissatisfaction with fit in women's ready-to-wear is a recurring topic in the literature on the garment/apparel industry (Anderson, Brannon, Ulrich et al. 2001; Oldham Kind and Hathcote 2000; Horne, Campbell and Scholz 1999; Yoo, Khan and Rutherford-Black 1999; Ashdown 1998; Chun-Yoon and Jasper 1996). A number of explanations have been proposed. Most refer to the fact that the standard sizes charts currently in use are so obsolete that they are useless, that order initiators[52] do not adhere to the proposed standards, and that size labels affixed to garments provide no information on the body measurements which they purport to identify. Consequently, not only have women lost time and coped with frustration throughout their shopping experiences of the last half a century but the industry has also missed out on potential sales (Goldsberry, Shim and Reich 1996a).

[52] We use the term « order initiator » from the accepted French expression *donneur d'ordre,* as the determination of garment specifications as well as the decision to manufacture is at times made by the retailer, at times by wholesalers/importers, and at other times yet by a manufacturer who may or may not actually manufacture the garment itself. This allows us to only use the term "manufacturer" when referring to the entity actually conducting the production activities.

Technological innovations such as the body scanner are currently presented as the panacea. A number of articles have already stated how this technology can benefit all involved in the supply chain by allowing the regular and continuous update of massive databases on a population's anthropomorphic measurements on which standard sizes charts are based or, on the other hand, by making them obsolete through the generalization of mass customization (Istook 2002).

This paper first presents a literature review on each of the proposed explanations to women's dissatisfaction with ready-to-wear standard sizes. We demonstrate that although the obsolescence of the existing standard sizes has been extensively discussed and analyzed, the order initiators' non-respect of suggested standard sizes and the insufficiency of label information have never been scientifically demonstrated. We present our research methodology and findings confirming the non-respect of suggested standard sizes and comment on the uselessness of updating standard sizes charts at great expense as long as the adherence to the said standards is not made mandatory. We conclude on possible further research avenues to address this issue.

3.3 Literature review

Garment order initiators do not adhere to a generally accepted size system; accordingly announced garment sizes have little meaning to the consumer. According to some authors (Workman and Lentz 2000; Yoo, Khan and Rutherford-Black 1999), the outdated standards and the inadequacy of the *PS 42-70* (*United States Department of Commerce 1971)* database have forced many apparel order initiators to develop their own sizing systems (Workman 1991; Goldsberry, Shim and Reich 1996a). To others, a standard or model size may vary from one order initiator to another because of the age, occupation, origin, or socio-economic group they aim to serve (Beazley 1998). Others yet will explain this variation by the fact that order initiators play on vanity with size hang-tags and knowingly over-size a standard size; a psychological practice that seems to please consumers (Goldsberry, Shim and Reich 1996b).

3.3.1 Weaknesses of existing standard sizes charts

"Sponsored and supervised by the Bureau of Home Economics from July 14, 1939, to June 30, 1940, under a Federal-project grant of the Work Projects Administration", the *Women's Measurements for Garment and Pattern Construction* (United States Department of Agriculture 1941) "study was conducted as a series of State Work Projects Administration projects in" eight states or district, "with the cooperation of local universities and other educational institutions". "The women included in the study" (14,698 women) that helped develop the first standard sizes charts, "were white residents" of "18 years of age and older", "both native and foreign-born" and "most of them lived in urban areas" (United States Department of Agriculture 1941).

The exercise was, according to (Glock and Kunz 2000), initially intended to facilitate the consumer's identification of her body type and size from the array of existing body types and to enable her to be identify her single best fitting size regardless of price, type of apparel, or manufacturer of the garment. Although not the initial objective of the exercise, standard sizes charts were an obvious advantage enabling the consumer to identify the best fitting garment no matter its origin or brand name (Gould-Decauville, Bruere, Uhalde-Roux et al. 1998).

Until recently very little had been done to update this initial survey. Yet the list of authors highlighting the need to do so, in order to reflect the changing population, is substantial. (Workman and Lentz 2000) cite Tamburrino (1992) who "noted that increased participation in physical exercise, changes in dietary habits, geographical migrations and other lifestyle factors produced changes in the U.S. population's anthropometry that made existing apparel size standards obsolete". The same authors also refer to Brunn who declared that body measurement charts needed to be revised at least every 10 years.

Moreover, as (Chun-Yoon and Jasper 1996), cited in (Workman and Lentz 2000), state, most measurement tables describe body size on only three body measurements (bust, waist and hip circumferences) which is insufficient to truly capture the specificity of a

human body. (Ashdown 1998) concurs: "Most apparel sizing systems are based on one or two body dimensions and rely on assumptions about proportional body relationships to project other dimensions necessary to design the garment pattern which will not fit a population with large variations in body proportions".

It is therefore not surprising to find that a large number of women do not "fit" the existing standard sizes charts!

3.3.2 Varying "standard sizes" among order initiators

A second often overlooked fact is, as stated in one of the original documents pertaining to standard sizes in the United States, the adoption and the use of *Commercial Standard* or of *Voluntary Product Standard* or of any updated standard are completely voluntary (United States Department of Commerce 1971), (Workman and Lentz 2000; Glock and Kunz 2000).

In Canada, for example, the stated principal object of the Canadian General Standards Board (CGSB) is to foster and to promote voluntary standardization as a mean of advancing the national economy, assisting and protecting the customer and facilitating domestic and international trade in the field of standards. "At the point of sale, apparel items should have a label showing the applicable size indicator body measurements and/or the size code." (Canadian General Standards Board 1987) CAN/CGSB-49.203-M87, p.2)

The (Canadian General Standards Board 1987) CAN/CGBS-49.203-M87, p.1) states that: "The standard contains a selection from the complete system of sizes which is of greatest commercial interest" and "may be used as a guide in choosing the sizes of women's wearing apparel." "Although the intended primary application of this standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the standard to judge its suitability for their particular purpose."

Standards should help the apparel firms in categorizing garments of different sizes in a way which customers will recognize (Glock and Kunz 2000). As a corollary, they also should help potential customers identify the garments that will provide them with a reasonable fit (Beazley 1997). Yet because adhesion to these standards is entirely voluntary (Workman and Lentz 2000), the actual sizes which standard sizes labels (SSL) identify vary from one firm to another (Anderson, Brannon, Ulrich et al. 2001; Campbell and Horne 2001; Workman and Lentz 2000; Beazley 1999; Winks 1997; Chun-Yoon and Jasper 1996; Goldsberry, Shim and Reich 1996a).

When an SSL identifying a specific size garment actually refers to a different size from one order initiator to another, the entire purpose of the standard is missed: consumers can no longer trust and use the label to determine the size of a garment and therefore its eventual fit.

As we stated before, the reasons for this situation are multiple yet simple. One of them is that, as stated previously, measurements on which standard sizes are based are obsolete and no longer reflect the modern woman's body shape and size (Gould-Decauville, Bruere, Uhalde-Roux et al. 1998).

A second reason is that an order initiator may develop its own size charts to better serve a specific target customer it has in mind (Burns and Bryant 2002). "Each company determines its own fit model measurement specifications and sizes designations." (Workman and Lentz 2000). (Glock and Kunz 2000)[53] even stated that "it is a manufacturer's responsibility to consider its target customer when developing appropriate specifications to customize its sizing and fit". An order initiator may well feel that standard sizes established on the basis of some type of survey of its clientele provides more accurate information for its size labels. This may be due to the age, occupation, origin, or socio-economic group of the target population (Beazley 1998).

[53] Cited in Workman & Lentz, p. 254

A perception that may prove true for the existing clientele yet confusing for potential clients who are not used to this order initiator's specific standard sizes.

Thirdly, order initiators often design their clothes for a mannequin or model that may be different from the one used by another order initiator. According to Orzechowski & Forney (1988), order initiators have many potential sources of body dimensions available: (1) professional fit models, (2) statistics provided by their government, (3) databases compiled by private non-profit organisations, (4) standard industry dress forms, (5) competitors' garments, (6) company's target customers and (7) databases from other industries such as automotive.

A fourth possible variation originates at grading[54]. Grading, although a theoretically standardized process, is often influenced by the experiences order initiators have had with their clientele, convincing them not to follow the generally recognized precepts. Moreover, in order to reduce production and inventory costs for all intermediaries in the supply chain, order initiators often try to fit a maximum number of customers with a minimum of number of standard sizes (Price and Zamkoff 1996). Both of these situations obviously lead to different decisions by different manufacturers when it comes to sizes offered and fit of these sizes.

A fifth reason for the variation in standard sizes is that order initiators do not necessarily measure the human body they wish to dress in the same way. They do not measure the same points of the body and often use different tools to do so (Anderson, Brannon, Ulrich et al. 2001). Taking manual measurements needs to be very precise and is, according to (Le Merrer 1997), an art which all do not possess equally. According to (Winks 1997) bust, waist and hips circumferences, vertical and girth dimensions constitute the most common parameters on which to fit clothes while length or height are the base of most body dimension standards when it comes to classifying garments for the lower and upper part of the body. With such precise guidelines, why should we find variations from one

[54] Pattern grading is the process whereby one will adjust a garment pattern designed on the measurements for a specific standard size to fit smaller and larger body sizes.

order initiator to the other? Because, for example, some will measure the length of the body by extrapolating the difference between two points (Price and Zamkoff 1996) while others will use a top to bottom measure to accomplish the same purpose. A deduction of body length arrived at by extrapolating a hip to bust or a hip to knee measurement may give a different result than an actual measure taken from hip to neck or hip to heel.

In short, sizes variations between order initiators may be a conscious decision made to better serve a specific target customer or the consequence of non-standardization of the measurement and grading processes.

3.3.3 Inadequate label information

Another factor often mentioned in the literature as contributing to the confusion at the consumer level is that size labels were originally designed to provide information which should help consumers select their correct size. However not only is "size labelling a complementary information enjoyed by consumers" (author's translation from (Gould-Decauville, Bruere, Uhalde-Roux et al. 1998) but standard size labels (SSL) generally provide no information about body measurements (bust, waist and hips measures) nor body shape the announced size is based on.

Female consumers are left with great variations in size identifications; as (Anderson, Brannon, Ulrich et al. 2001), state : today, a given SSL may reflect many possible sizes, rather than one uniform size.

Garments sold in Canada generally carry an SSL. The CGSB sizing system suggests the following codes: 5, 7, 9, 11, 13, 15, 17, 19 for junior sizes; the announced size is based on 6, 8 , 10, 12, 14, 16, 18, 20 for misses sizes; 10-½, 12-½, 14-½, 16½, 18½, 20½, 22½, 24½, 26½, 28½ for women's sizes; or again, 30, 32, 34, 36 , 38, 40, 42, 44, 46, 48 (based on the European system). In the USA, size codes usually suggest sizes for "Junior", "Junior Petite", "Misses Petite", "Misses", "Women", "Misses Tall", and "Half-Size". Quite confusing in itself.

To complicate things further, order initiators may even identify one of the four (or six, depending on the source) body types (Figure 3.1) for which a garment is designed. Those multiple size classifications and body types may be well known to some of the members of the supply chain but not necessarily to all, nor to the average consumer. Authors (Campbell and Horne 2001; Oldham Kind and Hathcote 2000; Beazley 1999; Yoo, Khan and Rutherford-Black 1999; Ashdown 1998; Goldsberry, Shim and Reich 1996a; Rasband 1994; Price and Zamkoff 1996) agree that this situation only serves to generate a further waste of time.

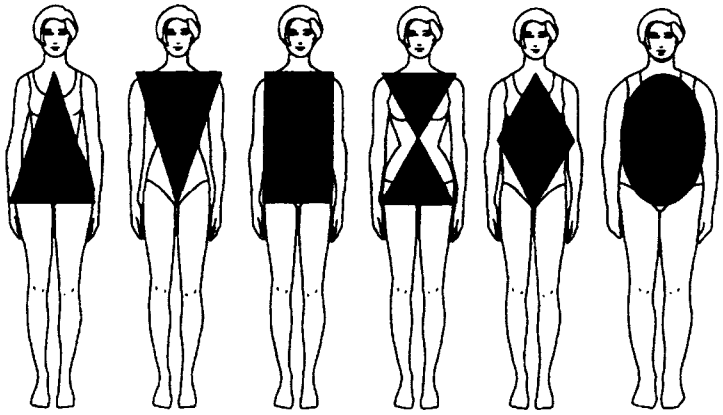

Figure 3.1 : Different body shapes[55]

The variation in measurements between order initiators for a given size and the weaknesses in labelling information combine to create a situation where consumers can hardly be expected to readily identify the best fitting garments. In the case of in-store shopping, they can try the garments on for fit. But in the case of distance shopping (Internet or catalogue), this option does not exist; they have to rely on a size chart provided by the seller which may, here again, differ, from the national standard sizes.

[55] Source: Rasband (1994)

As many researchers have reported (Lee, Kunz, Fiore et al. 2002; Workman and Lentz 2000; Beazley 1999; Goldsberry, Shim and Reich 1996a) consumers become disenchanted with the shopping experience. Not only are they poorly serviced with the existing offer, but they are sometimes forced to pay for necessary alterations following a less than perfect decision on fit.

3.4 Research and findings

Although numerous authors have written about the reasons for size variations, we have been unable to find one study that clearly demonstrates this fact. Hence, the objective of the research we report in this article was to verify:

- if there were measurement variations between garments of a same given size;
- if these variations were due to the non-adherence to the prescribed standard sizes, to production process weaknesses or to process control inadequacy.

Our research was conducted in the Eastern Canada women's ready-to-wear market. This market is comprised of a combination of local, national and international suppliers, which is probably quite representative of the situation found anywhere else in North America and Western Europe.

Measurement variations between garments of given sizes may arise from a number of causes. The three most important being:

- when order initiators do not comply with the standard sizes charts proposed by their local government and set their own standard, one may find (1) intra order initiator variation (when the same order initiator uses different measurement specifications for different product lines) or (2) inter order initiators variation (when two order initiators use different measurement specifications);

- when manufacturers intentionally, or not, do not follow the order initiators' measurement specifications, one may either find (1) intra order initiator variation (when the same manufacturer applies different measurements to two orders from the same order initiator or when an order initiator will use two manufacturers applying different measurements) or (2) inter order initiators variation (where manufacturers apply different measurements to the products of two order initiators with identical specifications);
- when the production processes used by manufacturers are incapable to meet the order initiator's measurement specifications and/or when quality control lacks, one may either find intra or inter order initiators variations.

3.4.1 Method and procedure

Our procedure required that we conduct comparisons on a given garment size:

- of individual order initiators' specifications with the CGSB, to determine order initiators - CGSB variation;
- of different sample products within a single order initiator's product offer, to determine intra order initiator variation; and
- of products offered by different order initiators, to determine inter order initiators variation.

We developed three hypotheses.

H_1: Order initiators' specifications follow the prescribed CGSB measurements.

H_2: Order initiators consistently apply the same measurements throughout their product lines.

H_3: Manufacturers respect the size specifications requested by the order initiators.

To achieve our objective, we first communicated with five of the most important Canadian order initiators (in this case some were manufacturers and others were retailers). We asked each one of them the same question: "What is the waist standard measurement (in inches or in centimetres) for a size 6 garment[56]". We also enquired whether they may use different measurements for a given size in different product lines. We informed them that, to confirm their information and verify that it had indeed been applied in the final manufacture of the garment, we would sample some of their garments in store and measure the actual waist size on ten product units of the said size 6. All order initiators contacted were very cooperative and willingly provided us with the required information.

The in-store measurements were done within the week following our inquiry with the order initiators. All garments were measured by the same individual using the same tape measure. We compared (1) the specifications provided by the order initiators, (2) the standard measurements prescribed by the CGSB, and (3) the in-store garment measures.

The (Tableau 3.1) presents each order initiator's waist measurement specification for a size 6, the CGSB prescribed measurement, our in-store measurements and some comparisons on our findings. We chose to present our findings in inches as the initial CGSB were set in this unit and numerous Canadian order initiators still use the English system in spite of the country having switched to the metric system some 30 years ago.

[56] We chose size 6 as this is generally either the size in which the garment is originally designed or a size very close to the design size (which would then be size 8). This enabled us to minimize the impact of gradation rules on size variations.

Tableau 3.1 : Waist measurements (in inches) for a size 6 garment for five major Canadian order initiators

	Order initiators				
	A	B	C	D	E
A. Waist measurement specification	25	26	26	29	29½
B. CGSB prescribed waist measurement	23	23	23	23	23
C. Variation A, B	2	3	3	6	6.5
D. Garment sample (10) average waist measurement	23.6	29.7	29.9	29.8	29.7
E. Variation A, D	1.4	3.7	3.9	0.8	0,1
F. Variation B, D	0.6	6.7	6.9	6.8	6.7
G. Garment sample (10) highest waist measurement	24.5	31	31	31	30
H. Garment sample (10) lowest waist measurement	23	28	29	29	29.5
I. Maximum variation G, D or H, D	0.9	1.7	1.1	1.2	0.3

Knowing that, according to the CGSB, the waist measurement variation between each size should be approximately 2 inches (i.e. the waist on a size 8 garment, for example, should be two inches larger than a size 6 garment, and that of a size 4 garment should be 2 inches smaller), a number of observations may be made from the information presented in (Figure 3.2):

- order initiators clearly do not follow the CGSB prescribed measurements. In fact the waist measurement used by the order initiators surveyed, for a size 6 garment, ranges from that of a size 8 garment to slightly more than that of a size 12;

- 3 out of 5 garment manufacturers did not respect the specifications of the order initiators with average waist measurements being more than 1 inch off the specification;
- of 50 garments measured, only one met the CGSB size 6 specifications, with some (at least one example for 4 out of 5 order initiators) meeting the size 14 CGSB standard;
- garments produced by the same manufacturer may vary by as much as 3 inches (order initiator B);
- garments identified as size 6 may vary by 8 inches (from lowest identified value for order initiator A to highest identified value for order initiators B, C, and D).

Figure below presents a scatter plot of the same observations using the *Statistica* software. This plot allows us to better visualize the inter- and intra-order initiators variations.

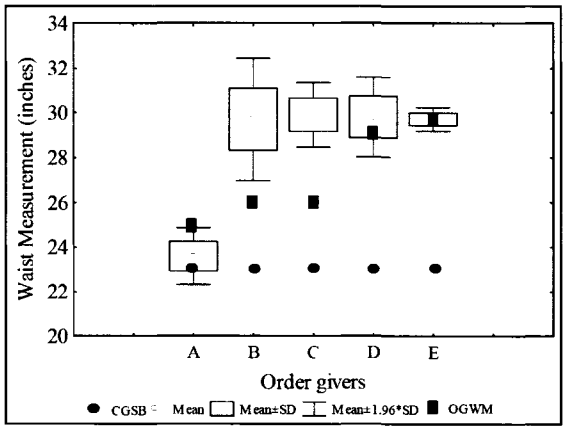

Figure 3.2 : Scatter plot

3.5 Discussion

Only our second hypothesis:

> H_2: Order initiators consistently apply the same measurements throughout their product lines,

was supported by our research as none of the order initiators contacted indicated using different measurements for different product lines.

Our first hypothesis:

> H_1: Order initiators' specifications follow the prescribed CGSB measurements;

is clearly not supported by our findings. The CGSB's prescribed waist measurement for a size 6 is 23 inches. In our sample, waist measurements specifications went from 25 inches in the case of order initiator A to 29 ½ for order initiator E; a variation of 4 ½ inches. In fact, the measurements specified by the order initiator meet the requirements for sizes 8 to 12 as suggested by the CGSB.

The observations we can make in as far as our third hypothesis:

> H_3: Manufacturers respect the size specifications requested by the order initiators;

is concerned, are twofold. Our first observation is that our hypothesis is not supported in three out of five cases (order initiators A, B, and C) as the average waist measurements of the garments inspected deviate by more than one inch (the generally accepted upper and lower tolerances) from the requirement. This leads to the second observation which comes in answer to the question "Is the manufacturers' non-respect of the order initiators' requirements a conscious decision or the result of processes that are not in control or incapable to meet the requirements?" Our samples (10) for each order initiator were unfortunately too small to arrive at a definite answer on this issue.

Yet, identifying the most important variations from the mean, does not lead us to believe that, except in the case of manufacturer B, manufacturing processes were out of control. All the garments measured would probably fall within the generally accepted three standard deviation upper and lower limits. A second element to this discussion is that the average waist measurements of the garments inspected either more closely match the CGSB prescribed standard than the order initiator's requirement (in case A) or, interestingly, appear to match some unwritten measurement standard of 29-30 inches (cases B, C, D, and E). These lead us to conclude that the non-respect of the order initiators' requirements probably has more to do with a manufacturer's conscious decision than a process weakness of some sort.

We expected to find either intra order initiator variation or inter order initiators variation. We did find some intra order initiator variation in as far as the garments measured varied on what can probably be considered a normal tolerance window. Although this normalcy would need to be confirmed through a more focused research on the subject, one can say that these variations, albeit important when looking for a close fitting garment, may not be a cause of major consumer dissatisfaction with a garment shopping experience. We also found some inter order initiators variation. Yet an interesting point to note is that there was more inter order initiators variation in the specifications than in the actual garments measured.

An observation which can only be explained by saying that manufacturers appear to think that "they know better" and apply their own specifications. Although this situation contributes to decrease the inter order initiators variation, it does not say much for the latter's quality control (our samples were drawn at retail level), and still leaves enough variation to cause consumer dissatisfaction.

3.6 Conclusions

Notwithstanding the other factors discussed in this paper (obsolescence of standard sizes charts and labelling inadequacy), the findings presented here certainly contribute to explain the difficulties and frustrations that women experience when purchasing a garment. Our research clearly demonstrates that: (1) garment order initiators do not adhere to the standard sizes charts and (2) garment manufacturers are incapable or unwilling to produce garments that meet the order initiators' specifications.

Two problems need to be addressed. The first deals with the order initiators non-adherence to set standards. As discussed above, a number of factors contribute to this situation: obsolescence of the existing standards, variations in body shapes and sizes that the existing standards do not account for, marketing ploys aimed at flattering certain consumers. TC^2, in the United States, and a number of other organizations elsewhere have already developed the technology and conducted extensive surveys to update the standard sizes charts and thereby address the first potential cause to the problem. Yet, as different order initiators target different target markets with different body types, sizes and needs and since over-sizing (labeling as a size 4 a garment with the measurements of a size 6) marketing ploy has proved effective: "Why would order initiators willingly adhere to the new standard sizes charts ?" "Should they, or can they, be forced to do so?" "How will the new standard sizes charts help consumers if order initiators do not use them?"

The question also begs to be asked: "Can standard sizes charts account for all body shapes (4 or 6 depending on the authors), in all body sizes (a conservative estimate, based on existing charts would be in the neighbourhood of 12)?" "In other words, is it possible to satisfy all of the female population with a manageable number of standard sizes?" Based on the conservative estimates expressed in our question above, a retail store would have to carry some 72 different sizes to cover the entire female population! "If not, do the

data acquiring, data transmission, and flexible production technologies currently exist to apply mass customization[57] to all garment sales at a reasonable cost to the consumer?"

The field offers tremendous opportunities for future research. Can we, and in the affirmative, how can we design all-encompassing standard sizes charts? Is mass customizing all garment sales a realistic option with the technology available in 2004? Could or should all order initiators be forced to adhere to Standard Sizes charts? How will globalization impact all of the above questions?

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CHAPITRE 4 : WOMEN'S WEAR STANDARD SIZING: A HISTORICAL PERSPECTIVE (PART I)

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Le premier article démontre qu'il y a des différences entre les mesures de vêtements d'une même taille. Les deux articles qui suivent présentent de façon plus approfondie l'étude précédemment faite. L'article qui suit, *Women's wear standard sizing a historical perspective (part I)* présente une recension complète des écrits en démontrant l'évolution des standards de tailles. Il s'agit d'une présentation chronologique qui tienne compte des grands événements qui ont influencé l'étiquetage par tailles. Il en résulte que l'étiquetage par tailles semble porter à confusion. L'article suivant *Women's wear sizing: an analysis of the Canadian situation on pants' sizes (part II),* nous présentons la validons sur une grande échelle que des vêtements (pantalons) étiquetés de la même taille peuvent avoir des mesures différentes, que les manufacturiers ne suivent pas les mesures offertes par l'Office des normes générales du Canada et qu'ils ne suivent pas non plus les spécifications données par les donneurs d'ordres.

Nous commentons également que les mesures de tolérances sont trop généreuses. Enfin, nous démontrons que les manufacturiers produisent pour une silhouette type et ce nonobstant la grandeur.

Ci-après les deux articles (part I et part II) soumis à la revue *Journal of Fashion Marketing and Management.*

4.1 Abstract:

Purpose – To review the evolution of standard sizing and size labelling in the ready-to-wear garment industry.

Design/methodology/approach – Presents in a chronological manner all the most important contributions of the twentieth century to today's size system: birth of thr pattern, introduction and impact of mail order sales, call for standards, national surveys renowned for their objectives and applications and the key measurement points retained for today's ready-to-wear garments.

Findings – Demonstrates the need for standards in garment mass-production along with the non-adherence of garment manufacturers to said standards.

Research limitations/implications – The focus of the literature review is the production end of the garment industry. Does not address the marketing imperatives affecting the size labelling decision. This study and the following parts focus on the Canadian manufacturers and order initiators although since the Canadian general standards Board used the American survey to build their own charts and standards the literature review focuses on the American sizing system.

The Canadian General Standard Board used the American standards to build their own charts and standards. Therefore **Practical implications** – Demonstrates the pertinence of garment size standards and the need for a new approach to decrease the existing confusion in size selection.

Originality/value – Fills an important void in the existing literature as, although a number of authors have stated that garment manufacturers do not respect the standard sizes proposed by different national organizations or governmental agencies, the authors could not identify any research studies demonstrating this fact.

Keywords: Canada, Garment, Label, Ready-to-wear, Sizes, Standards,

Article Type: Research paper

4.2 Introduction

As stated by Gould-Decauville *et al.* (1998) garment size labelling is complementary information appreciated by consumers. Chun-Yoon & Jasper (1996) further state that size labels are a tool provided to assist consumers in selecting the best fitting garment. It has however been pointed out that many women are dissatisfied with the fit of ready-to-wear apparel as currently labelled for size (Alexander *et al.*, 2005; Schofield & LaBat, 2005; Otieno *et al.*, 2005; Anderson *et al.*, 2001; Oldham Kind & Hathcote, 2000; Yoo *et al.*, 1999; Ashdown, 1998; Goldsberry *et al.*, 1996; LaBat & De Long, 1990).

Eckman *et al.*'s (1990) in-store purchase decision process model states that the consumer's interest phase is immediately followed by a trial phase, in particular to verify fit. In a previous research study (Faust *et al.*, 2006) we demonstrated, based on an experimental study on women's pants done in collaboration with five important Canadian order initiators, that there were measurement variations between garments of a given size. Women recognize and respond to this variation more than 50% of women bring two or more sizes of the same style pants to the fitting room to determine the best fit.

Similarly Gould-Decauville *et al.* (1998), replicating an O'Brien (1941) study, found that over 40% of mail orders are returned due to inadequate fit. Contrary to the original intent, reading the numerical (or alphabetical) size labels does not currently enable women to identify a properly fitting garment. It appears that women still have to guess which size (6, 8, 10, 12, etc.) fits them best.

In order to understand this situation and possibly to suggest remedies, one first has to be informed of why and how size standards and labels came about. Schofield & LaBat (2005) point to the fact that very little has been written or published on the origin of the grading practice, sizing and anthropometric data from which emanate sizing standards and size labels.

The present series of articles address this issue. Part I of this study summarizes the evolution of size standardization in the ready-to-wear garment industry. To accomplish this task, we use a chronological approach. We highlight the key measurement points identified for pattern making and mass production and then follow with the determination of sizes and needs for national standards. Throughout this chronology of events we present how the industry (manufacturers, distributors and consumers) behaved or reacted to these standards and size labelling systems. We then list the key measurement points retained in the industry and present an example of the key measurements of the lower part of the body and the objectives of the Canadian standards charts. Finally, we conclude on some potential explanations for the existing state of affairs and offer a number of steps to undertake in order to confirm and correct what every woman instinctively feels: that size standards and labels are inconsistent and not useful.

4.3 Literature review

4.3.1 Pre 20th Century: First Key Measurement Points

Until the eighteen century, women's garments were custom-made (Fan *et al.*, 2004); fit was personalized (Workman, 1991). The first nested patterns for women's wear appeared in 1820-1840 (Kidwell, 1979) and the grading systems a few years later (Bryk, 1988).

Ebenezer Butterick and James McCall were the first to market nested patterns in the 1860's thereby initiating the ready-to-wear industry (Burns & Bryant, 2002). The key measurements points were then the bust, selected because it was used by Europeans (Workman, 1991), and the waist. Paper patterns were graded on the bust circumference for blouses and dresses and on the waist for skirts (Kidwell, 1979 as read in Schofield & LaBat, 2005). All the bodice measurements were based on the bust. In that era, patterns used a proportional grading system to create different sizes. Workman (1991) shows that the basic sample was graded at 36, which meant that it was suitable for a 36 inches woman bust. It was then adjusted in 2 inches linear decrements or increments (Ashdown, 1998). The proper fit of the finished garment depended on the dressmaker's skill (Schofield & LaBat, 2005).

4.3.2 **1900-WW I: Sizes Established According to Age**

In 1902 the *Sears Roebuck* and *Co. Catalogue* offered clothing in sizes ranging from 32 to 42 inches bust circumference (Workman, 1991). It stated an example that a garment with a 32 inch bust size should suit young ladies 14 years of age; a 34 inch size should suit young ladies aged 16 years old, and a 36 inch size young ladies 18 years of age (*Sears Roebuck* and *Co. Catalogue*, 1902). It specified that these garments were suited for young ladies since their construction was different from those for women (Workman, 1991). Ladies skirt sizes varied from 22 to 29 inch waists. For the first time, the dress grading code reflected both the critical body measurement points and age (Swearingen 1999 in Fan, 2004) as was the case for young children.

4.3.3 **WW I- WW II: Manufacturers Adapt**

The decades following WW-I saw the introduction of ready-to-wear fashion. "In the cities, department stores such as Dupuis Frères, T. Eaton or Simpson introduced ready-to-wear clothes and modified the entire population's shopping habits.

Millions of their catalogues were distributed throughout Canada"[58] (Bernier *et al.*, 2003 p. 77). In the US, ready-to-wear was also sold through catalogues such as Montgomery Ward or in the nascent urban department stores. According to Kidwell (2001) the modern age of apparel production and the "democratization of clothing" had begun. Burns & Bryant (2002) state that "separates for women" (two-piece outfits combining a blouse and a skirt) created by Gibson and worn by young girls, had a large influence on the women's ready-to-wear industry. Garments were then "a cheap interpretation" of the current fashion trend. Women purchasers knew that they would need to alter them to obtain an appropriate fit (Cooklin, 1990).

Manufacturers did their best to develop grading and size labelling systems but lacked adequate scientific data to do so (O'Brien & Shelton, 1941). Schofield & LaBat's (2005) studies reveal that each manufacturer reinvented the process. Bust, waist, and hips were the basic key measurement points use, providing a certain consistency. Yet no reliable grading standards existed: all the manufacturers used their own (Gould-Decauville *et al.*, 1998) which led to different garment measurements for a same size (Workman, 1991).

4.3.4 1939-45: Women's Measurements for Garment and Pattern Construction

At the end of the thirties, mass production of armed forces' uniforms triggered the establishment of a standard sizing system (O'Brien & Shelton,1941). According to O'Brien & Shelton (1941; p.1) "*no scientific study of body measurements used in the construction of women's clothing has ever been reported. As a result, there were no standards for garment sizes*". Merchandise returns due to poor fit were high; it was not unusual for the necessary alterations to the purchased garment to increase its cost by as much as 25% (Winks, 1997). Mass production, variations in measurements and sizing systems and catalogue shopping, all led to high return percentages and the need for a standardized sizing system (O'Brien, 1939, Yu, 2004).

[58] Author translation

The *Women's Measurements for Garment and Pattern Construction (WMGPC)* survey was conducted between July 1939 and June 1940 and its results were published by the *United States Department of Agriculture* in 1941. The WMGPC reported the objective was "*to provide measurements which could be used for improving the fit of women's garments and patterns*". It was the first time anthropometric measurements were used for that purpose (O'Brien & Shelton, 1941; Goldsberry *et al.*, 1996; Chun-Yoon & Jasper, 1996; Burns & Bryant, 2002; Ashdown, 1998; Workman & Lentz, 2000; Fan *et al.*, 2004; Shorfield & LaBat, 2005). The survey report stated that the data would best be used for sizing charts divided, among other things, by "short", "regular" and "tall".

4.3.5 1945-1970: The Need for Standards to Guide the Ready-to-Wear Industry

Standards were developed to facilitate commercial communication because they conveyed information about a product or material in a consistent manner; they resulted from the cooperation of various interest groups and fulfilled a perceived need within an industry (Kadolph, 1998).

In 1945, the *Association for mail-order sales* recommended a standard for the garment industry: the Commercial Standard. It materialized in 1958 with the *"Body Measurements for the Sizing of Women's Patterns and Apparel"*, commonly called the *CS215-58*. The statement that *"The adoption and use of a Commercial Standard is voluntary"* appears on its first page. Its primary and secondary goal were

> "*to provide standard classification, size designations, and body measurements for consistent sizing of women's ready-to-wear apparel (Misses', Women's, Juniors', etc.) for the guidance of those engaged in producing or preparing specifications for patterns and ready-to-wear garments. The measurements given in this standard are body, not garment, measurements*" and "*to provide the consumer with a means of identifying her body type and size from the wide range of body types covered, and enable her to be fitted properly by the same size regardless of the price, type of apparel, or manufacturer of the garment.*" (U.S. Dept. of Commerce, 1958; p.1)

The CS215-58 reports the "scopes" (four classifications of women: "Misses", "Women's", "Half-sizes" and "Junior"; and nine groups: "Short", "Regular" and "Tall" with four sub-groups within each: "Bust-hip", "Slender", "Average" and "Full"). It proposed various possible applications, definitions of the measurement points, measuring methods, sizing charts and the percentage of women in each class.

Several countries developed sizing standards or published reports on the subject in the fifties and sixties (*BS1345* of the *British Standard Institution* in 1945; survey by the *British Board of Trade* stating the need for 126 sizes to cover the female population in 1950; *DS923* of the *Denmark Standards Association* in 1954; anthropometric study by the *Polish Academy of Science* in 1954-59; United Kingdom report on the anthropometric measurements of military personnel in 1957; USSR conducts a survey in 1957-65; etc.)

Some believed that commercial standards would better serve their purpose if common to all countries. Seventeen countries formed the "International *Organization for Standardization" (ISO)* and implemented a TC133 "*technical committee*" entitled "*Sizing Systems and Designations*" in 1968.

4.3.6 **1970-2000: Countries Develop their Standards**

The *"Voluntary Product Standard" (PS 42-70)* for pattern development and grading (with increments of 1 inch in circumference and 1½ inch in height measurements for each size) was published in 1971 *"as a revision of the CS215-58"* (U.S. Dept. of Standards, 1971, p 1). It states (par. 1) that *"The objective of a Voluntary Product Standard is to establish requirements which are in accordance with the principal demands of the industry and, at the same time, are not contrary to the public interest".*

In 1975 the ISO developed and proposed a new standard for a size labelling system based on "key" body measurements, including a body pictogram. A similar system was proposed in Germany in 1983. Based on the anthropometric measurements of 9,402 subjects it concluded that 57 sizes were needed to cover 80% of the population, making a standard body chart too cumbersome to be useful (Yu, 2004).

Several other countries came up with their own body chart standards (Switzerland, 1972; *PC3137* and *PC3138* in the USSR, 1973; *GB1335-81* in China, developed in 1974 and implemented in 1981; anthropometric survey in Japan, 1978-1981; etc). Questions were also raised in America as to the relevance of sizing charts for market segments such as women aged 55 and over. Measurements of 6,000 American women age 55 and older were taken and used to develop *ASTM D5586-95*.

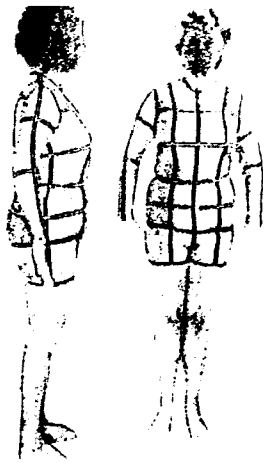

Figure 4.1 : Measuring suit used in the U.S. anthropometric study of women 55 and older (Goldsberry *et al.*, 1996)

4.3.7 New Millennium: Body Scanning to Update Anthropometric Data

Conscious of the need to update anthropometric data needed for the apparel industry several major initiatives were begun in the 1990's (with or without government organizations) in Asia, Europe and North America, using the *3D Body scanner* to accomplish this task. They scanned thousands of voluntary subjects of all ages (1992 to 1994, in Japan; 1999 to 2002, in the UK; 2002 and 2003, in the United States). To date, little has been published from this large amount of data. In some cases the studies were funded by the industry participants, for use in updating their own internal specifications. The impetus to create national standards does not exist fro these companies.

4.3.8 In Canada: Canadian General Standards Board

The Canadian General Standards Board (CGSB) has, over the decades, produced size standards and data charts copied from American standards for which "The principal objects of the Council are to foster and promote voluntary standardization as a means of advancing the national economy, benefiting the health, safety and welfare of the public, assisting and protecting the consumer, facilitating domestic and international cooperation in the field of standards." (CAN/CGSB-49.203-M87; p. 1). According to the CGSB, the best two horizontal measurements for garments designed to fit lower part of the body, are: waist girth and hip girth.

4.4 Conclusion

Numerous studies have been done and many articles written over the last century to understand garment sizing and possibly help the industry. A number focus on the development of standards from, ideally, well defined anthropometric data generated with a national survey using a statistically relevant sample. Some argue for regular revisions of standards while other take a more pragmatic view and point to the fact that we have, in the first years of the millennium, acquired tremendous amount of data which need to be analyzed.

Nowadays, body chart standards are debatable. It seams that the population varies (sizes and shapes) and that the industry desires to differentiate target market sizing.

Substantial literature also exists on the garment manufacturers' use of and adherence to national standards. In retrospect it appears that few manufacturers used the numerous anthropometric surveys and size charts produced. Schofield & LaBat (2005) analysed forty U.S. size charts from 1873 to 2000 and concluded that anthropometric data had limited impact and that grading practice pre-dated them by half a century. Some set their own sizing charts to serve their target customers (Burns and Bryant, 2002) and adhesion to standards is voluntary recalls Workman and Lentz (2000).

Finally, an important part of the literature looks at garment labelling. Notwithstanding the methods used to define size standards, manufacturers use the same key body measurements to size their garments (Beazley, 1997) (e.g. lower body key measurements constantly are: waist girth, hip girth and crotch height or leg length). Most of them use the same numerical size labelling system (6, 8, 10, ...24 or even 0 and 00) yet refer to their own size charts.

If, as some believe, size labels should help the consumer identify a well fitting garment, some steps need to be taken. The first is to determine if is possible to come to a manageable set of size standards that would cover the entire female population. The second, assuming the first is possible, is to elaborate the said standard presenting it in a manageable and intelligible manner to both producer and consumer. Finally, governments and the garment industry must come to an agreement to make use of the standards in a more universal format.

Yet these objectives will probably only become realistic once the industry realizes the tremendous variations currently existing in sizing and size labels and the consequent dissatisfaction it creates with the consumer. We demonstrated in an experimental research study in Faust *et al.* (2006) that there were measurement variations between garments labelled with the same given size.

In part II, we expand on these observations. We report on a research study conducted nationally with the collaboration of one of the largest Canadian retailers based on the measurement of more than 800 pants. Size specifications were in some instances determined by the retailer acting as the order initiator and, for manufacturer national brands, decided by the manufacturer. We present the methodology used to demonstrate the important variations in sizes within identically labelled garments. Our findings show that different order initiators target women of different body shapes; notably **A**, **X** and **H** shaped silhouettes and that they do not adhere to national standards. These findings lead us to hypothesize on the possible causes of these variations and the respective responsibilities of the order initiators and manufacturers. We conclude with a presentation of further research avenues, specifically on the adequacy of the current sizing offers given the actual female population and possible redefinition of the labelling system.

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CHAPITRE 5 : WOMEN'S WEAR SIZING: AN ANALYSIS OF THE CANADIAN SITUATION ON PANTS' SIZES (PART II)

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5.1 Abstract

Purpose – To demonstrate that garments identically labelled for size, in the Canadian market, show significant measurements variations.

Design/methodology/approach – Presents the methodology used in pre-testing and random selection of 800 items for measurement. Mathematical extrapolations were conducted to ensure comparability between different product styles. Proximity analyses between measurements within order initiators' lines of products and between order initiators were used to identify targeted market body shape.

Findings – Results show that identically size labelled pants (i.e.: 6, 8, 10...) measurements vary from one order initiator to another. Order initiators do not adhere to

the Canadian General Standards Board size standards and suppliers do not respect order initiators' specifications. Results also demonstrate that order initiators show consistency within their product lines.

Research limitations/implications – Our research focused only on women's pants in the Canadian environment. Further research will prove necessary to generalize our findings to all women's garments and to men's or children's.

Practical implications – Garment size labels lose their significance when identical size codes have different meaning from one item to the next. Our findings point to the necessity, in order for size labels to provide adequate information to the consumer, to look at different solution avenues such as making adherence to size standards compulsory for order initiators or developing a new labelling systems conveying information differently to the consumer.

Originality/value – To our knowledge, this is the first research demonstrating that order initiators do not adhere to set standard sizes. It is also the first study showing that different order initiators determine their measurements specifications with a clear body silhouette in mind (either **A**, **X** or **H** shape).

Keywords: Canada, Clothing, Fashion, Garment industry, Labelling, Ready-to-wear, Sizes, Women.

5.2 Introduction

Academics and practitioners interested in size labelling agree on the existence of wide measurement variations between identically size-labelled garments from different order initiators or bearing different brand names. Our research set out to prove the existence of such variations using women pants in the Canadian industry.

Over and above demonstrating this first point our research enabled us to determine that this situation is equally due to the order initiators not adhering to national standards and to suppliers not respecting the order initiators' specifications. These first level findings lead to the initial conclusion that size labels using identical size codes identifying garments of varying measurements lose all value to the consumer in her search for a well-fitting garment. In light of this conclusion and the assumed resulting consumer dissatisfaction with her shopping experience, we looked for a consistency in individual order initiators' deviations from standards and found that in most cases, they adhere to internal standards not in respect of national standards but adjusted to fit women of specific body shapes (defined as an **A**, **X** or **H** silhouette). This lead us to hypothesize in our conclusion on the relative merits of mandatory adherence to national standards, the creation of international standards or the reinvention of size labels.

5.3 Methodology

In Faust *et al.* (2006) we reported on an experimental research study where we looked into (1) the adherence of Canadian garment order initiators to the Canadian General Standards Board (CGSB) size standards, (2) the consistency of the size specifications they used within their product line, and (3) the suppliers' respect of the order initiators' specifications. Although we found the order initiators to show consistency within their product lines, our results demonstrated that they did not adhere to the CGSB standards and that, in turn, their suppliers did not respect the specifications given. In order to better comprehend this situation and its potential to affect consumer satisfaction, we conducted a national survey with the collaboration of one of the largest Canadian[59] retailers. For this survey we measured more than 800 women's pants. Before proceeding to the national survey, we first pre-tested our general hypotheses and tested and refined our methodology though a pilot test. We hereafter present these pilot test hypotheses, methodology and findings.

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[59] Largest Canadian garment retailer, by market share, in 2000, based on an internal document of the *Ministère de l'Industrie et du commerce du Québec*.

5.4 Pilot Test

5.4.1 Pilot Test Hypotheses

Our first hypothesis is that identically size-labelled pants (i.e.: 6, 8, 10...) from any order initiator should have identical measurements. The size label would then serve its purpose in helping consumers find fitting garments:

H_{p1}: Pants identically size-labelled have identical measurements;

H_{p1}.alt: Pants identically size-labelled do not have identical measurements.

The garment industry is global and highly specialized. A large number of order initiators and manufacturers do not actually cut and sew the garments they sell but subcontract these tasks to suppliers. To obtain consistency within their product lines, they provide specifications to their suppliers, leading to our second hypothesis:

H_{p2}: Suppliers respect the order initiators'[60] measurement specifications;

$H_{p2\text{-}alt}$: Suppliers do not respect the order initiator's measurement specifications.

Our third hypothesis focuses on the fact that all specifications allow for a certain tolerance giving the supplier a margin for human and mechanical error or lack of precision while still ensuring the discriminating aspect of the sizing system (i.e.: a size 6 remains a size 6 even at the tolerance limit and can not be confused with a size 8 or a size 4).

H_{p3}: Tolerances among measured pants do not reduce the size discriminating ability of the sizing system[61];

[60] The hypothesis only refers to one single order initiators who we study, the biggest retailer in Canada.
[61] Again limitation in this study since the hypothesis refers to one single order initiators.

$H_{p3\text{-}alt}$: Tolerances among measured pants reduce the size discriminating ability of the sizing system.

Our fourth and final hypothesis refers to Yoo and Rutherford-Black (1999) statement that order initiators have largely ignored standards to adopt sizing systems that are better adapted to their target market's body shapes.

H_{p4}: Order initiators adhere to national standards;

$H_{p4\text{-}alt}$: Order initiators do not adhere to national standards.

This last hypothesis derives from the literature pertaining to the existence of a number of female silhouettes and to the relationship between sizing standards and an "ideal" silhouette. Armstrong (1987, in LaBat & DeLong 1990) mentions that the commonly perceived ideal female figure influences garment sizing systems which are often based on proportions, or relationships between body parts. For some, this ideal figure has a shoulder width equal to hip width and a bust girth equal to hip girth; waist girth being 9 to 11 inches smaller. For others the ideal should have 10 to 12½ inch difference between bust and waist and between hip and waist. "Body specifications used for apparel sizing by such merchandisers as Sears, J.C Penney, and Land's End show conformity to this basic proportion and balance"(LaBat & DeLong, 1990; p. 44).

Rasband &Liechty (2006) state that almost no one has the ideal silhouette used in pattern and clothing where bust and hip circumference are identical with a waist circumference approximately 10 inches smaller. "It doesn't take that much people watching to discover that figures are different from one another" (Rasband & Liechty, 2006; p. 19). They identify seven figure types beside the ideal figure type: Triangular, Inverted Triangular, Rectangular, Hourglass, Diamond, Tubular, and Round.

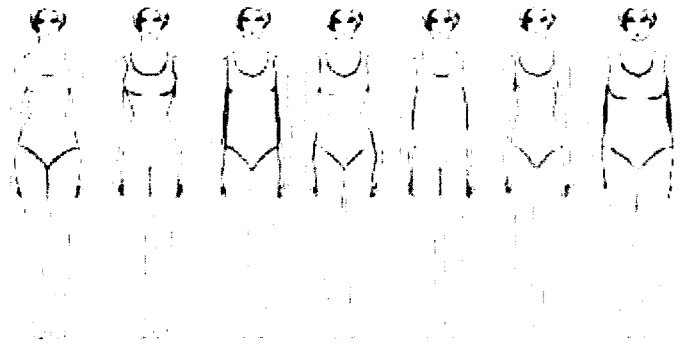

Figure 5.1 : Figure types[62]

They describe each figure type and define measurements for some of them (e.g.: Rectangular should have a waist circumference 7 inches or less smaller than bust or hip; Hourglass should have a waist circumference 11 or more inches smaller than bust and hip circumference; etc). [TC]^2 also set some conditions for silhouettes definitions (e.g. Hour Glass has shoulder width and hip width within 2 inches of each other and a hip circumference more than 10 inches larger than the waist circumference; Straight Profile has shoulder to shoulder width within 2 inches of hip width and a hip circumference less than 8 inches larger than the waist circumference; etc), ([TC]^2 2004).

We therefore not only needed to determine (1) if order initiators adhered or not to national standards but also, when not (2) if they adapted their sizing systems to fit a specific market. To accomplish this, we grouped the measured garments in lower body shape categories. We then stated that a smaller than seven inches waist to hip girth difference would be classified as an **H** silhouette; that a waist to hip girth difference of between 7 and 11 inches would be classified as an **X** silhouette; and that a waist to hip girth difference exceeding 11 inches would be classified as an **A** silhouette.

[62] Rasband & Liechty, 2006; Cover page

5.4.2 Pilot Test Measurements and Findings

We first conducted a pilot test with a sample slightly in excess of 200 pants, in sizes ranging from size 4 to 18, to:

1. verify that some variations existed in the measurements of identically size labelled pants; and
2. identify an adequate and reliable measurement method for the subsequent major analysis.

We used a convenience sample for the pilot test. Pants were gathered based on their accessibility in the store's racks.

Measurement technicians were instructed to manually record information such as style, labelled size, and measurements obtained on a master sheet. Pants were laid one by one flat on the measurement table. The first measurement point was the waist band circumference, followed by garment width taken at points 5cm, 10cm, 15cm, and 20cm from the top of the pant. Thigh width was taken at the crotch. Front leg length, back leg length and inseam length were also measured. Finally, front and back rise were measured from waist to crotch (Figure 5.3). Data were then transferred to an Excel spreadsheet for analysis. All styles were identified alphabetically using a sequential alphabetical naming (A, B, C..., Ap, Bp, ...) in order both to simplify our data sheets and to eliminate any kind of brand name bias in subsequent information treatment. A, B, C letters represent the regular sizes and Ap, Bp, etc. represent the petite. Take note that the results present in the next part only refer to regular sizes.

Tableau 5.1 : Manual data entry sheet for pants measurements (styles and sizes (*sku*) with 5 repetitions)

	Style	Size	Repetition	WA	HH1	HH2	LH1	LH2	TH	FR	BR	IN	WA.1
Regular	**A**	6	a										
	A	6	b										
	A	6	c										
		...											
	A	**8**	a										
		...											
	B	6	a										
		6	b										
		...											
	...												
Petite	**Ap**	4	a										
		4	b										
			...										
		6	a										
		...											
	...												

The pilot test led us to reject our four hypotheses. H_{p1} (identical measurements for identical size labels) was rejected as the results from the test showed that width measurements differed from one style to another in identical size labelled pants. Front rise and back rise length were different from one garment style to another so data were extrapolated to compare valid waist and hip width measurements in different pant styles (Figure 5.2).

The pilot test results revealed that manufacturers did not respect the order initiator's specifications (even taking the tolerances into account) forcing us to reject our H_{p2}. We also rejected H_{p3} (discriminating ability of sizing system) on the basis of our results showing that measurements for identically size labelled pants vary from one to another with some overlapping existing between two sizes. In comparing a specific hip measurement point for all the styles in sizes 6 and sizes 8, we found; some of the sizes 6 to be equal or larger than a size 8.

Finally our findings, through a mathematical grouping function, enabled us to identify underlying body shapes (**A**, **H** and **X** silhouettes) in the pant measurements used forcing us to reject our H_{p4} to the effect that they would adhere to national standards.

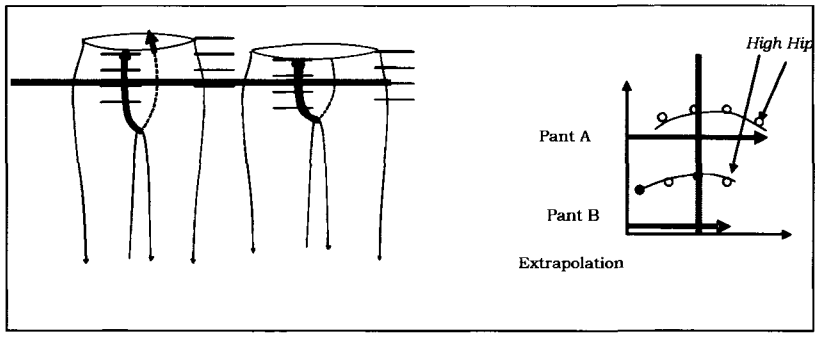

Figure 5.2 : Diagram showing comparison of width measurement heights

Yet the most important contribution of our pilot was to help us develop our methodology and select appropriate measurement tools. It also enabled us to conceive a mathematical application, polynomial extrapolation, to allow between-style measurement comparisons.

5.5 Research and findings

5.5.1 Research sample Selection

We elected not to sample styles and sizes (S&S) but to measure all pants offered for the Autumn & Winter 2004-2005 season (moment of our research). All measurements were made at the retailer's distribution centre in Canada in the period from September 2004 to January 2005. We had 31 pant styles (24 *Regular* and 7 *Petite* styles) available for the study. Each style came in five to seven sizes (from size 4 to 24 depending on the style); a total of 138 *Regular* S&S and 35 *Petite* S&S were measured.

To ensure the reliability of our data, we measured five pants of each S&S (e.g.: five pants in style A, size 6, five pants in style A size 8, etc). Pants were randomly pulled from the distributor's stock. A total of 866 pants were measured: 679 *Regular* pants and 187 *Petite* pants. Two measurement technicians made all measurements. Some S&S were out of stock before attendants had time to measure them and were therefore the object of fewer measurements. Inter and intra reliabilities of measuring technicians were analysed. Even if variations existed they were not statistically significant.

5.5.2 Research Pants Measurement Method

The pilot test confirmed our understanding of the literature and enabled us to better identify the horizontal and vertical measurement points of interest.

The horizontal measurement points we chose to measure were:

1. WA for waist girth;
2. HH1 for very high hip width (i.e. at 3 2/8" from the top for *Regular* sizes and at 2 7/8" from the top for *Petite* sizes);
3. HH2 for high hip width (i.e. at 5 ½" from the top for *Regular* and at 4 ¾" from the top for *Petite)*;

4. LH1 for the hip width (i.e. at 8" from the top for *Regular* and at 7 ¼" from the top for *Petite)*;
5. LH2 for the low hip width (i.e. at 10 ½" from the top for *Regular* and at 9" from the top for *Petite)*;
6. TH for the thigh girth one inch bellow the crotch.

The vertical measurement points were:

1. FR for front rise length;
2. BR for back rise length;
3. IN for inseam length;
4. WA1 for the length of the waist band (when pants had added waist band).

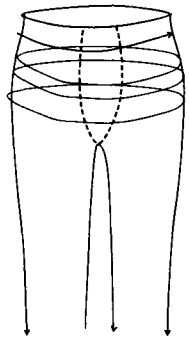

Figure 5.3 : Horizontal and vertical point measurements

All measurements were done positioning pants flat on the table. The exact positioning of the garment on the table replicated the method proposed by the retailer in "*How to Measure*" section of its catalogue and took into consideration the experience acquired in the pilot test. All measurements were read in one eight of an inch increment and converted to decimals when transferred to the *Excel* spreadsheet.

All sets of pants (usually 5 pants) were distributed to the measurement technician so both would be involved on all sets (i.e. 3 out of 5 style "A" size 6 pants measured by technician "X" and the other 2 by technician "Y") in order to minimize technician bias. All data were entered on a manual spreadsheet identifying styles with an alphabetical code as in the pilot test.

5.5.3 Research Measurement Attendants Training

Both measurement technicians were trained to ensure measurements would always be done the same way. Both technicians worked for the Retailer's quality control department. After a first training session, both technicians were asked to measure the same 10 pants. Results differed between technicians, although the differences were not statistically significant.

5.5.4 Research Equipment and Tools

The equipment and tools used for this study were mostly traditional.

Tables

Two measuring tables (i.e., one for each measurement attendant) were permanently installed in the warehouse. Each table had a measuring tape embedded.

Pocket measuring tape

Pocket measuring tapes were also used. Each measuring technician had their own pocket measuring tape. Both tapes were compared and had the same measuring standard. One side was graded in centimetres and the other one in inches. Measurement technicians found it easier to measure with the pocket measuring tape than with the tables' embedded measuring tapes.

Recording sheet - Master-sheet

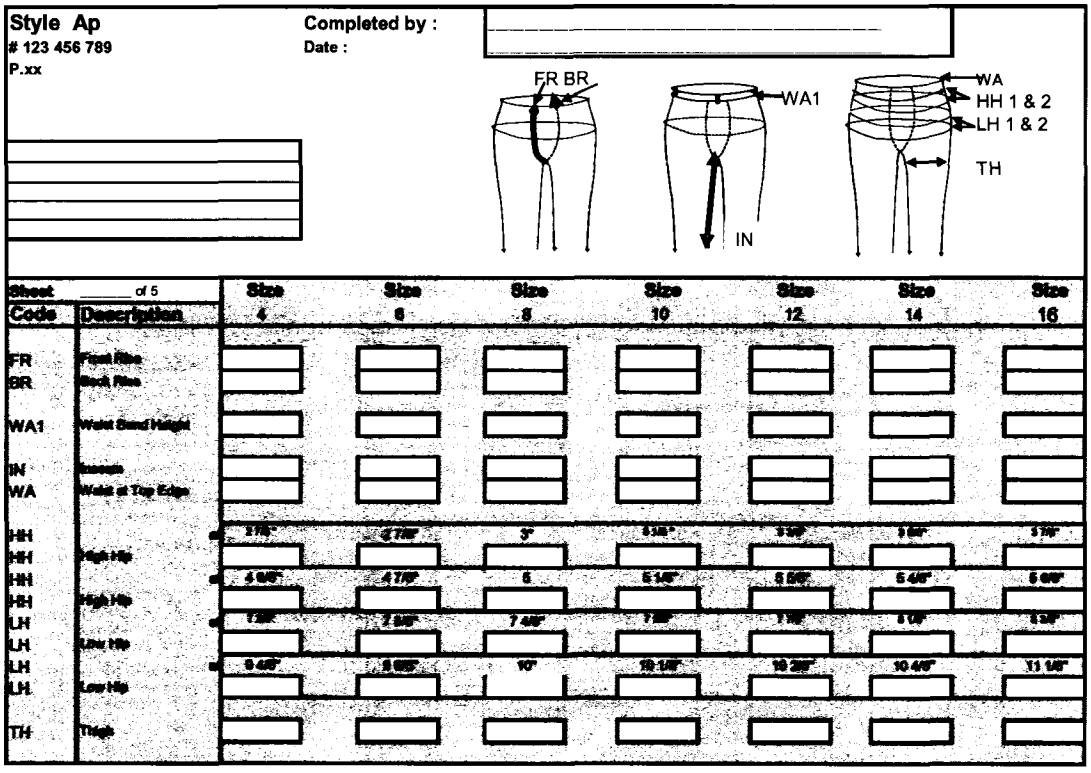

Figure 2.4 : Master-sheet for Style "A"

Five master-sheets, one for each S&S were prepared and given to the measurement technicians to record the data: technician name, date and the measures obtained for each sizes. Illustrated sketches were put on each master-sheet as a reminder of the measurement method and points.

Other simple tools were used such as hangers, needles etc.

5.5.5 Research Samples Selection

Measurement technicians were provided with no information with regards to statistical tools or tables to guide them in their gathering of samples to measure. They were simply asked to go to the stock locations of the items and to pick, at random, five units of the product, ensuring that it was the proper item number to measure. We believe that sample collection was done randomly in the warehouse.

5.5.6 Research Data Collection and Classification

The collected data were first classified in two groups: 24 *Regular* styles and 7 *Petite* styles. *Regular* styles were renamed A to X and *Petite* styles were renamed Ap to Gp. Data on the technicians' manual spreadsheets were transferred to an *Excel* spreadsheet by the researcher. Data analysis was done using both *Excel* and *Statistica*. Standard deviations were calculated for each set of 5 pants. Dispersion was, in all cases, small enough to justify using the average (of the five) measurement for each S&S for analysis.

As mentioned when key point measurements were not available on certain styles, we calculated it using a polynomial extrapolation mathematical function to ensure comparable data. All extrapolations were calculated from the crotch. Data analysis is based on these corrected measurements at 3 inches, 5 inches and 7 inches from the crotch (Figure 5.2).

5.5.7 Research Hypotheses

Our pilot test had led us to reject our four hypotheses. We needed to validate those findings with a full study.

First Hypothesis

In order for a sizing system to help consumers rapidly identify a potentially fitting garment, all pants of a given size (i.e.: 6, 8, 10...), regardless of style or manufacturer, should have the same measurements.

H_1: Pants identically size-labelled have identical measurements.

To validate this first hypothesis, we conducted three analyses. Our first, we named *within-within,* analyzed measurements obtained for a same style in each size (same SKU). Our second, named *within-between,* compared measurements of pants from a same supplier but offering different styles; again for each size. Our third, *between-between,* compared pants from different suppliers and obviously of different styles; again in all sizes.

Second Hypothesis

Order initiators do not, in most cases, manufacture the products; they generally concentrate on the value added processes such as garment design, grading, and marketing. They subcontract the other processes (cutting, sewing, finishing). The consistency in sizing they show within their lines is therefore highly dependent on their suppliers' respect of the specifications they write.

H_2: Suppliers respect the order initiator's measurement specifications.

To validate this hypothesis we first needed to obtain the order initiator's specifications and then compare the actual garment measurements against those specifications. As we were unable to get the national brand names' specifications we had to limit our analysis to those products for which our partner retailer was the order initiator. Therefore only approximately 50% of the pants measured could be used for this part of our analysis.

Third Hypothesis

Tolerances in measurement specifications are a necessity to account for normal human or mechanical lack of precision. Yet they should not be important enough to render a product unusable or, in the case of garments, to eliminate the discriminating ability of the sizing system.

H_3: Tolerances allowed by order initiators do not reduce the size discriminating ability of the sizing system.

To validate this hypothesis, we compared the garments' specified measurements accounting for tolerances to see if the maximum acceptable measurement of one size was sufficiently distant form the minimum allowed measurement in the next larger size.

Fourth Hypothesis

Finally our fourth hypothesis set to determine whether order initiators (according to measured pants and not according to their specifications) adhere to national standards:

H_4: Order initiators adhere to national standards.

To validate this hypothesis, we used the extrapolated data (adjusted measurements) obtained with the polynomial extrapolation mathematical function used to define underlying shapes such as **A**, **X** and **H** shapes for each styles as some styles may not lend themselves to a measurement at a point specified by the standards (e.g., "low-rises" do not have a traditional waist as the concept was perceived at the time of the standards' elaboration some 50 years ago).

5.5.8 Research Analysis and Findings

We present our analyses and findings independently for each hypothesis.

First Hypothesis

To validate our first hypothesis, we conducted three analyses for each size (4, 6, 8, etc.).

Dispersion "within-within"

A priori, results were the same as found in the pilot test (measurements were consistent within a style). We compared pants (Tableau 5.2) of given sizes, of one style, and in different colors within each style (using *T-tests*). Results showed no dispersion within a given style (again n value was five measured pants for each size and color).

Tableau 5.2 : Tests comparing styles R and T in different colors in size 14

T-tests; Grouping: Nom
Group 1: Style R
Group 2: Style T
Include condition: grandeur = 14

Variable	Mean R	Mean T	t-value	df	p	Valid N R	Valid N T	Std.Dev. R	Std.Dev. T	F-ratio Variances	p Variance
FR	10,27500	10,40000	-1,88982	8	0,095452	5	5	0,136931	0,055902	6,00000	0,1107
BR	15,05000	15,07500	-0,22086	8	0,830732	5	5	0,209165	0,142522	2,15385	0,4757
WA	18,05000	17,75000	1,75977	8	0,116488	5	5	0,111803	0,364434	10,62500	0,0418
HH1	20,37970	20,52970	-0,64055	8	0,539725	5	5	0,199311	0,484212	5,90213	0,1137
HH2	21,39504	21,52004	-0,62646	8	0,548467	5	5	0,151524	0,419653	7,67039	0,0736
TH	13,88878	14,03878	-1,23749	8	0,250994	5	5	0,215336	0,164602	1,71144	0,6154
IN	30,92500	30,85000	0,84853	8	0,420806	5	5	0,142522	0,136931	1,08333	0,9400

We also performed an ANOVA (Tableau 5.3) comparing pants of given sizes, of same style in three different colors. Results showed no significant difference (p-value > 0,05) within a style (again n value was five measured pants for each size and color).

Tableau 5.3 : ANOVA comparing styles R, S and T in different colors for a size 14

Variable	Analysis of Variance Marked effects are significant at p < ,05000 SS Effect	df Effect	MS Effect	SS Error	df Error	MS Error	F	p
WA	0,958554	2	0,479277	208,5720	88	2,370136	0,202215	0,817298
HH1	0,092813	2	0,046407	155,5937	88	1,768110	0,026246	0,974103
HH2	0,300252	2	0,150126	168,9526	88	1,919916	0,078194	0,924849
TH	0,043179	2	0,021589	81,1299	88	0,921931	0,023417	0,976861
FR & BR	1,476300	2	0,738150	152,9990	88	1,738625	0,424560	0,655390

Figure 5.5 is drawn from our analysis using *Statistica* and presents the measurements for the ANOVA showing the same results differently.

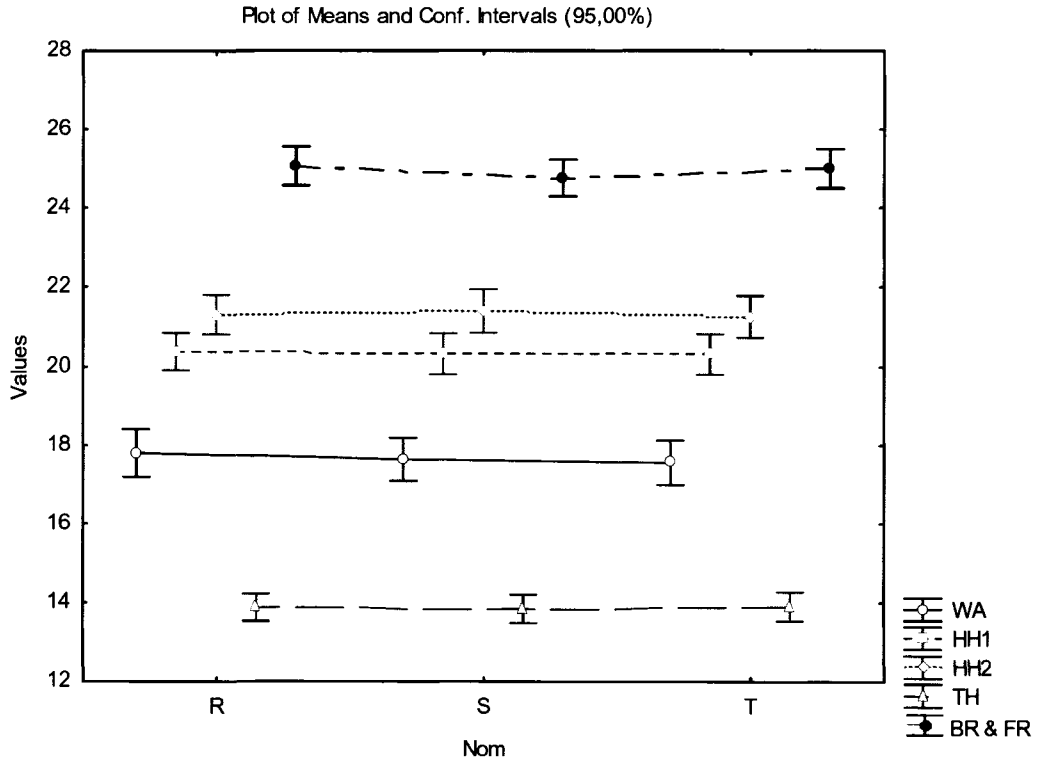

Figure 5.5 : Average measurements (n=5) of styles R, S and T, in size 14 compared

Dispersion "within-between"

We repeated the analysis comparing different styles in given sizes obtained from a same supplier. Results showed significant measurements variations from style to style for almost every size (Tableau 5.4). Distance measures of similarity, based on the extrapolated data, clearly demonstrated that some styles were closely related, within a given size, while others differed widely.

Tableau 5.4 : Extract of the distance measures of similarity for some styles in size 6

	6									
	a	k	j	f	g	b	e	d	m	l
6 a	0	[illegible]	9,495	11,6	15,63	19,6	20,21	20,49	29	31
6 k	[illegible]	0	[illegible]	7,461	10,32	10,91	17,4	14,34	22,4	22,5
6 j	9,495	[illegible]	0	1,793	[illegible]	1,896	7,775	[illegible]	8,08	8,03
6 f	11,6	7,46	1,793	0	[illegible]	[illegible]	4,573	[illegible]	5,22	5,44
6 g	15,63	10,3	[illegible]	[illegible]	0	[illegible]	8,965	[illegible]	4,95	5,06
6 b	19,6	10,9	1,896	[illegible]	[illegible]	0	6,978	1,824	[illegible]	[illegible]
6 e	20,21	17,4	7,775	4,573	8,965	6,978	0	[illegible]	4,11	6,22
6 d	20,49	14,3	[illegible]	[illegible]	[illegible]	1,824	[illegible]	0	1,9	[illegible]
6 m	29,03	22,4	8,085	5,221	4,946	[illegible]	4,11	1,896	0	0,49
6 l	31,03	22,5	8,025	5,441	5,061	[illegible]	6,219	[illegible]	0,49	0

Tableau 5.5 : Extract of the distance measures of similarity for all styles in size 6

	1	1	1	1	1	2	2	2	2	3	3	3	3	3	3	4	4	4	4	4
	B-6	N-6	P-6	Q-6	X-6	A-6	O-6	W-4	W-6	D-6	E-6	H-6	K-6	L-6	T-6	F-6	G-6	M-6	P-4	V-6
1 B-6	0,0000	0,3513	0,9426	0,8013	1,0887	1,5634	2,3500	1,1452	1,0151	1,6258	1,6186	1,1889	1,5858	1,9698	1,6055	0,9214	1,3786	0,9051	1,2934	2,8131
1 N-6	0,3513	0,0000	0,7411	0,6246	1,0273	1,3601	2,0434	1,0287	0,9973	1,8864	1,8677	1,3669	1,8582	2,1729	1,8429	0,6117	1,1217	0,6038	1,0571	2,5349
1 P-6	0,9426	0,7411	0,0000	0,3254	0,5183	0,8747	1,6002	0,9801	0,9567	2,0897	2,1724	1,6748	2,1908	2,3342	2,1384	0,7221	1,3564	0,8427	0,5583	2,3851
1 Q-6	0,8013	0,6246	0,3254	0,0000	0,4884	1,1531	1,8250	1,2000	1,1429	2,0937	2,1416	1,7047	2,1805	2,4223	2,1193	0,7435	1,2505	0,7789	0,6401	2,4595
1 X-6	1,0887	1,0273	0,5183	0,4884	0,0000	1,1916	1,9789	1,3653	1,2215	2,0164	2,1444	1,7865	2,1863	2,3663	2,1236	1,1658	1,6868	1,2265	0,8050	2,7223
2 A-6	1,5634	1,3601	0,8747	1,1531	1,1916	0,0000	1,1235	0,9969	0,9882	2,2360	2,2971	1,7459	2,3722	2,2965	2,2449	1,2632	1,9487	1,4661	1,2054	2,6576
2 O-6	2,3500	2,0434	1,6002	1,8250	1,9789	1,1235	0,0000	1,7248	1,9347	3,3267	3,3453	2,7509	3,4149	3,3420	3,2958	1,6400	2,0245	1,8189	1,5505	2,1325
2 W-4	1,1452	1,0287	0,9801	1,2000	1,3653	0,9969	1,7248	0,0000	0,4276	1,9113	2,0283	1,3674	1,9110	1,8637	1,9794	0,9529	1,6698	1,1655	1,2631	2,4868
2 W-6	1,0151	0,9973	0,9567	1,1429	1,2215	0,9882	1,9347	0,4276	0,0000	1,5236	1,6534	1,0324	1,5720	1,5385	1,6089	1,1453	1,8811	1,3300	1,3813	2,8510
3 D-6	1,6258	1,8864	2,0897	2,0937	2,0164	2,2360	3,3267	1,9113	1,5236	0,0000	0,5015	0,7805	0,4138	0,7122	0,4834	2,3881	2,9848	2,4524	2,5864	4,2395
3 E-6	1,6186	1,8677	2,1724	2,1416	2,1444	2,2971	3,3453	2,0283	1,6534	0,5015	0,0000	0,7028	0,5103	0,9919	0,1428	2,4096	2,9624	2,4595	2,6933	4,3248
3 H-6	1,1889	1,3669	1,6748	1,7047	1,7865	1,7459	2,7509	1,3674	1,0324	0,7805	0,7028	0,0000	0,7120	0,9481	0,6431	1,8328	2,4409	1,9142	2,1851	3,7043
3 K-6	1,5858	1,8582	2,1908	2,1805	2,1863	2,3722	3,4149	1,9110	1,5720	0,4138	0,5103	0,7120	0,0000	0,7322	0,4898	2,3659	2,9165	2,4138	2,6689	4,2047
3 L-6	1,9698	2,1729	2,3342	2,4223	2,3663	2,2965	3,3420	1,8637	1,5385	0,7122	0,9919	0,9481	0,7322	0,0000	0,9334	2,5658	3,2161	2,6719	2,8100	4,2918
3 T-6	1,6055	1,8429	2,1384	2,1193	2,1236	2,2449	3,2958	1,9794	1,6089	0,4834	0,1428	0,6431	0,4898	0,9334	0,0000	2,3781	2,9414	2,4276	2,6612	4,2823
4 F-6	0,9214	0,6117	0,7221	0,7435	1,1658	1,2632	1,6400	0,9529	1,1453	2,3881	2,4096	1,8328	2,3659	2,5658	2,3781	0,0000	0,7569	0,2659	0,7366	1,9516
4 G-6	1,3786	1,1217	1,3564	1,2505	1,6868	1,9487	2,0245	1,6698	1,8811	2,9848	2,9624	2,4409	2,9165	3,2161	2,9414	0,7569	0,0000	0,5937	1,1388	1,6575
4 M-6	0,9051	0,6038	0,8427	0,7789	1,2265	1,4661	1,8189	1,1655	1,3300	2,4524	2,4595	1,9142	2,4138	2,6719	2,4276	0,2659	0,5937	0,0000	0,8104	1,9496
4 P-4	1,2934	1,0571	0,5583	0,6401	0,8050	1,2054	1,5505	1,2631	1,3813	2,5864	2,6933	2,1851	2,6689	2,8100	2,6612	0,7366	1,1388	0,8104	0,0000	1,9201
4 V-6	2,8131	2,5349	2,3851	2,4595	2,7223	2,6576	2,1325	2,4868	2,8510	4,2395	4,3248	3,7043	4,2047	4,2918	4,2823	1,9516	1,6575	1,9496	1,9201	0,0000

In Tableaux 5.4 and 5.5 small values denote high similarity between styles whereas larger values denote low similarity.

Dispersion "between-between"

We again repeated the analysis using different styles from different suppliers in all sizes.

Tableau 5.6 : Extract of the distance measures of different styles in different sizes

	0,5	1	1	1,2	1,5	1,5	2	2	2	4	4
	E-12	A-12	E-10	A-10	E-8	G-12	A-8	G-10	G-8	A-14	E-14
0,5 E-12	0	1,5394	1,3333	3,3826	3,2743	3,2636	5,9446	5,7753	6,5018	2,1342	2,8835
1 A-12	1,5394	0	1,0659	1,9812	2,4684	2,4107	4,711	4,8128	5,5602	2,6703	4,0972
1 E-10	1,3333	1,0659	0	2,2431	1,9452	1,9318	4,6447	4,4456	5,1729	3,2134	4,2147
1,2 A-10	3,3826	1,9812	2,2431	0	1,6203	1,5063	2,7783	3,1529	3,8892	4,5728	6,0739
1,5 E-8	3,2743	2,4684	1,9452	1,6203	0	0,1342	2,8981	2,5162	3,2292	5,0627	6,1576
1,5 G-12	3,2636	2,4107	1,9318	1,5063	0,1342	0	2,8486	2,5178	3,2448	5,0216	6,1456
2 A-8	5,9446	4,711	4,6447	2,7783	2,8981	2,8486	0	1,3487	1,7252	7,345	8,762
2 G-10	5,7753	4,8128	4,4456	3,1529	2,5162	2,5178	1,3487	0	0,7926	7,4739	8,6562
2 G-8	6,5018	5,5602	5,1729	3,8892	3,2292	3,2448	1,7252	0,7926	0	8,2227	9,3853
4 A-14	2,1342	2,6703	3,2134	4,5728	5,0627	5,0216	7,345	7,4739	8,2227	0	1,9159
4 E-14	2,8835	4,0972	4,2147	6,0739	6,1576	6,1456	8,762	8,6562	9,3853	1,9159	0

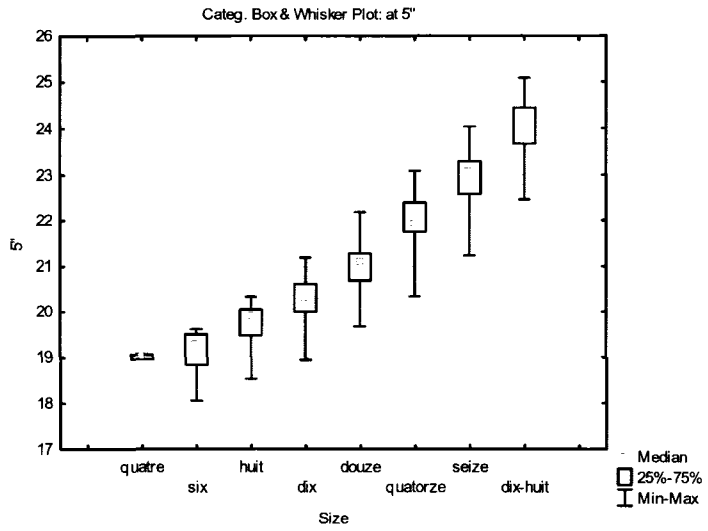

Figure 5.6 : Dispersion graphic of extrapolated measurements at 5 inches for all Regular pants sizes from 4 to 18, n=679.

The histogram in Figure visually and numerically shows the variations in measurements for a given size. Numerous measurements overlaps between sizes can be seen. For example, a precise hip measurement point taken at 5 inches from the crotch, for all styles in size 6 and in size 8 resulted in some size 6 pants having the exact same measurements as some size 8 pants and even some size 10 pants.

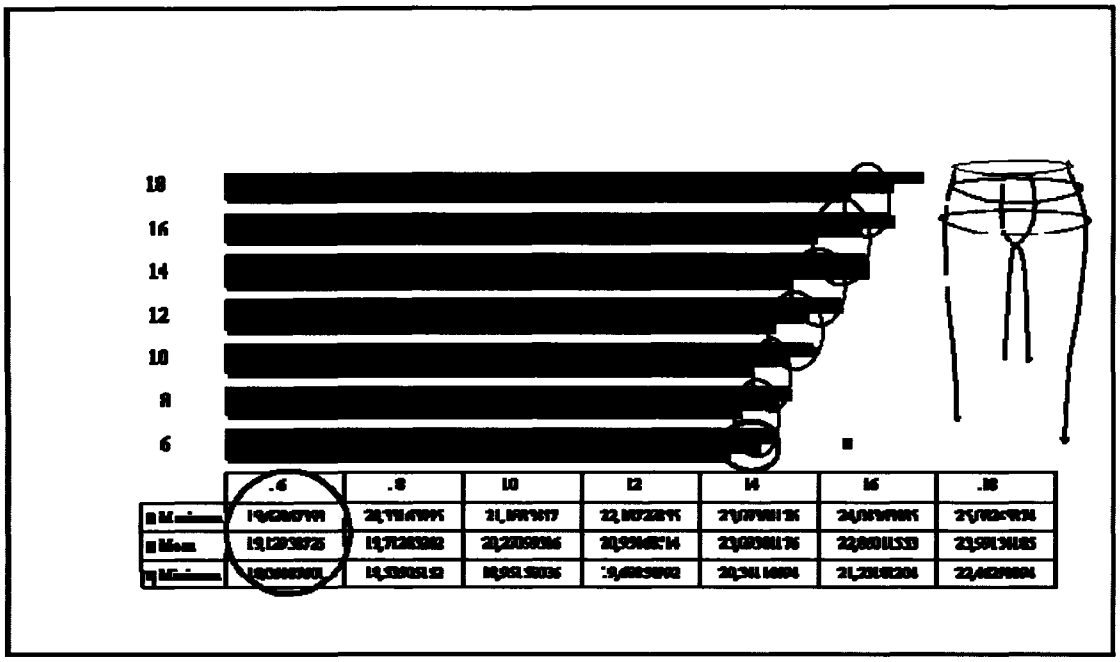

Figure 5.7 : Extrapolated measurements at 5 inches for different sizes.

We therefore rejected our first hypothesis as identically size labelled pants clearly do not have the same measurements.

Second Hypothesis

To validate our second hypothesis we compared our measurement results with the specifications provided by the order initiator. Tableau 5.7 presents a few selected examples showing discrepancies. We rejected our second hypothesis as suppliers did not respect this order initiator's specifications. Interestingly, we find this non-respect more importantly at the upper specification than with the lower specification.

Tableau 5.7 : Actual VS specified measurements for the order initiator's style-sizes

Style	Size	Specification (real or extrapolated) at 5 inches above the crotch	Actual or extrapolated average measurements at 5 inches above the crotch	Respect of specifications and tolerances (YES-NO)	
				Lower	Upper
H	8	15 ½ (+ or – ½ tolerance)	15 ½ to 16	YES	NO
H	10	15 ¾ (+ or – ½ tolerance)	16 ¼ to 17	YES	NO
M	12	16 ½ (+ or – ½ tolerance)	16 ½ to 17 ½	YES	NO
N	14	17 $^{1}/_{8}$ (+ or – ½ tolerance)	17 ¼ to 17 ¾	YES	NO
R	16	18 ½ (+ or – ½ tolerance)	18 ½ to 19 ¼	YES	NO

Third Hypothesis

As can be seen in Figure and Tableau 5.7 above, we identified numerous measurements overlaps between sizes. For example, a waist measurement specification of 29 inches, in size 8 pants, with a tolerance of ½ inch meets a waist measurement in the next size up (size 10) of 30 inches again with a tolerance of ½ inch. The high end of the first is identical to the low end of the second with the resulting confusion in distinguishing one size from the other. In theory, a supplier could manufacture a lot of pants with a 29 ½ waist and label half of them size 8 and the other half size 10 and still meet the order initiator's specifications.

We rejected our third hypothesis as the specifications provided by the order initiator, notwithstanding the suppliers' adherence or non-adherence, reduce the discriminating ability of the sizing system.

Fourth Hypothesis

A simple comparison such as the one presented in Tableau 5.8 for selected styles in 6 size allows us to conclude that this order initiator does not adhere to the national standards and that we need to reject our fourth hypothesis.

Tableau 5.8 : Canadian waist standard VS waist measurement for size 6

	Canadian National Standard	Size 6 Specification Style K	Specification Style H	Specification Style R
Waist	22 ¾	28	29 ½	30

The fourth hypothesis is rejected.

Cluster Analysis

Having rejected our four hypotheses, we wondered why the order initiator would opt for such an approach. Burns & Bryant (2002) offered a potential explanation when they stated that order initiators adapted their sizing system to fit the women in their target market.

We were able, based on the measurements taken and the extrapolations realized, to cluster pants in three groups according to underlying shape as done by Ashdown (1998). They, notwithstanding variations in sizes, fit in the generally accepted **A**, **X** and **H** categories. Data from styles J and K clustered in all sizes underlying an **X** shape, while data from styles A and P clustered with an underling **A** shape. Approximately 35% of the styles measured in our research were **A** shape, 60 % were **X** shape and only 5 % were **H** shape (according to our definitions of such shapes).

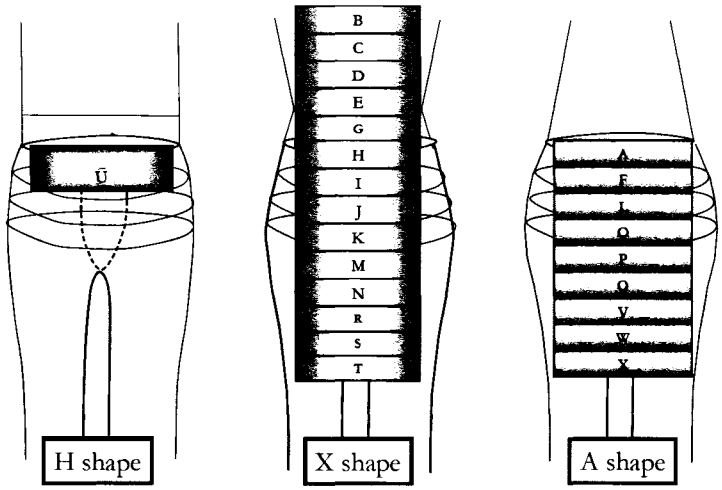

Figure 5.8 : Pants underlying shapes

Upon investigation we were told that styles J and K were provided by a single supplier while the styles D and E were manufactured by another supplier. Tableau 5.9 shows how styles clustered (different color) for each size. In most cases notwithstanding the sizes, shapes remain the same.

Tableau 5.9 : Clustered pants styles according to their underling shapes (refer to figure 8 for shapes)

6	8	10	12	14	16
K T L	I J K R S T C F	I J K R S T F	I J K R S T C F	J K R S T C	J K R S T C
H D E B G M N	H D E G M N	H D E B G M N U	H D E B G M N	H D M N U	H D E B M N U
A P Q W F O V X	A P Q W L O V X	A P Q W L O V X	A P O V X	A P O V X	A P W O V X

We also noticed that pants style R, S and T previously analyzed (when comparing differences *within-within*) formed a cluster (Tableau 5.9, in blue). Distance measures of similarity presented in next table provide an example of proximity of styles D and E.

Tableau 5.10 : Distance measures of similarity for D and E's styles

	1	1	1,5	1,5	2	2	3	3	4	4	5	5
	D-6	E-6	D-8	E-8	D-10	E-10	D-12	E-12	D-14	E-14	D-16	E-16
1 D-6	0	0,1626	1,0075	0,9788	2,2628	2,5382	3,8648	3,6899	5,4423	5,9952	7,7051	8,0188
1 E-6	0,163	0	1,107	1,0435	2,3466	2,6223	3,955	3,7703	5,5259	6,0802	7,7932	8,1063
2 D-8	1,007	1,107	0	0,2624	1,2774	1,5392	2,8611	2,6894	4,4416	4,9907	6,7023	7,0132
2 E-8	0,979	1,0435	0,2624	0	1,3227	1,5868	2,9237	2,7291	4,4876	5,0407	6,758	7,0685
2 D-10	2,263	2,3466	1,2774	1,3227	0	0,3586	1,6296	1,4788	3,1879	3,7535	5,4522	5,7741
2 E-10	2,538	2,6223	1,5392	1,5868	0,3586	0	1,3379	1,1634	2,9068	3,4595	5,1736	5,485
3 D-12	3,865	3,955	2,8611	2,9237	1,6296	1,3379	0	0,3959	1,5924	2,142	3,8425	4,157
3 E-12	3,69	3,7703	2,6894	2,7291	1,4788	1,1634	0,3959	0	1,7877	2,317	4,0524	4,3466
4 D-14	5,442	5,5259	4,4416	4,4876	3,1879	2,9068	1,5924	1,7877	0	0,6106	2,2757	2,5963
4 E-14	5,995	6,0802	4,9907	5,0407	3,7535	3,4595	2,142	2,317	0,6106	0	1,7519	2,0301
5 D-16	7,705	7,7932	6,7023	6,758	5,4522	5,1736	3,8425	4,0524	2,2757	1,7519	0	0,4535
5 E-16	8,019	8,1063	7,0132	7,0685	5,7741	5,485	4,157	4,3466	2,5963	2,0301	0,4535	0

5.6 Conclusion

Our findings clearly show that garment sizes do not correspond to the national standards. It also demonstrates that apparel manufacturers may cut and sew pants according to their own specifications more or less regardless of the order initiators' measurements. It also brings forth the fact that order initiators' tolerances can be too generous thereby diminishing the size discriminating ability that size standards purport to create. We therefore have come to the conclusion that garment size labels do not serve their initial purpose, which was to help the consumer in her search process.

Our research also enabled us to observe that some pant manufacturers may not respect the order initiators' specifications but rather appear to establish their own. Theses "modified" specifications do not use random measurements but adhere to a certain underlying body shape.

These observations lead us to a number of questions and future research avenues. The first is why order initiators accept, or if they notice, that suppliers do not respect their specifications.

A second question would lead us to try and determine if the order initiators' also have, as appears to be the case for suppliers, an underlying body shape in mind when they set their specifications. As a corollary to this second interrogation, one would certainly look into the order initiator's target market to evaluate the adequacy of the selected body shape and eventually its relative success.

From a different perspective one can also identify a number of research avenues pertaining to standard sizes. Why do the existing standards not account for different body shapes? Is it possible to devise a set of standards that could accommodate all of the necessary body shapes and sizes while remaining manageable at the manufacturing and retailing levels?

From a technological perspective one may ask if and how the new body scanning, cutting and assembling or Internet retailing technologies will impact the need for garment standards.

We surmise, from the present situation, that manufacturers can not be forced to adhere to any national standards. With globalization, the concept of national standards itself tends to be obsolete. Yet women in general, and women of different ethnic backgrounds, come in different body shapes. With the ever increasing importance of distance retailing and keeping the consumer's satisfaction in mind, the question begs to be asked as to "what type of information should size labels convey to help consumers find the clothes that best fit best their size and shape?"

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CHAPITRE 6 : WOMEN'S WEAR SIZING: AN ANALYSIS OF SIZE STANDARDS (PART III)

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Nous avons étudié les standards et les spécifications des vêtements prêt-à-porter et analysé les mesures de pantalons dans les trois articles précédents. Les deux articles suivants portent sur les mesures corporelles. Dans un premier temps nous présentons une recension des écrits sur les grandes études anthropométriques du dernier siècle ainsi que leur impact pour l'industrie du prêt-à-porter. Ce premier article retrace le but de chacune de ces grandes campagnes de mesures anthropométriques, indique quel était l'échantillon utilisé, décrit la méthodologie utilisée, énumère les points de mesures sélectionnés et relève les points forts et les faiblesses de chacune. Cet article relate aussi l'opinion de plusieurs auteurs quant à la façon d'analyser les mesures corporelles afin d'aider l'industrie du prêt-à-porter et présente la méthode proposée par certains auteurs.

6.1 Abstract

Purpose – To demonstrate that size standards and labels have not properly served their intended purpose in the twentieth century.

Design/methodology/approach – Presents the most important anthropometric surveys conducted in the twentieth century and the academic discussions on the determination of standards from such data.

Findings – Shows that the initially proposed size standardization criteria conveyed better information for the consumer. Demonstrates that the new body measurement technologies (i.e. body scanning) do not solve the size standardization quandary in and by themselves and that the solution requires a labelling system that better reflects the main factors in human body size: measurements and shape.

Research limitations/implications – Literature review.

Practical implications – Apparel size standardization needs to take into consideration that body size is best described by the combination of body measurements and body shape. New body scanning technologies enable us to efficiently gather this data yet they do not solve the age old problem of standardizing the data. To be of use, a standardization system or any sizing system must be supported by an information conveying label.

Originality/value – To our knowledge, very few papers presenting the evolution and discussion on apparel size standardization has ever been published.

Keywords: Apparel, Clothing, Fashion, Garment, Labelling, Standards

6.2 Introduction

We verified, in previous studies, several hypotheses concerning apparel sizing and labelling. We first demonstrated that apparel manufacturers adapt their size specifications to their target market somewhat regardless of national standards or order initiator's measurement specifications. We showed that Canadian apparel order initiators do not adhere to national standards. We confirmed that identically size labelled women pants often have different measurements. Lastly, we found that order initiators' tolerances are so generous as to allow for overlapping sizes thereby decreasing the fit identification value of existing size labels. These observations led us to wonder about the possibility to create new size standards or a size labelling system that order initiators would or could adhere to and that would provide the consumer with better information.

The present article begins to answer this question by reviewing the processes used in the past to arrive at national standards as well as the literature pertaining to the determination of such standards. We first show that the apparel size standards currently in use in North America are obsolete and that this obsolescence is in part related to the dearth of major anthropometric measurement surveys conducted in the past. We also demonstrate that, even if basic data were available, there is a lack of agreement, among academics, about what constitutes an acceptable procedure to arrive at size standards. Following a presentation of the new body measurement technologies and the potential, or lack thereof, they offer to arrive at size standards, we conclude that the answer probably lies in a new labelling system.

6.3 Literature Review

"How is it that a 5'8", 150 lbs. woman, a 5'6", 135lbs. woman and a 5'9", 125lbs. woman all claim to wear a size 8?"([TC][2], 2004; p. 1).

Measuring methods, standard sizes, grading systems, size labelling and apparel fit have been discussed for the past seven decades (O'Brien & Shelton, 1941; Diffrient, 1974; ISO, 1976; Workman, 1991; Ashdown, 1998; Winks, 1997; McCulloch *et al.*, 1998; Gould-Decauville, 1998; Turner & Bond, 1999; Anderson *et al.*, 2000; Workman & Lentz, 2000; Yertutan, 2001; Schofield & LaBat, 2005). For some, national surveys leading to the elaboration of size standards based on anthropometric data were the solution (O'Brien & Shelton, 1941). Nowadays more and more authors agree that standards originating in national surveys have not served their purpose; they generally argue that the spectrum of female body shapes and measurements is too wide (Hamel & Salvas, 1992; Rasband, 1994; Yu *et al.*, 2006). Manufacturers therefore prefer grading their garments based on a body shape adapted to their target market (Burns & Bryant, 2002).

Numerous articles dealing with female apparel market segmentation based on age, size, ethnicity, and a number of other factors have been written (Shim & Bickle, 1994; Goldsberry *et al.*, 1996; Horne *et al.*, 1999; Yoo *et al.*, 1999; Otenio, 2000; Oldham Kind & Hathcote, 2000; Cambell & Horne, 2001; Otieno *et al.*, 2005); yet body shapes have received little attention (Anderson *et al.*, 2001; Rasband & Liechty, 2006). Rasband & Liechty (2006) argue that an ideal figure does not exist but that characteristics such as height, bone size, weight and proportions between body areas are useful for shape determinations and fittings. In addition Mullet & Chen (2006), propose that two elements need to be considered when developing apparel: the intended wearer's body size (anthropometric measurements) and the garment size (key measurement points). In both cases, they add, measurement procedures are complex.

It therefore appears that arriving at size standards is a complex process. Fan *et al.* (2004) state that today's challenge is to get accurate body measurements while Whitestone & Robinette (1997) and Ashdown (1998) underline that the need to identify proper statistical tools to arrive at appropriate size segmentation is also a challenge.

Even if size standards are determined, the information still needs to be conveyed to the final apparel consumer. Whereas certain authors (LaBat & Delong, 1990, Otieno *et al.*, 2005; Rudd & Lennon, 2005) state that size label information seems to be crucial and to affect women' perception of apparel, numerous others also point out that, considering the order initiators' adaptation of their garments to a target market, the size labels actually in use do not help women in finding the apparel that suit them best (LaBat & DeLong, 1990; Lennon, 1992; Chun-Yoon & Jasper, 1996; Kinley, 2003; Alexander *et al.*, 2005).

The first question therefore is whether it is possible to arrive at apparel size standards that satisfy both the order initiator's need to manufacture a garment for its target market and the consumer's need for information. To answer this question we must first understand how size standards were arrived at in the past.

6.3.1 Some Vocabulary

Before we proceed further, let us take the time to review the terms and expressions commonly used when we discuss apparel size standards.

6.3.1.1. Anthropometric Measurements

The word anthropometry refers to the measure of humans. It comes from the Greek *Anthropos,* meaning human and *metrikos*, meaning measurement. Anthropometry is often defined as the measurement of lengths, widths, depths and circumferences of various parts of the human body (Chamberland *et al.*, 1997-98). According to Roebuck (1995) anthropometry was first used in an attempt to distinguish among races and ethnic groups of humans.

According to Whitestone & Robinette (1997) anthropometric measurements were also used for the development of apparel size standards by the US Navy and US ARMY, from which its use was (Roebuck, 1995) extended to several industries.

6.3.1.2. **Standards**

What exactly are standards? Standards can be *de facto* (generally agreed upon for convenience) or *de jure* (established through legal documents). Numerous organizations write them; some for internal usage only, other intended for use by a group of people, a group of companies, or an industry.

The definition of standards varies depending on the purpose for which they are used and on the school of thought that organizations adhere to. We present a few of the most generally accepted definitions used in the apparel industry.

Standards defined by national and international organizations

According to the oldest standards body institution in the world, the British Standards Institution (BSI), which was formed in 1901, a standard is (see Website):

> "a *published specification that establishes a common language, and contains a technical specification or other precise criteria and is designed to be used consistently, as a rule, a guideline, or a definition*".

The International Standard Organization (ISO), the non-government federation of national standards bodies established in 1947 which now includes 150 member countries refers to the BSI for a definition on its website.

In Canada, the Canadian General Standards Board (CGSB, 1997; flyleaf) state that a national standard is:

> *"A National Standard of Canada is a standard which has been approved by the Standards Council of Canada and one which reflects a reasonable agreement among the views of a number of capable individuals whose collective interests provide, to the greatest practicable extent, a balance of representation of producers, users, consumers and others with relevant interests, as may be appropriate to the subject in hand. It normally is a standard that is capable of making a significant and timely contribution to the national interest."*

Standards defined by apparel academicians and industrials

Glock & Kunz (1995, p. 133) define standards as "*a set of characteristics or procedures that provide a basis for resource and production decision*". For Kadolph (1998; p. 47, 48) standardization is

> "*the process of developing and applying rules for a consistent and uniform approach to specific activity for the benefit and the cooperation of all concerned ....standards are developed with the cooperation of various interest groups, such as producers, suppliers, manufacturers, government agencies, and consumers because a need is perceived.*"

In the apparel industry, order initiators, the Canadian apparel retailer we worked with being a prime example (see Faust *et al.*; 2006), do not generally define standards or even use the terminology. They rather refer to specifications (which are garment measurement points and measures for each style and size) shortened to the ubiquitous (in the trade) "spec". Standards provide body measurement tables for sizes; many apparel companies never generate a body chart.

Apparel standards first appeared toward the middle of the twentieth century in the United States of America in response to demands from the industry and from the consumers. We identified three important publications in the evolution of size standards for the apparel industry during this century. All originated in a national survey. We present them briefly to develop a better understanding of the past evolution of standards.

6.3.2 National Surveys: Purposes, Methodology, Samples and Body Measurements

Major anthropometric studies and reports were first conducted in the twentieth century. The earliest was published after the First World War, in 1921; data was gathered during the demobilization and more than 100,000 men participated. The next major ones, the result of a series of Administrative State Work Projects, led to a publication two decades later by the *United States Government Printing Office in Washington, D.C.*, endorsed by

the *U.S. Department of Agriculture,* sponsored by the *Bureau of Home Economics.* Two of the best known were:

> "B*ody measurements of American boys and girls for garment and pattern construction: a comprehensive report of measuring procedures and statistical analysis of data on 147,000 American children" (BMABGGPC), by the U.S. Dept. Agr. Misc.Ppub. no. 366".*

and:

> *"Women's Measurements for Garment and Pattern Construction" (WMGPC) U.S. Dept. Agr. Misc. Pub. 545.*

In 1945, the *Mail Order Association of America* recommended that the industry be provided with scientific body measurement data for the sizing of women's apparel. It was under the title: *Commercial Standards Report* (CS151). The "*Body Measurements for the Sizing of Women's Patterns and Apparel*" commonly called the (*CS215-58),* was published in 1958. In December 1970, again at the request of the *Mail Order Association of America* from May 1968, an updated version of the CS215-58 study was published: "*Voluntary Products Standards PS42-70, Body Measurements for the Sizing of Women's Patterns and Apparel*", commonly named the "PS42-70". And the latest standard version is the 1994: ASTM D5585-94.

Besides, anthropometric studies for American and Canadian army personnel were also done at the end of the last century for the purpose of design and sizing of female military clothing and equipment "*Sizing Evaluation of Navy Women's Uniforms"* (Mellian *et al.*, 1991). The same was done in Canada with "*Preliminary Anthropometric Survey of Canadian Forces Women*" (MacDonald *et al.*, 1978) and *"Anthropometric survey of the Land Forces"* (ANSUR1988; Chamberland *et al.,* 1997).

Before the 1939-41 National Survey researchers' concern was with not having anthropometric data to work with (O'Brien & Shelton, 1941). A few decades later they concerned themselves with the obsolescence of the data and the lack of analysis.

According to [TC]^2 (2004) the biggest weakness in anthropometric standards and charts was the lack of studies of size and shape distribution of the United States civilian population. This absence of studies was an important concern for industrialists.

Our understanding of the past surveys and their impact on size standards would not be complete without a brief presentation of their purpose, methodology, key measurement points used, proposed measurement classifications, and finally their strengths and weaknesses.

6.3.2.1. Women's Measurements for Garment and Pattern Construction

Purpose

The *Women's Measurements for Garment and Pattern Construction* (WMGPC) survey took place between July 1939 and June 1940. Its sample size was in excess of 10 000 women in 7 states within the United States (Arkansas, California, Illinois, Maryland, New-Jersey, North Carolina and Pennsylvania). According to O'Brien & Shelton, (p. 1) the WMGPC research project was:

> "*undertaken in order to provide measurements which could be used for improving the fit of women's garment and patterns. No scientific study of body measurements used in the construction of women's clothing has ever been reported....there are no standards for garment sizes and retailers and consumers are subjected to unnecessary expense and hazarded by the difficulties involved in obtaining properly fitting clothing.*"

Sample used

O'Brien & Shelton (1941) already stated in those years that a sample may be called representative if it led to results not materially different from those that would have been obtained had the entire population been analyzed.

We must note that most of the initial 14 698 women who participated in the survey were white American women between the ages of 18 and 80. A number of women were eliminated for different reasons, such as: not being of Caucasian race, an unidentified date of birth, being under 18 years of age old, measurements were incomplete or erroneous, a physical deformity was identified, or the information arrived in Washington after the deadlines. This sample obviously did not cover the entire American female population and, according to O'Brien & Shelton (1941), it specifically underrepresented the Middle West and Rocky Mountain areas and overrepresented single women.

Body measurements

The survey was accomplished with the collaboration of local Universities and Educational Institutions. Many anthropometry specialists worked on the project (Driftmier, McNaughton, Boiseau, etc.). Most measuring procedures employed the Hunt anthropometric measuring method which was developed during the children's measurement project *(BMABGGPC)* and were the result of discussions with leading pattern and garment manufacturers as well retailers of women's clothing. They included weight and 58 body measurement points (Tableau 6.1).

Tableau 6.1 : List of body measurement points for the WMGPC

Vertical measurements		Body measurements	
Stature	Sitting height	Chest girth armscye	Elbow girth
Cervical height	Vertical trunk girth	Bust girth	Forearm girth
Bust height	Cervical to waist anterior	Waist girth	Wrist girth
Waist height	Anterior waist length	Abdominal-extension girth	Shoulder length
Abdominal extension height	Shoulder to waist	Hip girth	Anterior chest width
Hip height	Neck to bust	Sitting-spread girth	Highest-bust level width
Sitting spread height	Posterior waist length	Maximum thigh girth	Posterior chest width
Crotch height	Scye depth	Midway thigh girth	Anterior bust arc
Tibiale height	Trunk line	Bent knee girth	Anterior waist arc
Ankle height	Arm length, shoulder to scye	Knee girth at tibiale	Abdominal-extension arc
Total posterior arm length	Waist to hip	Maximum calf girth	Posterior hip arc
Upper posterior arm length	Total crotch length	Maximum leg girth	Bust girth over foundation garment
Anterior arm length	Anterior crotch length	Ankle girth	Waist girth over foundation garment
		Neck-base girth	Abdominal-extension girth over foundation garment
		Armscye girth	Hip girth over foundation garment
		Upper-arm girth	Shoulder slope

Final report

The final report presented the measurement points, purpose of the survey, sample and appraisal of the sample, measuring procedures, and schedule. It also presented the distribution of the 59 measurements for the 10 042 women retained as well as basic data analysis such as means, medians, modes, standard deviations, coefficient of variation, correlations. As, there were no correlations between vertical and horizontal measurements both measurements were analyzed separately. The study proposed different section such as "standard system for body measurements" which served "as a basis for garment and pattern sizes" along with a "scientific selection of a sizing system". It also presented the "measurements of women classified by six criteria[63] and lastly a "comparison of women's measurements with those of girls 15, 16, 17 years old".

Numerous authors have since commented on the impact and benefits of this report; yet the original database has proven impossible to trace and thus impossible to access. Eventually this original standard was replaced by the CS215-58.

6.3.2.2. Body Measurements for the Sizing of Women's Patterns and Apparel or Commercial Standards Report for the Clothing Industry: CS215-58

The "*Body Measurements for the Sizing of Women's Patterns and Apparel*" (*CS215-58)*, which was based on statistical data analysis of the same 1939-40 data from the WMGPC, was published in 1958. It mentioned (p. flyleaf) in foreword that:

> "*Commercial standards are developed by manufacturers, distributors, and users in cooperation with the Commodity Standards division of the Office of Technical Services and with the National Bureau of Standards. Their purpose is to establish quality criteria, and to provide uniform bases for fair competition.*"

[63] Criteria being: State, Habitat, nativity, material status and number of children borne, occupation and family income.

It also specified (p. flyleaf) that: "The adoption and use of a Commercial Standard is voluntary."

Purpose

The purpose (p. 1) of this report was:

> *"...to provide standards classifications, sizes designations, and body measurements for consistent sizing of women's ready-to-wear apparel (Misses', Women's, Juniors', etc.) for the guidance of those engaged in producing, or preparing specifications for, patterns and ready-to-wear garments.....to provide the consumer with a means of identifying her body type and size from the wide range of body types covered, and enable her to be fitted properly by the same size regardless of price, type of apparel, or manufacturer of the garment."*

Women were first divided into four groups:

- misses' sizes varied from size 8 to 22;
- women's sizes varied from size 30 to 42;
- half-sizes sizes varied from size 8 ½ to 24 ½; and finally
- junior sizes were based upon extrapolations of proportions of the Misses' classification and had odd number size designations that varied from size 7 to 19.

Each group was divided into three heights: Tall (T), Regular (R) and Short (S), and each height group was further divided in three bust-hip groups: Slender ("-" or minus), Average (without any symbol), and Full ("+" or plus). Size numbers and symbols were then combined to arrive at a complete size designation such as:

- "14R" for size Misses, 14 bust, regular height and average hip type;
- "14T-" for size 14 bust, height tall and slender hip type;
- "14S+" for size 14 bust, height short and full hip type.

The CS215-58 report also presented: applications, definitions, measuring methods and body measurements taken, size range tables and corresponding body measurements, and lastly size identification. It recommended (p. 28) that "*catalogues, trade, and sales literature carry the following statement: Sizes of Misses', Women's, Half-sizes, and/or Juniors' apparel are designated and proportioned in accordance with CS215-58, ...*". The following quote probably best summarizes the CS215-58's reason for existence (p. 33):

> "*...the sizing system proposed provides the means for fitting the maximum number of women with good fitting clothes, without the need for repeated try-ons and expensive alterations.*"

A further update of this study was published in 1970 under the title PS42-70.

6.3.2.3. Voluntary Products Standards, Body Measurements for the Sizing of Women's Patterns and Apparel: PS42-70

At the request of the Mail Order Association of America, made in May 1968, an updated version of the CS215-58 was published in December 1970 under the title: "Voluntary Products Standards PS42-70, Body Measurements for the Sizing of Women's Patterns and Apparel", often referred to simply as "PS42-70".

Purpose

The objective was to bring the existing standards up to date to better reflect the (then) current female population. Definitions and measuring methods remained the same; while span charts and grading guides were added, e.g.:

- Women sizes vary from 34 to 52;
- Half-sizes vary from 12 ½ to 26 ½;
- Junior Petite sizes vary from 3, 5(P) ... 15(P) even 17.

Misses Petites and Tall sizes were identified as 6, 8(P), 10(P,T)… 18(P,T), 20(T), 22(T). Three measurements (sitting spread height, sitting height, and crotch length front) were removed.

Body measurements

Besides weight, 47 body measurement points were used. Following is the complete list of measurements for the CS215-58 and the PS42-70. Where descriptions differ, the PS42-70 new description is in parentheses.

Tableau 6.2 : List of measurement points for the CS215-58 and the PS42-70 (all measurements in inches)

Girth measurements	Arc measurements	Width and length measurements
Bust	Bust front	Cross-back width
Waist	Waist front	Cross-chest width
Hip	Abdominal front (High hip)	Bust point to bust point
Neck base (Mid-neck)	Hip back	Neck to bust point
Armscye		Scye depth
Abdominal-extension (High hip)	**Vertical measurements**	Armscye to waist
Sitting spread	Stature (total height)	Waist to hips
Thigh maximum	Cervical height	Shoulder length
Thigh mid	Waist height	Shoulder slope (degrees)
Knee	Abdominal extension height (High hip)	Arm length shoulder to wrist
Calf	Hip height	Arm length shoulder to elbow
Ankle	Sitting spread height (deleted in PS42-70)	Underarm length
Upper arm	Crotch height	Crotch length total
Elbow	Knee height	Crotch length front (deleted in PS42-70)
Wrist	Ankle height	Cervical to center front at waist
Vertical trunk	Sitting height (deleted in PS42-70)	Waist length front
		Waist length back

A priori the classification in three heights: Tall (T), Regular (R) and Short (S) was a major point along with separating each height group in three bust-hip groups: Slender, Average, and.Full. However, as one can observe from current apparel size labelling, this last information component was dropped and labels now only refer to a size (6, 8, 10....) and, sometimes, a length or height (Petite, Regular or Tall).

All three of the previous publications contributed both to the determination of the important measurement points to base a standard sizing system on as well as to the development of statistical tools.

Besides, ASTM D5585-94 standard were developed. As Ashdown (1998) stated they were not derived from new anthropometric data, although they were compiled from designer experience and market observations. They reflect the sizing most commonly used by manufacturers and retail organizations in the USA at that period. The ASTM D5585-94 consists of ten sizes (2 to 20) where each size identified by 39 body measurements.

6.3.3 Statistical Methods and Chart Tables

Bust, waist and hip circumference are the most regularly mentioned key body measurements in the apparel literature concerned with size charts. Paper pattern sizes dating back to 1860 were already based on the bust circumference for blouses and dresses, while waist circumference was used for skirts (Kidwell, 1979 in Schofield & LaBat, 2005). Schofield & LaBat (2005), who did an extensive review of size charts, found that bust circumference was used as a size designation in all forty charts they studied. Nowadays constant intervals between bust, waist and hip circumferences are universally accepted even though there is no agreement on what these intervals should be (Schofield & LaBat, 2005). Until 1939 the majority of charts used 2 inch increments between sizes while many manufacturers now grade their sizes in 1, 1 ½ or 2 inch increments depending on whether they are working in small, medium or large sizes.

Averages, percentiles and basic statistical methods were commonly used in national surveys' reports and in studies that described how to determine sizing systems and charts from body measurements (Beazley, 1997-98-99; Roebuck, 1995). According to Beazley (1997-98-99) the development of an anthropometric sizing system requires four steps once the sample measurements have been taken (p. 264):

1. *selection of the intervals for the key dimensions which will establish the sizing categories*;
2. *development, for each size, of all other dimensional data which would be used in the design or sizing of the item*;
3. *conversion of the summary data to an appropriate design value for the end item in terms of fit and function*;
4. *establishment of estimates of the sizing tariff (the proportion of the population that falls within the limits of each size category), for manufacturing of the end item.*

The author explains how to divide samples based on measurements. For example, apparel length (height of the wearer) is proportionally divided into short, medium and tall as is done in national standards. To do this, one needs to calculate average height and variance; one then retains only the values within two standard deviations covering 95.45 % of the population, thus eliminating extreme measurements that can cause distortion. In the author's example (see Figure 6.1), average height was 165cm and range was 30cm. Dividing the range by three she arrived at an interval of 10cm for each of the three groups: "short", "medium" and "tall".

Comparison of height control measurements to establish size dimensions and intervals

1996 Survey of Students: Range 30cm: size intervals 10cm				
Size code		Short	Medium	Tall
Range	150	160	170	180
Central size		155	165 mean	175

1988 CDT Dept.: Range 30cm: size interval: 4in /10cm				
Size code		Short	Medium	Tall
Range	146	155.5	164.5	173,5
Central size	151	160	169	

Recommended Height Sizes: Range 30cm				
Size code		Short	Medium	Tall
Range	150	155.5	164.5	173,5
Central size		151	160	169

Figure 6.1: Extract from "Chart 5" Presented by Beazley (1998; p. 266)

Beazley (1997-98-99) recommends using the same method to divide bust size, waistline and hips by groups. In her studies, she compared the measurements she obtained to those of commercial size charts. A bust size of 86cm corresponds to a commonly labelled size 12, she then determined waist and hip measurements to match the same commercial size 12.

Tableau 6.3 presents a size chart developed by increasing or decreasing the measurement points with regular intervals of 4 centimetres at a time.

Tableau 6.3 : Extract from "Table 8" Presented by Beazley (1998; p. 275)

	Short 155 cm			Medium 165 cm			Tall 175 cm		
"Size"	8	10	12	8	10	12	8	10	12
Bust (+4)	78	82	86	78	82	86	78	82	86
Waist (+4)	60	64	68	60	64	68	60	64	68
Hips (+4)	88	92	96	88	92	96	88	92	96

Beazley (1998) also notes that manufacturers who base their size charts on statistical data are rare. They generally prefer regular and consistent intervals. However, as she points out, the number of such intervals should be limited to four or five sizes as they rapidly create distortion from true body measurements.

Melzer & Moffitt (1997) present a different point of view and describe the use of methods based on statistics (percentiles, average, etc.) as the impossible dream. They argue that percentiles are univariate statistics and that problems arise when one tries to use more than one variable at a time, as is the case with body measurements. Robinette and McConville (1981) show that: the sum of percentiles does not equal the percentile of the sum. Zehner *et al.* (1992) corroborate the difficulty of using statistical approaches showing that the range of people accommodated with percentiles decreases as the number of variables increases. They demonstrate that the actual percentage of people who are within the 5th to the 95th percentile for one variable decreases to 57% when using 6 variables.

Tableau 6.4 : Example of successive reduction in accommodation for each application of 5th to 95th percentile values[64]

Head Length	90% of population
Head Breadth	82% of population
Pupil to Vertex	78% of population
Face breadth	69% of population
Face Length	63% of population
Ear to Vertex	57% of population

Rasband & Liechty (2006) also disagree with the use of a simple statistical approach to sizing arguing that women have different body shapes. They define seven figure types (Figure **6.2**) besides the "Ideal": Triangular, Inverted Triangular, Rectangular, Hourglass, Diamond, Tubular and Round. They describe each figure and provide measurements for most of them. They state, for example that a Rectangular figure type has a waist circumference that is 7inches or less smaller than the bust or hip, whereas the Hourglass figure has a waist circumference that is 11inches or more smaller than the bust and hips, and the Triangular figure has small waist with wider hip making it appear that the extra weight goes on the lower torso.

[64] Whitestone & Robinette, 1997; chap. 8, p. 3

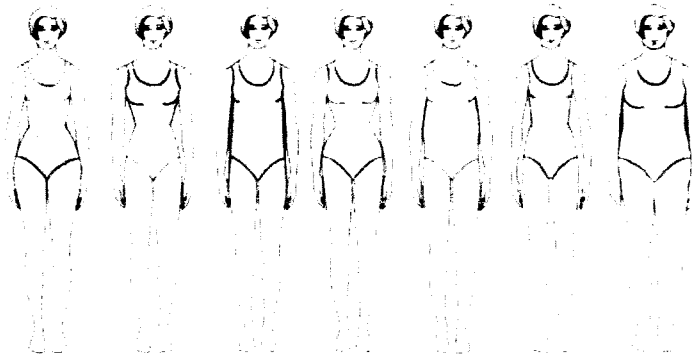

Figure 6.2 : Figure types from "Fabulous Fit Speed Fitting and Alteration"[65]

They add that six characteristics need to be looked at to achieve a fabulous fit:

- height (petite under 5'4", average from 5'4" to 5'7" and tall over 5'7");
- weight;
- bone size or structure (referring to height and weight);
- proportional body areas;
- contour; and
- posture.

Ashdown (1998), presents a different method of using anthropometric data to create size sets. She demonstrates one way to better serve the population using distance templates with key points from anthropometric data allowing the grouping (clustering) of similar subjects together. To illustrate this, Ashdown (1998) uses the waist, hips, crotch height and length as measurement points. She then presents the comparative results of size measurements according to several grading methods (ASTM's, Linear method and Distance template). She also indicates, for all three approaches, the number of people from the sample of 376 she used that would fall into each size category proving her point that distance templates allow a more equal distribution of subjects.

[65] Rasband & Liechty (2006; cover page)

Tableau 6.5 : Data obtained combining Table III, Table IV, and Table IX (Ashdown; 1998)

Size	Hip circumference inches	Difference inches	Waist circumference inches	Difference inches	Frequency	Size	Hip circumference Inches (increase of 2.6%)	Waist circumference Inches (increase of 3.7%)	Frequency	Size	Hip circumference Inches (increase variably)	Waist circumference Inches (increase variably)	Frequency
ASTM						**Linear**				**Distance template**			
2	34.5	1	24	1	1	A	35.05	24.63	11	A	35.86	25.52	45
4	35.5	1	25	1	10	B	35.97	25.55	27	B	36.95	26.60	59
6	36.5	1	26	1	23	C	36.91	26.49	65	C	37.69	27.39	43
8	37.5	1	27	1	64	D	37.88	27.48	82	D	38.16	27.39	26
10	38.5	1.5	28	1.5	110	E	38.86	28.50	82	E	39.14	29.02	33
12	40.0	1.5	29.5	1.5	89	F	39.88	29.55	50	F	38.77	28.33	37
14	41.5	1.5	31	1.5	43	G	40.92	30.65	28	G	39.36	28.81	40
16	43	2	32.5	2	25	H	41.99	31.78	18	H	39.54	29.20	23
18	45	2	34.5	2	10	I	43.09	32.6	9	I	40.64	30.59	30
20	47		36.5		1	J	44.22	34.18	4	J	41.45	31.35	40
total					376				376				376

Melzer & Moffitt (1997) concur with Ashdown stating that sophisticated anthropometric classification schemes such as statistical clustering (McCulloch & Ashdown, 1998) are now starting to be employed and that they are sufficient to arrive at well fitting sizes.

In short the many surveys and reports done and published on the subject confirm apparel order initiators' empirical knowledge that using a sizing chart adapted for a population segment or cluster is the best approach.

U.S. and Canadian laws require that a label disclose what each garment is made of and where it is made; yet no law governs the relation between labelled size of a garment and its actual measurements. Order initiators can therefore either adhere to national standards, target a specific market (in terms of silhouette) by adapting their measurements, or use a ploy such as vanity sizing ([TC]^2, 2004) [66] and all may use the same generally accepted numerical size labelling systems. This renders the determination of a standard size chart that would please manufacturers, retailers, and consumers quite complex and creates a real marketing challenge (Beazley, 1998).

6.3.4 Changing of Millennium, Getting into New Technologies: 3D Body Scanning to Update Anthropometric Data

Part of the problem with apparel size standards is that they have to be revised regularly in order to adapt to a population's anthropometric changes (Workman & Lentz, 2000). Brunn (1983, in Workman & Lentz, 2000) propose that they should be revised at least every decade. Marks & Spenser, a large U.K. retailer, revises their body charts every 15 years. In North America, the existing apparel sizing standards are based on an obsolete anthropometric survey (Tamburrino, in Workman & Lentz, 2000). In the early third millennium, major corporations and government agencies, aware of the situation, took advantage of new available technology the "3D body scanner", to upgrade their information.

[66] [TC]2 defined vanity sizing as something "That's aimed at the shopper who has always worn a size 8 and doesn't want to graduate to a 10 or 12 as she gets older. Manufacturers accommodate her by resizing garments, sewing size 8 labels on what used to be larger-size clothing. (http://www.tc2.com/news/news_sizearticle.html)

One of the first groups to initiate such a project was the *Civilian American and European Surface Anthropometry Resource* often known as CAESAR. It brought together companies from industries such as Automobile, Aerospace, Furniture, Apparel, and others initially from three countries (U.S.A, Netherlands and Italy) as well as the U.S. Air Force (Robinette *et al.* 1999). The initial measurement method used (3D body scanning with Cyberware WB4 in North America and Vitronic Vitis in Europe) was so innovative at the time (both use multiple sets of cameras) that it required calibration against manual measurements (Burnsides *et al.* 2001). The CAESAR survey was expected to be the most trustworthy large-volume anthropometric dataset ever produced (Burnsides *et al.* 2001). In spite of continuous improvements in operational efficiency difficulties with the early stage scanning technology and the project's high cost caused difficulties. The data from this study has been used in many innovative studies but it is not regarded as an effective anthropometric study of the population.

In the United States, $[TC]^2$ was mandated to conduct a similar exercise. Improved scanner technology permitted collection of a broader, more complete survey with gender, age ethnicity and to some overall size characteristics of the population statistically sampled. Although the data gathering portion of the survey has now been completed for a few years, very little analysis of the said data has been published as individual companies have been using the data in internal, unpublished studies.

3D body scanning technology has already been extensively used; thousands of voluntary subjects of all ages in Asia, Europe and the United States have been scanned. Yet the benefits of this new technology are only now starting to be seen (Fan *et al.*, 2004). It provides new measuring capability (volume, surface areas) as well as a faster, relatively inexpensive, and reliable way to survey the population (Robinette *et al.*, 1999). Moreover the information gathered is now readily transferable to be used in computer aided design (CAD) and manufacturing (Robinette *et al.*, 1999).

Computer assisted anthropometric national surveys are as yet only a tool enabling us to rapidly acquire large databases. In order to arrive at national standards, this data has to be treated and decisions made on how to arrive at classifications to determine meaningful standards.

6.3.5 Strengths and Weaknesses of Manually and Automatically Extracted Body Measurements

Both methods of acquiring body measurements (manually or 3D body scanner) have their strengths and weaknesses. For some authors the biggest strength of the manually taken measurements is the ability to identify measurements. It is not easy to take reliable measurements due to difficulties in identifying consistent landmarks, While its most important weaknesses are the labour costs and the imprecision caused by human error when transcribing data (Fan *et al.*, 2004). On the other hand, the strengths of the 3D body scanning are the speed and the relatively low cost while its main weakness are in the measurement inconsistencies due to movement (Istook & Huang, 2001), the lack of exactness when compared with manually measurements (Simmons & Istook 2003), and the difficulty to obtain correct measurements for some areas of the body (McKinnon & Istook, 2002). Accurate body measurements can be difficult to obtain with 3D body scanning due to factors such as posture, landmark indications, instrument position and orientation on the other hand issues with variation in pressure and tension exerted are possible in manual measures (Fan *et al.*, 2004).

Not so long ago, body scanning was still at the stage of acceptance and maturation in the industry; the benefits of automation were not clearly visible (Mckinnon & Istook, 2002). Female consumers who have been scanned generally react well to the results, yet women from specific socio-demographic groups are less comfortable with the idea of being body scanned (Loker *et al.*, 2004).

As Melzer & Moffitt (1997) write, 3D body scanning is now an accepted tool in the apparel industry. As time goes by, the non-contact body measuring technologies generate more and more interest and applications in the apparel industry. It can be used in numerous applications: anthropometric measuring surveys, development of three-dimensional apparel, computer aided design (CAD), virtual garment environments and animation, mass-customization, etc. (Jones *et al.*, 1995; Hardaker & Fozzard, 1998; Stylios *et al.*, 2001; Koontz & Gibson, 2002; Xu *et al.*, 2002; Ulrich *et al.*, 2003).

6.4 Conclusion

As written on the $[TC]^2$ website "... Average body shapes have changed, morphing from the hourglass of the past to pear shape. Lovejoy estimates that 60 percent of people today are pear-shaped, with hips bigger than their shoulders....". Likewise, the "*Campagne Nationale de Mensuration*" held in 2006 in Paris concluded that the young French people were on average 2cm taller than their parents at the same age.

These observations to the effect that the population's anthropometric data are changing rapidly confirm the order initiators' and some academics' conclusions that the population can probably best be described by population clusters than by all encompassing size standards.

Accordingly, would it not be more appropriate for the apparel industry to determine a basic set of size standards relying on a very limited number of key measurements supported by a labelling system conveying silhouette information? Such an approach would allow the order initiators to select and produce for a given target market while at the same time enabling the consumer to use the size label as a tool to simplify her search for a fitting garment.

6.5 References

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CHAPITRE 7 : WOMEN'S WEAR SIZING: AN ANALYSIS OF THE DATA GATHERED IN THE SIZE USA, SURVEY AND POTENTIAL TO UPDATE SIZE STANDARDS (PART IV)

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7.1 Abstract

Purpose – To demonstrate that the data gathered by $[TC]^2$ in the S*ize USA, Let's size up America* survey allows for a more realistic classification of women than the existing standard sizing system.

Design/methodology/approach – Presents our analysis of the $[TC]^2$ data on women's lower body measurements to arrive at a classification of women that takes both their silhouette and their actual measurements in consideration.

Findings – Shows that body scanning technology still needs to be perfected. Also demonstrates that it is possible to arrive at a manageable number of sizes, taking into consideration three lower body female silhouettes (**A**, **H** and **X**) with different measurements at key body points, providing all participants to the supply chain with a

sizing system that truly reflects different women's needs and conveys useful information to the consumer.

Research limitations/implications – Limited to lower body (pants).

Practical implications – Governments, apparel associations, order initiators, distributors, and consumers need to decide whether it is preferable to design and impose a new standard sizing system for women's apparel or if is more realistic to simply label each garment in a way that truly provides useful information for all. Our conclusions show that it is possible to classify women in a manner conducive to new size standards; however this may not be the ideal avenue to select because of retail constraints.

Originality/value – Proposes a new classification of women based on a limited number of lower body measurements.

Keywords: Apparel, Clothing, Fashion, Garment, Labeling, Standards

Article Type: General review

7.2 Introduction

The literature review, presented in parts I to III, reveals that although efforts have been expanded to arrive at size standards since the *Women's Measurements for Garment Pattern Construction* WMGPC which led to the Commercial Standard report (CS215-58) in 1958, most were never adopted by the apparel industry (Schofield & LaBat; 2005). Order initiators have either continued using sizing systems by adapting the prescribed measurements to the market they target, or they have developed a system of their own. Size labels are based on voluntary standards identified by code numbers that do not correspond to body measurements.

They consequently provide little useful information to the female consumer who generally find size labels less than helpful when looking for a fitting garment

We therefore attempt to determine whether it is possible to arrive at a size standardization system that is specific enough to provide good fit for most women yet does not require such a large number of sizes as to become unmanageable.

The present research, based on the data gathered by $[TC]^2$ in the 2003 S*ize USA, Let's size up America* survey, (1) demonstrates that women can be grouped based on silhouette and body measurements, (2) that this grouping can serve as a basis for classification which in turn (3) may be used to update existing size charts to better reflect women's morphologies and garment needs, and (4) lead to a new size label. We conclude on the suggestion that new size standards may encounter the same problems as the old ones and that a new labeling system may be a more realistic solution to improve the female consumer's shopping experience.

This paper constitutes part IV of a five part series. We regularly refer to findings presented in part II (*Women's wear sizing: an analysis of the Canadian situation on pants' sizes)* where we reported on an analysis of pants measurements completed in the mail-order division of the largest Canadian garment retailer by market share in 2000. Results from the analysis of the $[TC]^2$ anthropometric data will in part be validated against the data previously presented in part II.

7.3 Methodology

In order to evaluate the possibility to develop usable size standards, we needed a large population measurement database. We have, through the collaboration of a large Canadian retailer, established contact with $[TC]^2$ who provided us with all data gathered during the *Size USA Let's size up America... The National Sizing Survey, Body Measurement and Data Analysis Reports on the U.S. Population* in 2003.

The *Size USA* ([TC]^2, 2003) survey was entirely conducted with the use of body scanning technology. As discussed in the literature, this technology provides massive volumes of data; the challenge is to identify and retain only the useful information (Fan et *al.*, 2004) discarding unreliable or unusable data (McKinnon & Istook, 2002). This observation led to our first two hypotheses:

H_1: Numerous measurements obtained through body scanning technology are duplicates and therefore of limited use in the determination of size standards.

H_2: Numerous measurements obtained through body scanning technology reflect false or unreliable readings of the body.

To validate these hypotheses, we used an iterative approach. We first filtered the data (6310 individuals with more than 200 measurements on each) to only retain the most pertinent; eliminating such data as upper-body measurements which were not useful for our lower body analysis. We analyzed each measurement using descriptive statistics and eliminated the cases where validity was dubious.

Having pruned our database, we needed to determine which measurements best described the female lower body for classification purposes (keeping in mind critical points mentioned in literature review). We identified three broad data analysis methods in the literature. The most commonly used is descriptive and based on such statistics as the mean, percentage, etc. (O'Brien & Shelton, 1941; Beazley, 1997). It is highly criticized: the number of individuals in each group or class rapidly decreases as the number of relevant measurements increases (Whitestone & Robinette, 1997). The second method relies on ratios between variables ([TC]^2, 2004; Rasband & Liechty, 2006). Fundamentally interesting, this method also leaves a number of unclassifiable individuals, although less than the descriptive method. The third, presented by Ashdown (1998) using mathematical tools to regroup similar individuals, is the most interesting although it combined measurements that we would use separately as we shall demonstrate later.

These observations, supplemented by previous work reported in part II, led to two other hypotheses:

H_3: Height, weight and circumference measurements are not correlated;

H_4: It is possible to classify the entire female population on two circumference measurements: hip and waist

We performed correlation analyzes between available socio-demographic variables and some measurements as well as between measurements. We observed a number of correlations yet noted that none existed between height, weight and circumference measurements, confirming the 1941 WMGPC's findings; leading us (contrary to Ashdown,1998) to analyze these data separately.

To validate our third hypothesis, we used a second sample of merchandise returns data provided for mail-ordered pants from a Canadian retailer. Validation was done comparing 2 similar pants, presented one after the other one in catalogue, (p.36 and p.38, fall-winter), both offered in sizes from 6 to 16, produced by the same manufacturer, where crotch length and circumference (at 5, 7 and 9 inches from the crotch) showed no significant difference: only inseam measurement varied.

We limited the height analysis to inseam length since it is the single most critical height measurement for pants. We compared the survey results to traditional and empirical (pragmatic) *Petite, Regular* and *Tall* sizing. We performed summary analyzes taking into account such variables as scan location, (ethnicity) origin or age as they had previously been used in anthropometric surveys as a method of classifing individuals.

Our circumference analyses were more in-depth yet iterative as we had no information on the precision of the data gathering tool (3D body scanner). Our initial data validity verifications and numerous factor analyzes led us to retain only a small set of select measurements.

A first observation on the waist-hip cloud of points was its density and orientation. We tested all data analysis methods seen in the literature (descriptive, ratio and mathematical clustering method) to conclude that all led to dubious results. Hence we decided to use a principal component approach on which we shall expand later. Our results enabled us to not only conclude that women's measurements differ but that it is possible to group them in three silhouettes (for the lower body).

Any attempt to design a standardized sizing system faces a trade-off between identifying a very large number of specific sizes providing precisely fitting garments to the consumer but rapidly unmanageable for the supply chain, or providing few specific sizes, easy to manage but deficient in garment fit.

One size fits all	Standard size range for R.T.W. sizing system	Expended size ranges for mass-customization	One size per individual for made-to-measure

Figure 7.1 : Possible size labels Source, Ashdown, 2007; p. 84

Hence our last hypothesis:

H_5: Although women can be classified on three basic silhouettes, the number of classes needed to fit the entire population well is such that it is impractical as the basis for size standardization system.

To validate this hypothesis, we classified the female population initially dividing it along the lines of the existing size standards with a further subdivision on the three silhouettes identified. We observed how well such a division (1) covered the entire population and (2) provided specifications precise enough to manufacture a fitting garment.

7.4 Research process

[TC]2's *SIZE USA, LET'S SIZE UP AMERICA* SURVEY FOR WOMEN MEASUREMENTS AND SILHOUETTE ANALYSIS

This survey consisted in body scanning 6 310 women in thirteen locations throughout the USA.

7.4.1 **Variables**

The $[TC]^2$'s database is comprised of discrete variables (socio-demographic data) and continuous variables (key measurement points). Only selected variables were analyzed.

Women filled a 12-item questionnaire on:

- scan location (13 categories),
- ethnicity group (4 categories),
- income group (5 categories),
- age group (6 categories),
- lifestyle level of activities (4 categories),
- marital status (5 categories),
- educational level (5 categories),
- weight perception (4 categories),
- current employment (5 categories),
- clothing sizes (4 categories),
- shopping preferences (14 categories),
- clothing types purchased (16 categories).

We used socio-demographic variables to ascertain sample representativity (O'Brien & Shelton, 1941) and to verify possible correlations with body measurements and silhouettes.

7.4.1.1. ***Key measurement points***

The [TC]^2 survey identifies more than 200 key measurement points (Figure 7.2). As mentioned in the literature, body scanners can provide almost unlimited measurement data, the challenge rests in selecting significant and reliable variables (McKinnon & Istook, 2002; Fan *et al.,* 2004).

Numerous measurements dealt with the upper body and were therefore not pertinent for this study. All were eliminated the exception of bust girth and bust height which are widely cited in the literature and temporarily kept to ensure that they were truly irrelevant to lower body specifications. Insofar as lower body measurements were concerned, we opted to retain only those 34 points highlighted in the literature. (Limitation in the study: Focus was done on girth and therefore crotch was eliminated at this stage, although afterwards it should have been kept and not eliminated). We list them in table 1 along with their weighting, average, standard deviation, minimum and maximum values (height and weight are respectively shown in inches and pounds to facilitate comparison with previous research).

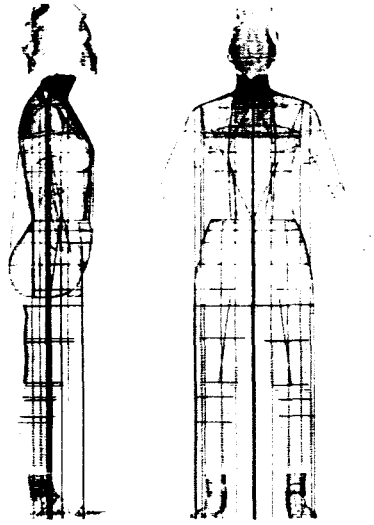


Figure 7.2 : Source [TC]^2, 2004; p. 112

Tableau 7.1 : Key measurement points

Key points	Key measurement points description	Weighting	Average	Standard deviation	Minimum	Maximum
H	Total height in inches	6 310	63,91	2,81	48,50	82,00
K	Weight in pounds	6 310	155,64	38,61	29,00	395,00
tB	Bust girth	6 310	40,71	5,06	27,89	63,30
hB	Bust height	6 310	45,79	2,40	34,80	54,71
tT	Waist girth	6 310	34,33	5,45	23,64	61,85
hT	Waist height	6 310	39,37	2,36	26,16	47,12
tHH	High hip girth	6 310	40,23	5,64	27,56	68,83
hHHv	High hip height right side	6 310	36,11	2,26	23,57	43,70
hHHw	High hip height left side	6 310	37,32	2,15	26,13	44,80
tH	Hip girth	6 310	43,04	5,01	32,01	71,13
hH	Hip height	6 310	31,95	2,67	24,21	41,11
tHC	High thigh girth	6 310	24,54	2,94	17,07	39,43
tHCv	High thigh girth right side	6 309	24,44	2,92	16,80	39,02
tHCw	High thigh girth left side	6 309	24,30	2,91	16,90	39,04
hHCv	High thigh height right side	6 310	27,33	1,93	0,10	35,39
hHCw	High thigh height left side	6 310	27,33	1,93	0,10	35,39
tC	Thigh girth	6 310	20,13	2,49	10,37	33,53
tCv	Thigh girth right side	6 310	20,13	2,49	10,37	33,53
tCw	Thigh girth left side	6 310	20,08	2,50	13,13	34,42
hCv	Thigh height right side	6 310	22,96	1,49	15,50	29,35
hCw	Thigh height left side	6 310	22,97	1,48	15,12	29,16
tG	Knee girth	6 310	15,34	1,49	10,03	26,32
hG	Knee height	6 310	17,40	1,20	7,90	22,27
hGv	Knee height right side	6 310	17,40	1,20	7,90	22,27
hGw	Knee height left side	6 310	17,42	1,19	7,90	21,87
tM	Calf girth	6 310	14,98	1,57	9,17	36,92
tMv	Calf girth right side	6 310	14,97	1,55	9,10	25,84
tMw	Calf girth left side	6 310	8,99	0,77	2,31	13,86
tA	Ankle girth	6 310	10,78	2,83	0,50	25,56
hA	Ankle height	6 002	2,74	0,39	1,38	4,92
hAE	Ankle height right side	5 823	2,59	0,35	1,38	4,13
hAI	Ankle height left side	6 217	2,81	0,37	1,48	3,94
cF	Distance waist-crotch-waist	6 310	28,42	3,55	10,00	47,49
hF	Crotch height (inseam)	6 310	28,82	1,88	20,07	38,57

Tableau 7.2 : Redundant or limited use measurements

Key measurement points description	Repetition	Informative measurements although no directly useful for pants measurements
Total height in inches		√
Weight in pounds		√
Bust girth		√
Bust height		√
Waist girth		
Waist height		
High hip girth		
High hip height right + left side	1	
Hip girth		
Hip height		
High thigh girth + right + left side	2	
High thigh height right + left side	1	
Thigh girth + right + left side	2	
Thigh height right + left side	1	
Knee girth		√
Knee height + right + left side	2	
Calf girth + right and left side	2	√
Ankle girth		√
Ankle height + right + left side	2	
Distance waist-crotch-waist		
Crotch height (inseam)		

In the table 7.2 left and right are listed together, showing that 13 out of 34 measurement obtained through body scanning technology are redundant; e.g. "hHHv" with "hHHw" (High hip height right side and left side) or "hG", "hGv", and "hGw" (respectively Knee height, Knee height right side and Knee height left side). Separate left and right are generally very close in value as bodies are bi-laterally symmetrical. In addition, 7 of the 34 measurements listed such as total height, weight and bust measurements, are informative yet not directly used for pants measurements and therefore of limited use in the determination of size standards.

Conscious of the strengths and weaknesses of 3D body scanning measurements (McKinnon & Istook, 2002), each variable was scrutinized (data cloud, distribution, correlation, etc.) to identify outliers (e.g. subjects with abnormal data such as erroneous weight or undersized height) and removed from the database when justified (1,49% of cases). Distribution of all variables was studied. Figure 3 presents a few histograms.

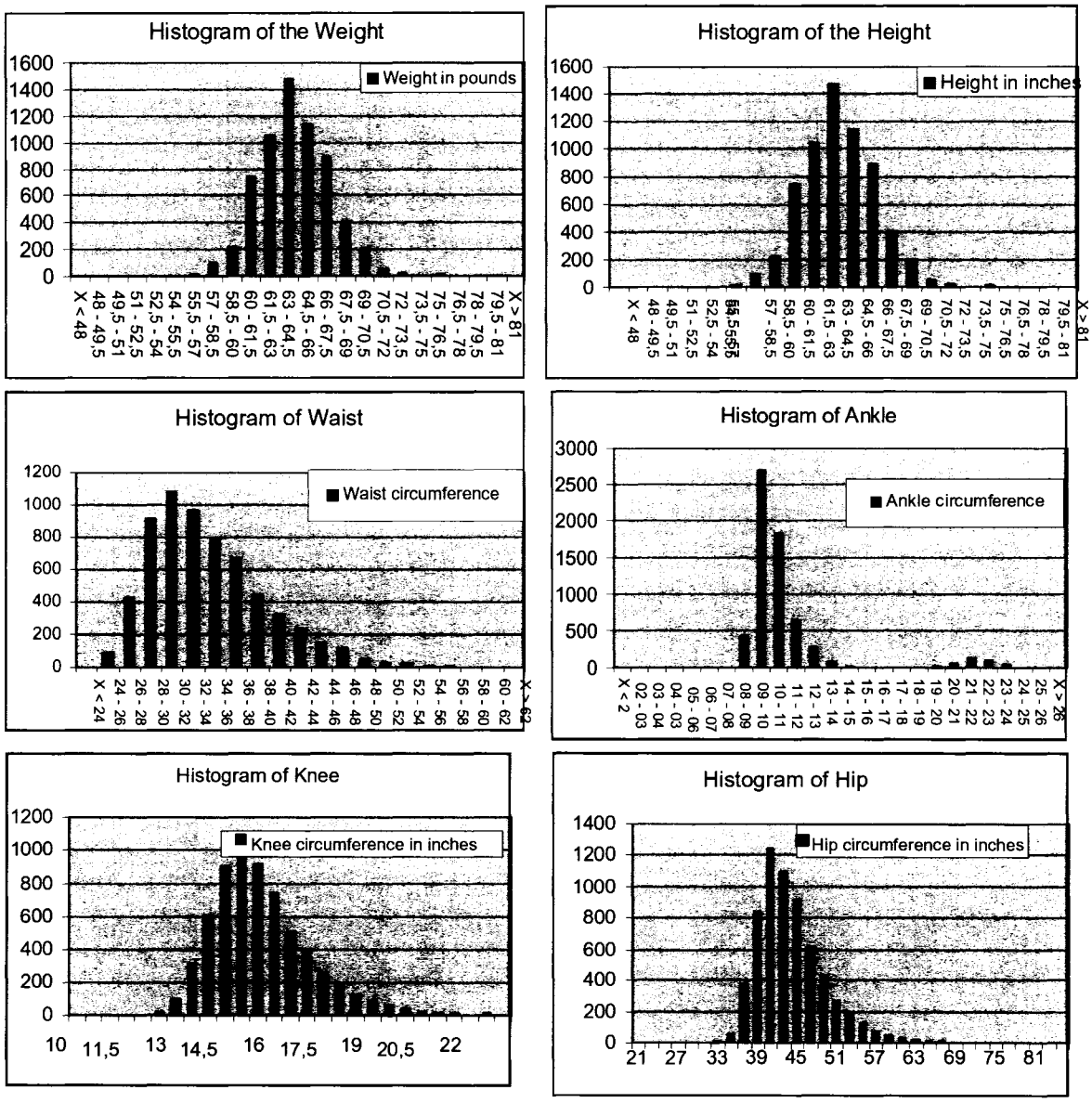


Figure 7.3 : Histograms of key measurement points

Ankle measurements presented a specific problem with more than 300 women showing an ankle circumference exceeding 20 inches due to the 3D body scanner reading the foot circumference on the ground as the ankle measurement. Our observations validate McKinnon & Istook's (2002) findings that foot placement and variations in body position resulting in mist-places landmarks can have a significant impact on the scanning results.

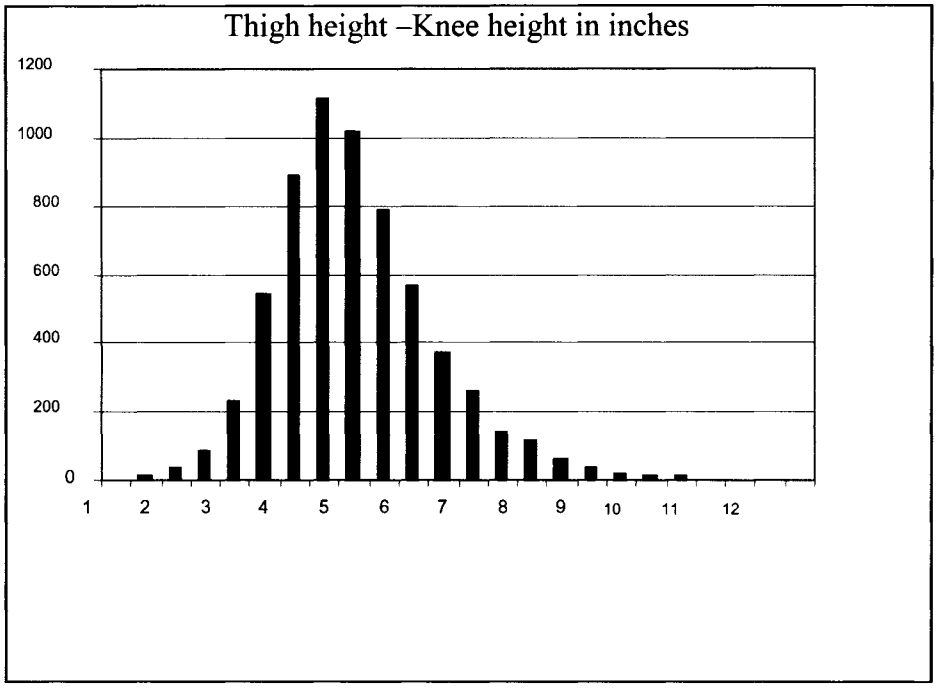
All other variables were either symmetrically distributed or slightly skewed to the right (considered normal since there is limit to how "small" a woman can be but not to how "blooming" she can be).

7.4.1.2. ***Conjoint analysis***

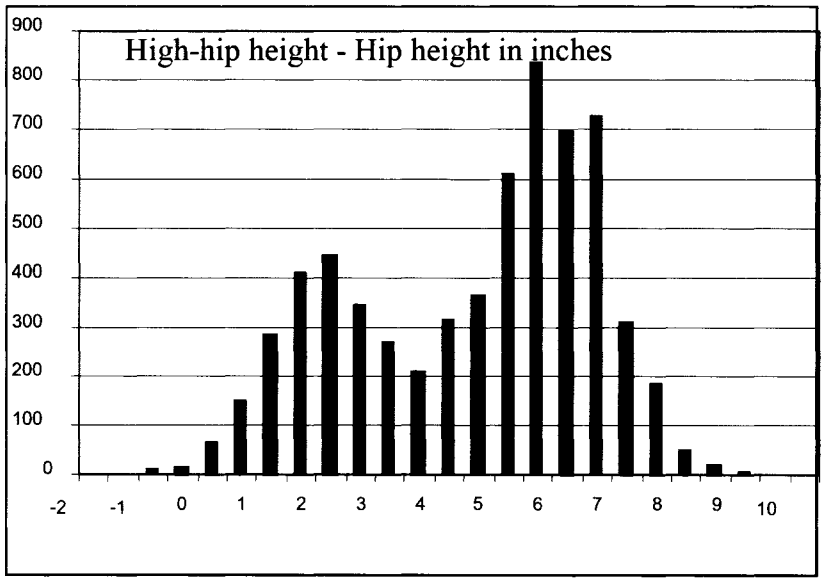
Inexactness in measurements can be detected by calculating height differences between variables; variables were systematically graphically represented, calculated and analyzed.

- Waist height to high hip height (right side)[67],
- High hip height to hip height (right side),
- Hip height to crotch height,
- Crotch to right high thigh height,
- High thigh height to thigh height (right side),
- Thigh height to knee (right side),
- Knee to floor (right side).

[67] Right side and left side having no significant difference, we selected the right side in order to reduce the number of variables.



Difference in height between thigh and knee (right side)



Difference in height between high hip and hip (right side)

Figure 7.4 : Histograms of differences between key measurement points

Almost all variables' scores were clustered around the mean in a symmetrical, unimodal pattern.

Figure 7.4 presents two examples, the second being the one exception we found (high hip height – hip height) which presented a bi-modal distribution (hip being the largest circumference of the body and high hip located 3 inches below the waist). Distance between high hip and hip shows that some women have "normal" high hip circumference and hip circumference height distance; some have very little difference and some even have negative difference.

According to our first results, altogether, 212 women were eliminated from the initial database either because their data showed aberrant or unreliable values, such as a weight of 29 pounds. We therefore only partially confirmed our H_2. Apart from specific body parts such as the ankle, body scanning provided reliable data for close to 97 % of the subjects.

7.5 Findings on [TC]2's Size USA, Survey

7.5.1 Socio-demographic sample representation

Cross-tabulation analyses were performed between demographic variables, between nominal variables and between demographic and nominal variables to evaluate how representative sample was. We present some of our results in tables 7.3 to 7.6. Only ethnicity had missing values.

Tableau 7.3 : Age, ethnicity and scan location observations

	Statistics		
	aA aA: 6 Age group	aE aE: 6 Ethnicity class	aL aL: Scan location
N Valid	6098	5696	6098
Missing	0	402	0

Tableau 7.4 : Age group frequency and percentage

			Frequency	Percent	Valid percent	Cumulative percent
Valid	1,00	aA1: 18-25	1472	24,1	24,1	24,1
	2,00	aA2: 26-35	1394	22,9	22,9	47,0
	3,00	aA3: 36-45	1322	21,7	21,7	68,7
	4,00	aA4: 46-55	1115	18,2	18,2	86,9
	5,00	aA5: 56-65	578	9,6	9,6	96,5
	6,00	aA6: 66 +	217	3,5	3,5	100,0
	Total		6098	100,0	100,0	

Tableau 7.5 : Ethnicity group frequency and percentage

			Frequency	Percent	Valid percent	Cumulative percent
Valid	1,00	aE1: Caucasian-American	3227	52,9	56,7	56,7
	2,00	aE2: African-American	1075	17,6	18,9	75,6
	3,00	aE3: Hispano-American	417	6,8	7,3	82,9
	4,00	aE4: Asian-American	487	8,0	8,5	91,4
	5,00	aE5: Other	490	8,1	8,6	100
	Total		5696	93,4	100,0	
Missing	Syst.		402	6,6		
	Total		6098	100,0		

Tableau 7.6 : Scan location frequency

			Frequency	Percent	Valid percent	Cumulative percent
Valid	1,00	aL1: Loc. 1: Cary	836	13,7	13,7	13,7
	2,00	aL2: Loc. 2: Columbia	598	9,8	9,8	23,5
	3,00	aL3: Loc. 3: Dallas	1249	20,4	20,4	43,9
	4,00	aL4: Loc. 4: Miami	69	1,1	1,1	45,1
	5,00	aL5: Loc. 5: New York	303	5,0	5,0	50,0
	6,00	aL6: Loc. 6: Chattanooga	282	4,6	4,6	54,7
	7,00	aL7: Loc. 7: Los Angeles	304	5,0	5,0	59,7
	8,00	aL8: Loc. 8: San Francisco	265	4,3	4,3	64,0
	9,00	aL9: Loc. 9: Portland	263	4,3	4,3	68,3
	10,00	aL10: Loc. 10: Lawrence	238	3,9	3,9	72,2
	11,00	aL11: Loc. 11: Winston-Salem	108	1,8	1,8	74,0
	12,00	aL12: Loc. 12: Buford	740	12,1	12,1	86,1
	13,00	aL13: Loc. 13: Glendale	845	13,9	13,9	100,0
	Total		6098	100,0	100,0	

Cross-tabulations show that the sample highly corresponds to expectation with two exceptions (see table 7):

- relation between ethnicity and age,
- relation between ethnicity and location.

Tableau 7.7 : Cross-tabulations on ethnic origin, age, and scan location

		Caucasian-American	African-American	Hispano-American	Asian-American/Others
18-25	Count	678	280	148	137
	Exp. Count	767.1	255.5	99.1	11.8
	Adj. Res.	-5.6	1.9	5.8	2.4
26-35	Count	633	282	117	125
	Exp. Count	726.9	242.1	93.9	109.7
	Adj. Res.	-6.0	3.2	2.8	1.7
36-45	Count	676	265	75	104
	Exp. Count	692.3	230.6	89.5	104.5
	Adj. Res.	-1.1	2.8	-1.8	-.1
46-55	Count	666	190	55	80
	Exp. Count	605.1	201.6	78.2	91.3
	Adj. Res.	4.2	-1.0	-3.0	-1.4
56-65	Count	402	52	17	31
	Exp. Count	313.9	104.6	40.6	47.4
	Adj. Res.	8.0	-6.0	-4.0	-2.6
66 and over	Count	172	6	5	10
	Exp. Count	121.8	40.6	15.7	18.4
	Adj. Res.	7.0	-6.1	-2.9	-2.1
Loc. 1: Cary	Count	510	247	5	33
	Exp. Count	464.0	154.6	60.0	70.0
	Adj. Res.	3.5	8.9	-8.0	-5.0
Loc. 2: Columbia	Count	416	97	7	59
	Exp. Count	334.8	111.5	43.3	50.5
	Adj. Res.	7.1	-1.6	-6.0	1.3
Loc. 3: Dallas	Count	698	297	106	49
	Exp. Count	681.0	226.9	88.0	102.8
	Adj. Res.	1.1	5.8	2.2	-6.2
Loc. 4: Miami	Count	37	14	1	0
	Exp. Count	33.4	11.1	4.3	5.0
	Adj. Res.	.9	1.0	-1.7	-2.4
Loc. 5: New York	Count	188	40	4	25
	Exp. Count	162.0	54.0	20.9	24.5
	Adj. Res.	3.2	-2.2	-3.9	.1
Loc. 6: Chattanooga	Count	131	124	5	4
	Exp. Count	155.8	51.9	20.1	23.5
	Adj. Res.	-3.1	11.4	-3.6	-4.3
Loc. 7: Los Angeles	Count	36	54	90	64
	Exp. Count	153.5	51.1	19.8	23.2
	Adj. Res.	-14.8	.5	16.8	9.1
Loc. 8:San Francisco	Count	149	19	7	65
	Exp. Count	142.8	47.6	18.4	21.5
	Adj. Res.	.8	-4.7	-2.8	10
Loc. 9: Portland	Count	77	6	14	21
	Exp. Count	85.5	28.5	11.1	12.9
	Adj. Res.	-1.4	-4.7	.9	2.4
Loc.10: Lawrence	Count	183	8	9	21
	Exp. Count	132.6	44.2	17.1	20.0
	Adj. Res.	6.8	-6.2	-2.1	.2
Loc. 11:Winston-Salem	Count	86	18	0	0
	Exp. Count	60.6	20.2	7.8	9.1
	Adj. Res.	5.0	-.5	-2.9	-3.2
Loc. 12: Buford	Count	504	127	6	50
	Exp. Count	409.0	136.3	52.9	61.7
	Adj. Res.	7.6	-.9	-7.2	-1.7
Loc. 13: Glendale	Count	212	24	163	96
	Exp. Count	411.9	137.2	53.2	62.2
	Adj. Res.	-16.0	-11.5	16.7	4.8

It appears that: young Caucasian-American women (less than 45 years old) were underrepresented while older ones were overrepresented, the opposite being true African-American, Hispano-American and Asian-American women.

Cross-tabulations reveal that, in certain locations, some ethnicities are overrepresented whereas others are underrepresented:

- Caucasian-American women are underrepresented on the West Coast (Glendale, CA; Los Angeles, CA) and overrepresented on the East Coast (Buford, GA; Cary, NC; New York, NY);
- Asian-American women are overrepresented on the West Coast (Los Angeles, CA and San Francisco, CA) and underrepresented in Cary, NC; Dallas TX; Miami FL; Chattanooga, TN or Winston-Salem, NC).

7.5.2 **Correlation analyzes**

To better understand each variable, we looked at its scatter plot and at potential correlations between variables. We show selected examples in Figure 7.5.

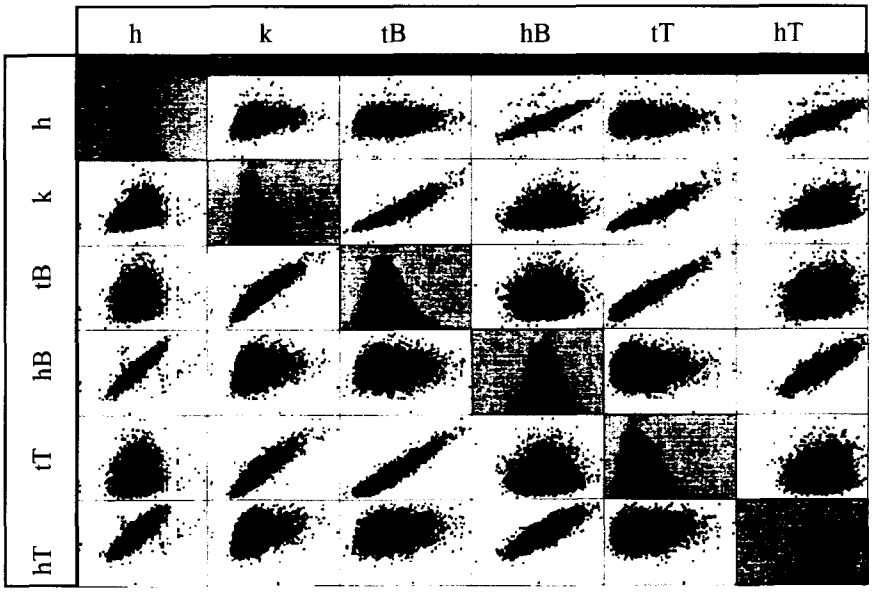


Figure 7.5: Scatter plot matrix or data cloud distribution.

Heights and girths in inches.

(h: Total height; k: Weight in pounds; tB: Bust girth;

hB: Bust height; tT: Waist girth; hT: Waist height).

Using a principal component analysis we validated (Tableau 7.8) that total height is correlated to most other height measurements (Pearson's r > 80 %) and not correlated to weight; weight on the other hand, is correlated to circumference measurements (Pearson's r > 0,85 in most cases). This validates our H_3 (height and weight measurements are not correlated) as well as the WMGPC (1941) finding that weight is correlated to circumference measurements.

Tableau 7.8 : Pearson's correlation coefficient: height, weight and circumferences correlation matrix.

	h	k	tB	tT	tHH	tH	tHC	tC	hT	hHH	hH	hF
h	1,00											
k	0.29	1.00										
tB	0.11	0.91	1.00									
tT	0.10	0.91	0.94	1.00								
tHH	0.09	0.92	0.91	0.96	1.00							
tH	0.18	0.95	0.87	0.90	0.94	1.00						
tHC	0.24	0.86	0.76	0.75	0.80	0.90	1.00					
tC	0.20	0.87	0.73	0.72	0.76	0.85	0.96	1.00				
hT	0.79	0.35	0.17	0.12	0.14	0.29	0.34	0.29	1.00			
hHH	0.81	0.39	0.22	0.17	0.17	0.30	0.37	0.31	0.98	1.00		
hH	0.52	0.59	0.58	0.58	0.58	0.51	0.40	0.34	0.62	0.67	1.00	
hF	0.80	0.08	-0.08	-0.12	-0.14	-0.03	0.10	0.06	0.85	0.87	0.49	1.00

(h: Total height in inches; k: Weight in pounds; tB: Bust girth; tT: Waist girth; tHH: High hip girth; tH: Hip girth; tHC: High thigh girth; tC: Thigh girth; hT: Waist height; hHH: High hip height; hH: Hip height; hF: Crotch height (inseam)).

Closer observation showed exceptions: i.e. the bust height and hip height. Heavier subjects appear to have lower bust height. It also seems that high hip height and hip height are less correlated than other height measurements. We assume this result to reflect a weakness of the 3D body scanner in determining the exact height of the hip and high hip; 27 women had to be discarded from the sample as the scanned had identified a negative height distance between high hip and hip.

7.5.3 Circumference measurement analysis

As mentioned above, our initial analysis of $[TC]^2$'s data allowed us to eliminate redundant or unrelated measurements and to retain only eight circumference measurements pertinent to the lower female body: waist, high hip, hip, high thigh, thigh, knee, calf, and ankle. We further reduced this number as some measurements (i.e. high hip girth) were unreliable or of limited use to determine pants fit (i.e. thigh, knee, calf,

and ankle measurements). Principal component and factor analyzes confirmed that we could retain the two measurements most frequently mentioned in anthropometric surveys and used in practice for sizing: waist and hip circumference.

We further reduced our sample in order to facilitate comparison with the pants measurements reported in part II. We only retained subjects with measurements within the Canadian sizes 4 to 24 (i.e. waist between 27.5 and 45.5 inches and hips between 36.5 and 53.5 inches) which 87,7 % of the original sample or 5615 individuals. In figure 7.7, these would be the subjects falling within the highlighted square. One may note that women's hips generally exceed waist measurements by 5 to 15 inches.

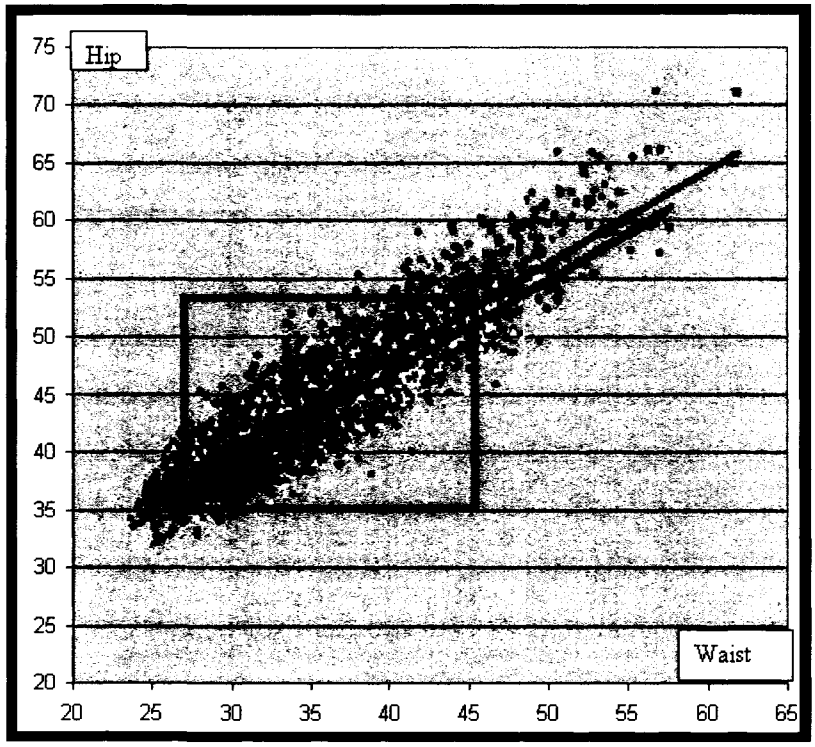


Figure 7.6 : Waist/hip sample space, limited to pants girth measurements in inches sizes 4 to 24

(Colors for ethnicities and slope: fuchsia for African-American women, Navy for Caucasian-American, and turquoise for Hispano-American)

Since the data forms a continuous cloud, we present the illustration (see Figure 7.7) for a better understanding.

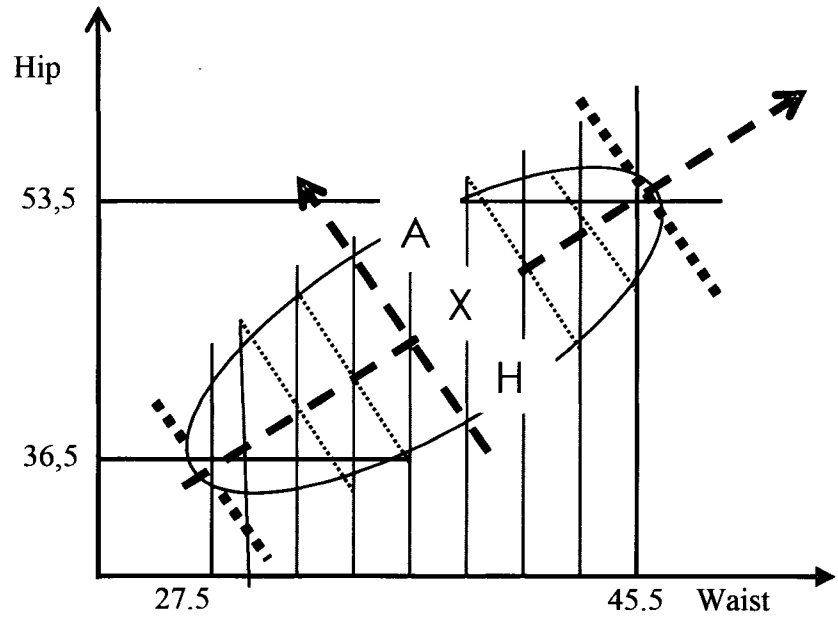


Figure 7.7 : Sample representation of the waist/hip space

Figure 7.7 shows that women with a larger waist-hip variation (**A** silhouette) are located over the diagonal line whereas women with a smaller waist-hip variation (**H** silhouette) fall below the diagonal.

7.5.3.1. **Clustering**

Our objective being to group women based on silhouette and size (measurements), we performed a data clustering analysis as Whitestone & Robinette (1997) suggested. Contrary to Ashdown (1998), we did not take height into consideration as we demonstrated earlier that no correlation exists between height and circumference measurements. No correlation shows a need for a new size category!

The data cloud slope (waist circumference - hip circumference) shows a proportional augmentation of the two dimensions according to the "general dimension" of each subject. The cloud gives the impression that abscissa and ordinate could be turned 45°. Rotation of the axes enables one to determine the two principal directions of each subject (1) "general dimension[68]", (2) the variations in the population (**A**, **X** or **H** silhouette), (3) as well the lesser variations between extremes of a same class.

This approach assumes an *a priori* established number of clusters. Some authors suggest that one should use no less than 57 sizes to cover 80% of the female population; others try to dress the entire population with *small, medium* and *large* sizes or even try to fit them all within *one size fits all.* We opted to use eleven size groups as this is the most common number of sizes on the Canadian market (sizes 4 to 24, increments of 2).

[68] General dimension in this case should be interpreted as general size from smaller (underweight) to blooming sizes (obese).

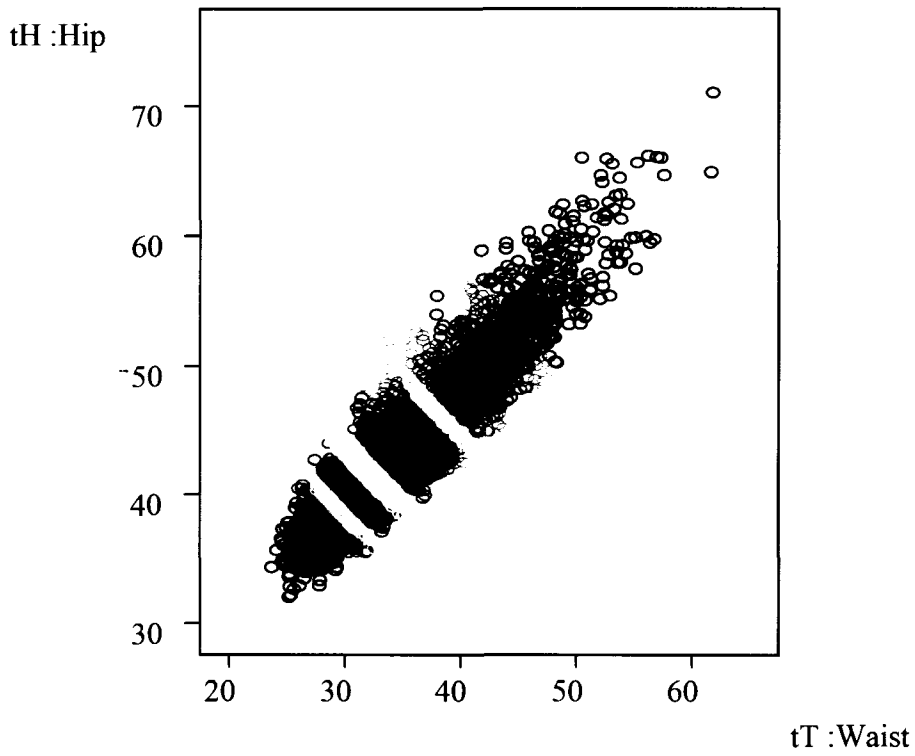


Figure 7.8 : Accommodated portion of the population divided into eleven classes

Our initial clustering results with a K-mean and 20 classes (Figure 7.9) showed two silhouettes. Although the literature states that full body silhouettes can be divided into eight groups (Rasband and Liechty, 2006) we chose to work with three lower body shapes as we demonstrated in part II that manufacturers generally produce for **A**, **X** or **H** silhouette.

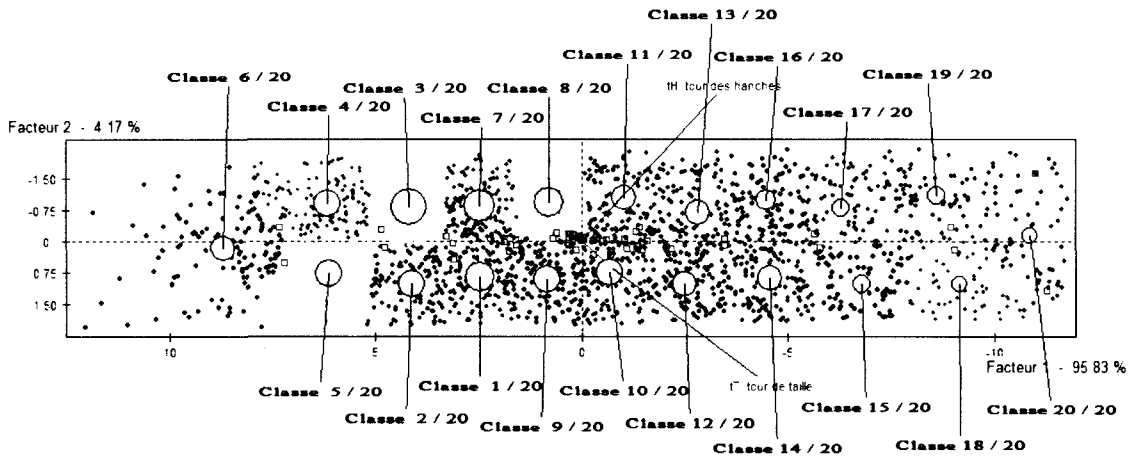


Figure 7.9 : Initial population clustering

The data cloud can therefore be sliced vertically in eleven sections and broken down horizontally in three layers.

We tested both equal numbers and equal amplitude clustering.

Figure 7.10 shows our results with equal numbers clustering. Figure 7.11 does the same with equal amplitude[69]. Both graphics use our Canadian retailer's specifications for sizes (S1 to S12, leaving us with 11 in-between classes). These results validate H_4: it is possible to classify the accommodated female population on two circumference measurements: hip and waist.

[69] Clustering was done with SPSS software which did not allow a perfect division of subjects in 33 equal clusters.

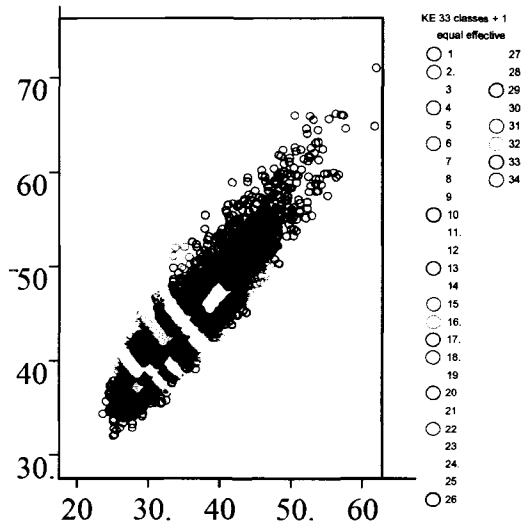


Figure 7.10 : Graphic representation of equal numbers with three silhouettes and eleven group sizes. Number of subjects for each A, X and H class are listed below

KE 33 classes + 1. Equal number

Valid	Frequency	Valid Percent	Cumulative Percent	Valid	Frequency	Valid Percent	Cumulative Percent
1	164	2.7	2.7	18	170	2.8	49.8
2	166	2.7	5.4	19	173	2.8	52.7
3	166	2.7	8.1	20	175	2.9	55.5
4	165	2.7	10.8	21	178	2.9	58.4
5	170	2.8	13.6	22	178	2.9	61.3
6	170	2.8	16.4	23	164	2.7	64.0
7	169	2.8	19.1	24	166	2.7	66.7
8	172	2.8	22.0	25	166	2.7	69.5
9	173	2.8	24.8	26	165	2.7	72.2
10	177	2.9	27.7	27	170	2.8	74.9
11	176	2.9	30.6	28	170	2.8	77.7
12	166	2.7	33.3	29	169	2.8	80.5
13	166	2.7	36.0	30	172	2.8	83.3
14	168	2.7	38.7	31	173	2.8	86.1
15	166	2.7	41.5	32	177	2.9	89.0
16	171	2.8	44.3	33	176	2.9	91.9
17	170	2.8	47.0	34	494	8.1	100

The classes along the diagonal cover a smaller graph area than those further away from the diagonal. From a producer's point of view, this means that the population is more densely distributed in this region and that it is therefore possible to satisfy a large number of consumers with a specific combination of waist-hip measurement, the measurement differences between adjoining clusters being small. As we move away from the diagonal, the population is distributed over larger areas: any given waist-hip combination of measurements will adequately fit a much smaller number of consumers, so measurement differences between products targeting two adjoining clusters would need to be more carefully determined to accommodate the largest number of women.

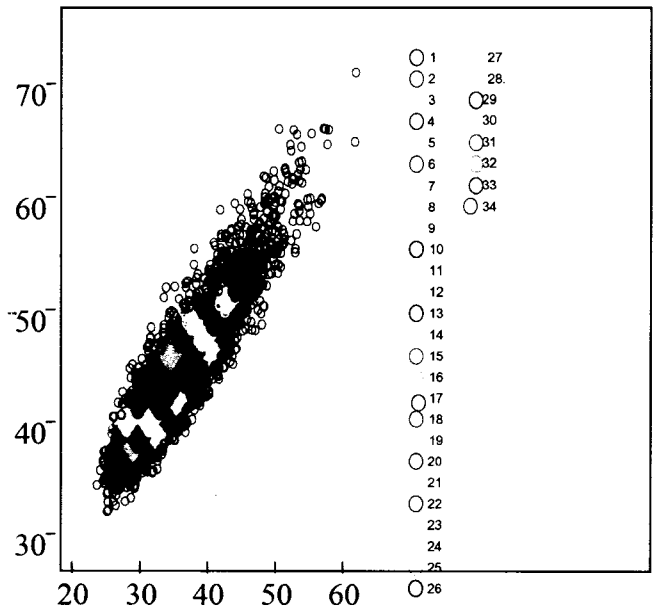


Figure 7.11 : Graphic representation of equal amplitude classes: three silhouettes and eleven group sizes. Number of subjects for each A, X and H class are listed below

KE 33 classes + 1. Equal amplitude

Valid	Frequency	Valid Percent	Cumulative Percent	Valid	Frequency	Valid Percent	Cumulative Percent
1	118	1.9	1.9	18	169	2.8	65.7
2	183	3.0	4.9	19	139	2.3	67.9
3	221	3.6	8.5	20	90	1.5	69.4
4	222	3.6	12.2	21	65	1.1	70.5
5	227	3.7	15.9	22	60	1.0	71.4
6	180	2.9	18.8	23	67	1.1	72.5
7	142	2.3	21.2	24	166	2.7	75.3
8	110	1.8	23.0	25	171	2.8	78.1
9	85	1.4	24.3	26	170	2.8	80.8
10	54	.9	25.2	27	143	2.3	83.2
11	44	.7	26.0	28	97	1.6	84.8
12	331	5.4	31.4	29	72	1.2	85.9
13	438	7.2	38.5	30	54	.9	86.8
14	490	8.0	46.6	31	39	.6	87.5
15	398	6.5	53.1	32	30	.5	88.0
16	314	5.1	58.2	33	30	.5	88.4
17	286	4.7	62.9	34	706	11.6	100

Tableau 7.9 shows the number of subjects for each of the 33 clusters (11 sizes, 3 silhouettes). When the cloud of potential measurements is divided equally into 33 size-silhouette clusters, some clusters cover loosely distributed population while others cover denser areas; e.g. cluster 11 (**A** shape & blooming size) covers slightly less than 0,7 % of the population while cluster 14 (**X** shape & third size) covers close to 8 %. From a producer point of view, this means that any specific combination of waist-hip measurement would adequately fit a larger number of women in the more densely sections of the graph (around the diagonal).

Tableau 7.9 : Number of subjects for each eleven A, X and H classes of equal amplitude.

Valid	Frequency	Percentage	Cum. %	Waist Girth min.	Waist girt max.	Hip girth min.	Hip girth max.
1	118	1.9	1.9	25.39	28.30	38.49	38.63
2	183	3.0	4.9	26.92	29.37	39.62	39.91
3	221	3.6	8.5	27.98	30.23	40.42	40.90
4	222	3.6	12.2	28.85	31.12	41.25	41.71
5	227	3.7	15.9	29.74	32.00	42.06	42.54
6	180	2.9	18.8	30.61	33.06	43.06	43.35
7	142	2.3	21.2	31.68	34.18	44.09	44.34
8	110	1.8	23.0	32.79	35.42	45.25	45.38
9	85	1.4	24.3	34.03	37.09	46.53	46.80
10	54	0.9	25.2	35.71	39.53	48.09	49.08
11	44	0.7	26.0	38.15	44.41	50.36	53.62
12	331	5.4	31.4	26.78	29.68	37.21	37.34
13	438	7.2	38.5	28.30	30.75	38.33	38.63
14	490	8.0	46.6	29.37	31.61	39.14	39.62
15	389	6.5	53.1	30.23	32.51	39.97	40.42
16	314	5.1	58.2	31.12	33.38	40.78	41.25
17	286	4.7	62.9	32.00	34.45	41.77	42.06
18	169	2.8	65.7	33.06	35.56	42.81	43.06
19	139	2.3	67.9	34.18	36.80	43.96	44.09
20	90	1.5	69.4	35.12	38.47	45.25	45.51
21	65	1.1	70.5	37.09	40.91	46.80	47.79
22	60	1.0	71.4	39.53	45.80	49.08	52.33
23	67	1.1	72.5	28.16	31.07	35.92	36.06
24	166	2.7	75.3	29.68	32.13	37.05	37.34
25	171	2.8	78.1	30.75	33.00	37.85	38.33
26	170	2.8	80.8	31.61	33.89	38.68	39.14
27	143	2.3	83.2	32.51	34.76	39.49	39.97
28	97	1.6	84.8	33.38	35.83	40.49	40.78
29	72	1.2	85.9	34.45	36.94	41.52	41.77
30	54	0.9	86.8	35.56	38.18	42.67	42.81
31	39	0.6	87.5	36.80	39.85	43.96	44.23
32	30	0.5	88.0	38.47	42.30	45.51	46.50
33	30	0.5	88.4	40.91	47.18	47.79	51.04
34	706	11.6	100				

It is of interest to note that, should this be the objective of the researcher, the average and upper-lower limits of each equal numbers clusters, or equal amplitude for that matter, could provide the basis to establish new size standards for the industry. Or again, one may note that the industry would prefer equal amplitude for easier grading. Tableau 7.10 shows this information for equal numbers clusters. One can see that the smallest size for an **A** silhouette should have a 26,85 inches waist and 38,56 inches hips whereas the smallest size for an **X** silhouette should measure 28,23 inches at the waist and 37,28 inches at the hips and again whereas the smallest size for an **H** silhouette should measure 29,53 inches at waist and 36,06 at the hips.

Tableau 7.10 : Average and upper-lower waist-hip measurements in an equal numbers distribution

Class number	Circumference Measurement limitations for **A** silhouette		Class number	Circumference Measurement limitations for **X** silhouette		Class number	Circumference Measurements limitations for **H** silhouette	
	Waist	Hip		Waist	Hip		Waist	Hip
1	26.85	38.56	12	28.23	37.28	23	29.53	36.06
2	28.14	39.77	13	29.53	38.48	24	30.84	37.25
3	29.08	40.69	14	30.48	39.39	25	31.82	38.14
4	29.97	41.50	15	31.35	40.21	26	32.68	38.98
5	30.85	42.32	16	32.24	41.03	27	33.57	39.79
6	31.79	43.25	17	33.17	41.97	28	34.52	40.71
7	32.87	44.28	18	34.23	43.00	29	35.61	41.73
8	34.03	45.38	19	35.39	44.11	30	36.77	42.83
9	35.48	46.74	20	36.82	45.49	31	38.21	44.20
10	37.51	48.68	21	38.88	47.41	32	40.29	46.09
11	41.17	52.09	22	42.54	50.82	33	43.96	49.50

Although validating our H_5 (Although women can be classified on three basic silhouettes, the number of classes necessary to cover the entire population is such that it can hardly lead to a functional ready-to-wear size standardization system) the above data also clearly points to the fact that some population clusters would not be well fitted with a standardized product.

Table 7.10 shows for example that, using average measurements, the difference at the hips from a class 10**A** silhouette to a class 11**A** silhouette is 3,41 inches (48,68 inches to 52,09). This means that a woman with 49,50 inches hips would feel uncomfortably tight in a class 10**A** and unappealingly loose in a class 11**A**.

7.6 Conclusion

A literature review shows that women find it difficult to find a well fitting garment with the sole help of the size labels which convey size information using a numerical code as proposed in the existing size standards. This difficulty is furthered by the order initiators' non-adherence to the measurements prescribed by size standards for specific body measurements. Yet very few size labels have to our knowledge, been proposed in the past decades (Chun-Yoon & Jasper, 1995, 1996; ISO, 1976), and fewer still studies have been done on the information that a size label should carry to truly be of help to the consumer.

This research first demonstrated that 3D body scanning can be a relatively reliable source of body measurements. It also confirmed that, for a sizing system for garments designed for the lower female body, some measurements were more important than others. It further established that body height measurements are not correlated to any body circumference measurement; although height and circumference measurements are generally highly correlated within themselves.

Three conclusions stand out: (1) that although women vary in height, this measurement is not highly correlated with weight or girths, (2) that the female body variation can be divided into three basic silhouettes: **A**, **H**, and **X**, and (3) that waist and hip circumference measurements are primary measurements needed to describe the female lower body.

Our findings open a number of avenues for further research. The first should try to answer the question whether apparel manufacturers, distributors, and consumers would prefer this data to be used for the development of new size standards or only to provide better size label information, leaving the order initiators entirely free to size their garments the way they chose.

The second two are somewhat parallel. One is that this same type of analysis should be conducted on the upper female body to determine if one can arrive at similar conclusions and, from these, at a full body label conveying all necessary information parsimoniously. A similar avenue would obviously be to perform the same type of research on the male body as well as on different age groups.

Finally, as Melzer & Moffitt (1997) suggest, should the available data be used to allow the decision on measurements to precede design?

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CHAPITRE 8 : WOMEN'S WEAR SIZING: A NEW LABELLING SYSTEM (PART V)

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8.1 Abstract

Purpose – To show that a new size labelling system based on the data gathered by $[TC]^2$ in the *Size USA, Let's size up America* survey would better serve the female population than the system currently in use.

Design/methodology/approach – Based on previous research conducted on $[TC]^2$ data and on pants measurements in the Canadian market, we propose a new labelling system where size information is provided with three specific body measurements along with a female silhouette pictogram.

Findings – Demonstrates that a size label showing three pants measurements: pants waist, approximate hips and inseam length accompanied by a silhouette identifying where these measures were taken can give useful information to predict the fit of pants.

Research limitations/implications – Limited to lower body (pants) for female.

Practical implications – A change to such a size labelling system would allow the apparel industry to move towards mass customization at minimal costs. It would be more effective for the apparel order initiators and retailers enabling them to target whichever market they wish yet convey the necessary fit information in a generally accepted format. This system would also be more efficient as it would reduce the consumer time spent in fit identification and merchandise returns, in the case of Internet or catalogue sales. As a corollary, it would both increase consumer shopping experience satisfaction and industry profitability.

Originality/value – Proposes a new labelling system.

Keywords: Apparel, Clothing, Fashion, Garment, Labelling, Mass customization, Standards

Article Type: Research paper

8.2 Introduction

We demonstrated in previous papers (Faust *et al.*, TBP) that apparel order initiators and manufacturers do not adhere to established national standards. A literature review enabled us to identify a number of causes for this situation ranging from standards obsolescence (based on a population survey conducted more than 60 years ago and updated irregularly for different purposes) to niche marketing (adapting sizes to please a specific group of consumer) or vanity sizing (using larger measurements than a given size designation to appeal to the consumer's vanity). The ready-to-wear industry has clearly chosen not to respect size standards; on the other hand, it has not yet acquired the tools or technology to offer *tailor-made* in the most price sensitive market segments. This has created a nightmarish situation for the consumer who can no longer rely on the size label to identify a well fitting garment and must therefore spend an undue amount of time shopping and trying on clothing.

This paper contends that a viable choice exists between the *tailor-made* and imposed size standards extremes of the mass customization versus total standardization spectrum: allow order initiators and manufacturers to size their products however they wish yet propose or impose a labelling system precisely reporting garments' specific measurements. This approach recognizes that order initiators may target and fit specific consumer segments while ensuring the provision of pertinent information to the consumer. It also improves supply chain management by allowing distributors and retailers to order garments fitting their target market. The size label for pants should include:

- three key measurements: waist, hips and inseam; and
- a pictogram of a forward facing female silhouette (**H**, **X** or **A**) identifying the measurement points to account for style variations.

To test the look and acceptance level of a possible "new" label, we conducted a mini-test with 36 women who participated in our pre-test and with 103 women who participated in the validation study: results showed that 87% of the pre-test and 78% of the validation participants respectively voted in favour of visual presentation of the above mentioned information.

8.3 Literature review

> "Measurement in the *ancient regime*, referred to a *particular* physical standard held in local hands and safeguarded by local officials."... "It was the obligation of local officials – these aldermen, guildmasters, seigneurs, and abbots – to enforce these standards, ensuring that exchanges in the marketplace were fair. In return, they were entitled to extract a small fee for their services. Not only did the physical standards differ from community to community, but the technique of measurement depended on local custom."[70]

[70] Alder, K. (2003). *The Measure of all Things; The Seven Year Odyssey That Transformed the World.* P.134, 3 par.

> Moreover, "many *ancient regime* measures – especially those that related to the world of production – had at their origin an anthropometric meaning derived from human needs and human interests."[71] One only have to think of the *pied* (foot), the *pouce* (thumb), the *pas* (yards).
>
> Since mandatory use of the metric system (in 1794 in some countries) and the availability of tools such as rulers and scales inspectors are rarely seen; "Only in case of extreme controversy are the inspectors actually obliged to check the calibration."[72] (Adler, 2003)

In the apparel industry, measuring methods, standard sizes, grading systems, and size labelling have been the object of discussions for a number of years, frequently in relation to fit (O'Brien & Shelton, 1941; Diffrient, 1974; ISO, 1976; Workman, 1991; Beazley, 1997-8; Ashdown, 1998; Winks, 1997; Anderson *et al.*, 1998; McCulloch *et al.*, 1998; Gould-Decauville, 1999; Turner & Bond, 1999; Workman & Lentz, 2000; Yertutan, 2001; Istook & Hwang, 2001). For researchers such as O'Brien and Shelton (1941), national surveys based on anthropometric data were the solution of choice to arrive at standard sizes ensuring that all females were fitted. Anthropometric measurements are defined as the measurement of lengths, widths, depths and circumferences of various parts of the human body (Chamberland *et al.*, 1997-98). They were first used in an attempt to distinguish among races and ethnic groups of humans and then used to support product design in several industries (Roebuck, 1995). Yet more and more authors believe that standards emanating from national surveys were of limited use in their time and are now obsolete (Schofield & LaBat, 2005). They justify their point of view based on the fact that women of this time have different body measurements and body shapes than those of when the study was conducted (Hamel & Salvas, 1992; Rasband, 1994; Yu *et al.*, 2006).

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[71] [71] Alder, K. (2003). *The Measure of all Things; The Seven Year Odyssey That Transformed the World.* P.136, 3 par.
[72] Alder, K. (2003). *The Measure of all Things; The Seven Year Odyssey That Transformed the World.* P.134, 1 par.

Data gathered in the [TC]^2 *Size USA, Let's size up America* survey, a major anthropometric measurement project conducted using body scanning technology, enabled us (Faust *et al.*, TBP) to confirm the possibility to standardize women apparel sizes within specific limitations. Our analysis of the data cloud for the female lower body enabled us to cluster women using only two circumference measurements: waist and hips (see figure 1 reprinted from Faust *et al.*, TBP) using both equal amplitude and equal number distributions. We used 33 classes to fit all women in our sample (lower body, for pants). These classes were based (1) in part on the actual sizing system currently in use further divided (2) into three common female silhouettes established from the waist and hips girth measurements. Yet even with such a high number of classes, we found that (1) a fairly high percentage of women were left out and (2) some classes, at the fringes of our population data cloud, the size categories were so wide as to be of little use in terms of adequately fitting a garment.

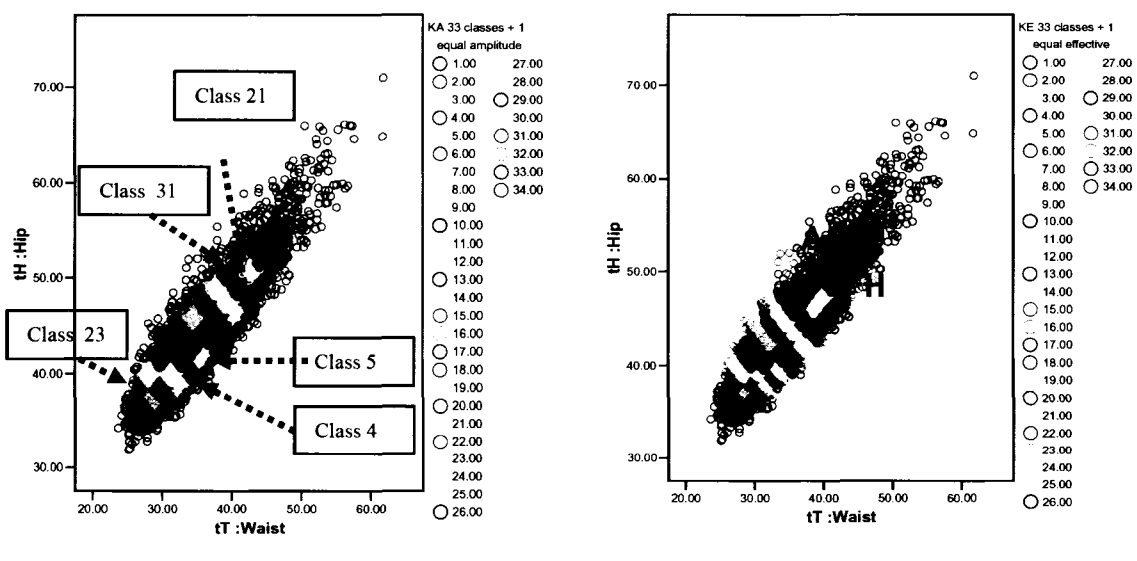

Figure 8.1 : Presentation of equal amplitude and equal number classes: three silhouettes and eleven sizes. A few classes are identified as examples.

Moreover, we also demonstrated (Faust *et al.*, TBP) that inseam length is important information not accounted for in the existing size standards. The *petite-regular-tall* classifications currently used in the industry are somewhat useless as. Although the correlation between a person's total height and inseam length is adequate (Pearson r>80%), an inseam variation of only a few inches makes all the difference in the world in terms of fit. Hence we came to the conclusion that to properly fit all of the female population with standardized sizing would require too large a number of classes: 33 classes for circumference measurements plus a number of inseam lengths.

Glock & Kunz (2000) state that, in order to ensure the best fit, it is an order initiators' responsibility to consider its target customer when developing specifications. Accordingly, order initiators often prefer grading their garments according to their target market's needs rather than a prescribed size chart (Burns & Bryant, 2002). Some feel that the garment industry is moving toward more diversity, providing more choice for petite and large (plus) sizes (Labat & Delong, 1990), developing sizing charts to satisfy their target consumer's needs (Schofield & LaBat, 2005).

Faust *et al.* (2006) confirmed that order initiators, considering the obsolescence of standards and their wish to satisfy their clientele, (a) do not adhere to national size standards and, in a subsequent paper (Faust *et al.*; TBP) (b) that they target women of specific silhouettes (either **H**, **X** or **A** shape). In Faust *et al.* (2006) they also showed that manufacturers did not respect the specifications provided by the order initiators although constantly targeting the same silhouette. Figure 8.2 shows the whole size labelling process.

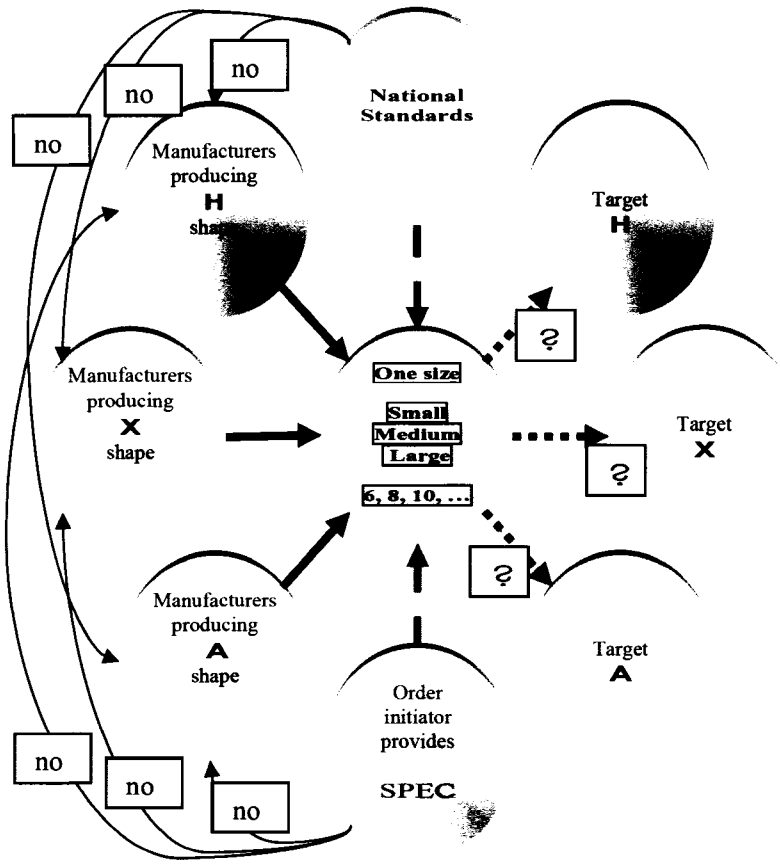

Figure 8.2 : Description of actual size labelling system

Consumer acceptance of, and production models of mass customization in the apparel industry have been the object of recent academic papers (Caldwell & Workman, 1993; Fiore *et al.*, 2001, 2002 & 2004; Anderson-Connell *et al.*, 2002; Istook, 2002; Ogawa & Piller, 2006; Blecker & Abdelkafi, 2006). Several apparel manufacturers and retailers have moved toward this new paradigm without difficulty. One needs only think of *Levi's adaptable standards*, *Nike* with *CUSTOMIZE WITH NIKEiD*, *Lands' End* and many other online distributors using *My Virtual Model*, etc. Ogawa & Piller (2006) suggest that, to provide better fit and satisfaction, businesses should integrate customers into the *a priori* innovation process, i.e. before entering the final development and manufacturing stages.

Applied to the ready-to-wear apparel industry, this means that the order initiators should be familiar with its target consumer size and silhouette before designing, grading, cutting and sewing its collection.

Yet some believe that the industry is reacting too slowly to specific target market segments of the population (Lennon, 1992; Goldsberry *et al.*, 1996; Campbell and Horne 2001); that order initiators often request, and retailers distribute, either *one size fits all* or *a limited number of size labels* that are insufficient to fit all customers (Kilney, 2003; Faust *et al.*, 2006). In the last decades, the apparel industry has also more and more perceived the world as a global market: global competition among global companies for global customers (Kerin *et al.*, 2005) increasing the need for better and more varied size choices.

That order initiators or manufacturers do not adhere to size standards is not a problem in itself. It can even be viewed as a first step toward mass customization: slicing the market in very narrow market segments or niches. The problem arises when they all use the same numerical sizing codes (such as 6, 8, 10 ... 24) to label garments of varying measurements (Workman, 1991). This begs the questions: Do size labels convey adequate information? Do they fulfil the primary function that led to their creation: to assist consumers in selecting the best fitting garment (Chun-Yoon & Jasper; 1996)? Are size labels appreciated by consumers Gould-Decauville *et al.* (1999)? "How is that a 5'8", 150 pound woman, a 5'6", 135 pound woman and a 5'9", 125 pound woman all claim to wear a size 8?"([TC]^2, 2004)[73]. What can a size "00" mean? From the consumer's point of view, the result is confusion, dissatisfaction, waste of time and high product returns and exchange rates. Consumers must guess the actual garment size or try them on to identify the best fit. Faust *et al.* (2006b) observed that more than 50% of women take two or more identical garments of different sizes when heading for the fitting room.

[73] http://www.tc2.com/what/sizeusa/index.html, read 2004-03-18

The objective of the current research is to develop a new "silhouette and size" apparel labelling system based on the analysis of the data collected by [TC]^2 *Size USA, Let's size up America* presented in earlier papers (Faust *et al.*, TBP). Frequently discusses alternatives to the present sizing system revolve around some form of customization hinging on the industry's ability to tailor-make all garments. As mentioned earlier, we do not feel that the industry is yet there, especially at the price sensitive end of the market. We therefore considered that size labels currently affixed to garments present three major weaknesses: (1) they only carry a numerical code assigned to standard measures which vary among manufacturers and retailers, (2) they do not reflect the adaptations to the standards that order initiators or manufacturers make, and (3) they provide no information on garment lengths.

8.4 Methodology

In order to address these weaknesses and convey useful information to the consumer, we propose that the apparel industry use a label presenting:

- Three key measurements: waist (along top edge of waistband from edge to edge or side to side), hips (measured about 1 inch above the crotch) and inseam (from crotch to bottom), (Figure 8.3); and

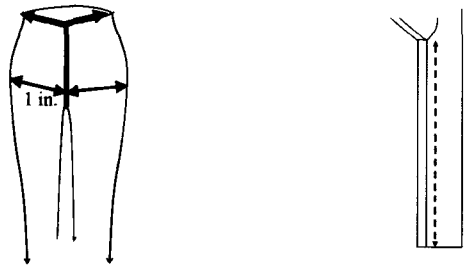

Figure 8.3 : Where and how to measure

- a pictogram of a forward facing female silhouette (**H, X** or **A**) identifying the measurement points to account for style variations (see Figure 8.4)

To confirm that such a label could improve the current situation, we first needed to validate the purpose of even proposing a new label. Our first hypothesis was that:

H_1: Order initiators measurement specifications cover the whole spectrum of sizes and shapes although garments are labelled with a same size code number

Our initial findings led us to conclude that the existing standards are focusing on what is known as an **X** silhouette woman. Yet order initiators and manufacturers often modify the standard measurements to target specific consumer groups (generally modifying the waist to hips ratio to fit **A** or **H** silhouetted women). The need for a new size label is based on the assumption that apparel manufacturers already offer garments covering most of the population segments (as defined with waist and hip measurements) although they only use a limited number of size codes to identify them (Figure 8.5). Validation of this hypothesis would demonstrate that females can find fitting pants in spite of the existing size standards.

To accomplish this task, we compared the order initiators' pants specifications to the $[TC]^2$ *Size USA, Let's size up America* survey data cloud.

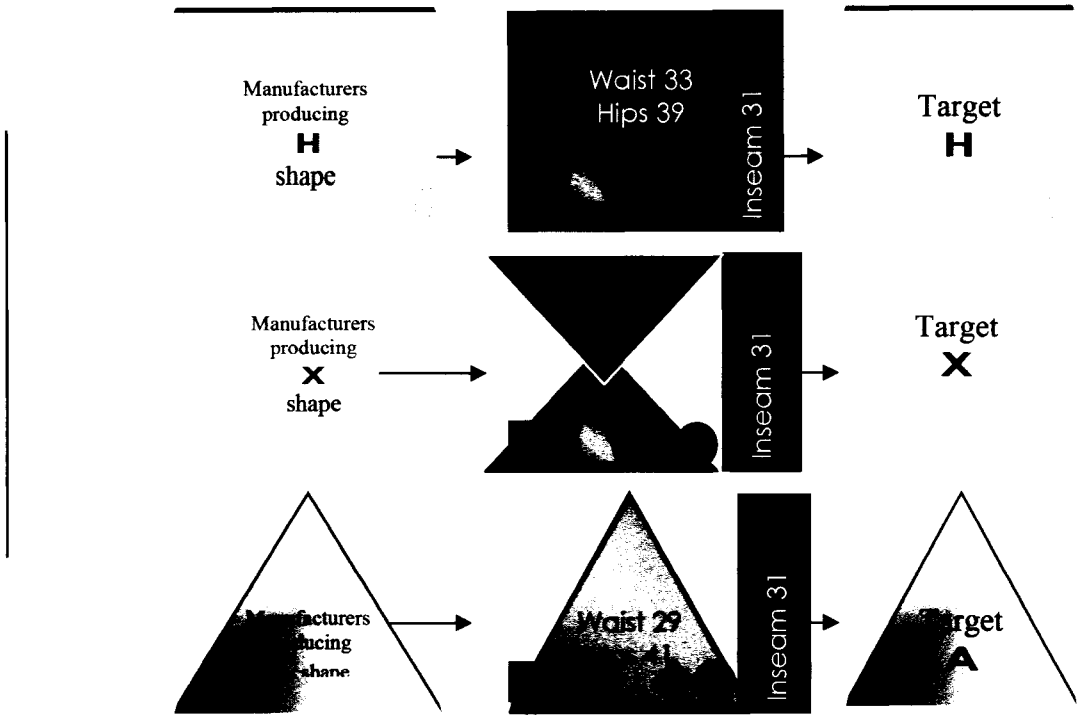

Figure 8.4 : Size and shape depicting label

Our second hypothesis dealt with the necessity to include the inseam value on the size label. It was based on research presented in an earlier paper (Faust *et al.*, TBP) showing (1) that there was no correlation between women's weight and height and (2) that, although a correlation existed between a woman's total height and her inseam, the current *petite-regular-tall* standards were insufficient to provide an adequate pants length fit.

H_2: Inseam is a critical in formation in selecting the right pants

To validate this hypothesis, we (1) present some of the data analysis done on the $[TC]^2$ *Size USA, Let's size up America* survey showing that women's inseam requirements vary and (2) substantiate this first information with a study of merchandise returns provided by a large Canadian garment catalogue retailer.

To verify the value of the information provided by our new label, we needed to validate two more hypotheses (see H_3 and H_4).

H_3: Women choose pants with waist and hips measurements similar to their body measurements

To determine this, we first conducted a pre-test for our H_3 and H_4 with 36 women (40 women contacted although 4 did not respond) asking each to measure their waist and hips and to identify and measure two of their best fitting pants in their wardrobe. Part of this pre-test was done at distance through e-mail. Women were between 18 to 75 years old with the majority living in the Eastern part of Canada. This sample is not representative and was used only as a pre-test. We soon learned that this approach led to some confusion and decided to do the actual test *in situ*. We also noticed that it would be preferable to provide our sample women with pants we had selected and which had similar front rise specifications thereby eliminating pants styles with a low waist. We selected thirty pants, from different brand names and produced by different manufacturers, labelled from size 4 to 14. We classified these pants as either **H**, **X** or **A** (based on our classification of silhouettes). We then took a convenience sample of 96 (103 were sampled with 7 rejections) women whom we measured at the waist and hips, and then asked each of them to try ten of our study pants (which we selected to more or less match their body size) for fit evaluation. Women were from different nationalities and their age ranged from 18 to 55 years old. Through a questionnaire, we also asked them, among other things, to report their evaluation of fit for each pant they tried on. We hypothesized that women would regularly report that the best fitting pants were the ones for which pants measurements matched their body measurements and that pants not matching their measurements would be rated as too loose or too tight.

In order to equate this information with our new label's ability to predict the pants a woman would choose we further needed to account for consumer preferences in terms of pants fit (tight, fitted or loose).

We measured this through another question asking for their preferences in terms of *tight-fitted-loose*. Our reasoning behind this last hypothesis was that women preferring loose-fitting pants would tend to choose pants with slightly larger measurements than their body measurements and women preferring tight-fitting pants would tend to opt for pants with slightly smaller measurements than their body measurements.

H_4: Women prefer wearing a specific type of pants fit (tight, fitted or loose)

We felt that this last hypothesis in no way weakened the predictive ability of our label as a woman constantly preferring tight or loose pants would simply look for a label identifying pants with either slightly smaller or slightly larger measurements than her body measurements.

We also took this opportunity to ask women a number of other questions which may have an indirect impact on the acceptability of our new size label. One of these questions pertained to the women's knowledge of their body measurements. One can argue that a label giving waist and hips measurements will only be of value if women know their measurements. We hypothesize that a number of women may not currently know this information because the actual size labelling system does not require it; however we believe they would soon learn it if it were of use.

Lastly we presented our sample (as well as those who participated in the pre-test) with different labels with some showing a pictogram with a woman's silhouette (**H**, **X** or **A**), and some identifying where the pants measurements were taken relative to a human body, asking them to identify the three they preferred. This information, not necessarily pertinent for the present research, could be of use in the ultimate label design.

8.5 Findings

8.5.1 **Current offer analysis**

We first compared the order initiators' specifications obtained and presented in (Faust *et al.*, TBP), with our two (equal amplitude and equal number) classifications. Tableau 8.1 presents the average waist and hips measurements of the Canadian retailer's twelve sizes (eleven sizes from size 4 to 24, increments of 2", with both a size 18 and a size 18W, therefore leaving us with twelve classes).

Tableau 8.1 : Waist and hip limit measurements of Canadian retailer eleven (twelve with 18 and 18w) sizes

Sizes	4	6	8	10	12	14	16	18	18w	20w	22w	24w
Codification	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
tT Waist circumference Boundary	27	28	29	30	31.5	33	35	37	38	40	42	44
tH Hips circumference Boundary	37	38	39	40	41.5	43	45	47	48	50	52	54

Figure 8.1 presented above, shows a graph of each of the 33 classes in both equal amplitude and equal numbers from the $[TC]^2$ data (with upper and lower boundaries) while Tableau 8.2 and Tableau 8.3 provide the values of the boundaries for each system.

Tableau 8.2 : Boundaries for each of the 33 classes with equal amplitude

Class No.	Circumference mMeasurement limitations for H silhouette			
	Waist		Hip	
	Min.	Max	Min.	Max.
1	28.16	31.07	35.92	36.06
2	29.68	32.13	37.05	37.34
3	30.75	33.00	37.85	38.33
4	31.61	33.89	38.68	39.14
5	32.51	34.76	39.49	39.97
6	33.38	35.83	40.49	40.78
7	34.45	36.94	41.52	41.77
8	35.56	38.18	42.67	42.81
9	36.80	39.85	43.96	44.23
10	38.47	42.30	45.51	46.50
11	40.91	47.18	47.79	51.04
Class No.	Circumference measurement limitations for X silhouette			
	Waist		Hip	
	Min.	Max	Min.	Max.
12	26.78	29.68	37.21	37.34
13	28.30	30.75	38.33	38.63
14	29.37	31.61	39.14	39.62
15	30.23	32.51	39.97	40.42
16	31.12	33.38	40.78	41.25
17	32.00	34.45	41.77	42.06
18	33.06	35.56	42.81	43.06
19	34.18	36.80	43.96	44.09
20	35.42	38.47	45.25	45.51
21	37.09	40.91	46.80	47.79
22	39.53	45.80	49.08	52.33
Class No.	Circumference measurement limitations for A silhouette			
	Waist		Hip	
	Min.	Max	Min.	Max.
23	25.39	28.30	38.49	38.63
24	26.92	29.37	39.62	39.91
25	27.98	30.23	40.42	40.90
26	28.85	31.12	41.25	41.71
27	29.74	32.00	42.06	42.54
28	30.61	33.06	43.06	43.35
29	31.68	34.18	44.09	44.34
30	32.79	35.42	45.25	45.38
31	34.03	37.09	46.53	46.80
32	35.71	39.53	48.09	49.08
33	38.15	44.41	50.36	53.62

Tableau 8.3 : Boundaries for each of the 33 classes with equal numbers

Class No.	Circumference measurement limitations for H silhouette			
	Waist		Hip	
	Min.	Max	Min.	Max.
1	27.85	31.07	36.06	36.21
2	29.43	32.13	37.05	37.58
3	30.53	33.00	37.85	38.54
4	31.31	33.89	38.68	39.42
5	32.25	34.76	39.49	40.21
6	33.05	35.83	40.49	41.08
7	34.10	36.94	41.52	42.10
8	35.17	38.18	42.67	43.17
9	36.33	39.85	44.23	44.39
10	38.11	42.30	45.85	46.50
11	40.57	47.18	48.11	51.04
Class No.	Circumference measurement limitations for X silhouette			
	Waist		Hip	
	Min.	Max	Min.	Max.
12	27.08	29.37	36.93	37.63
13	28.57	30.49	38.38	38.57
14	29.54	31.40	39.34	39.46
15	30.46	32.20	40.21	40.25
16	31.33	33.12	41.02	41.06
17	32.11	34.12	41.96	42.07
18	33.11	35.21	43.02	43.13
19	34.19	36.41	44.08	44.32
20	35.39	38.01	45.26	45.95
21	36.96	40.56	46.92	48.12
22	39.39	45.45	49.20	52.65
Class No.	Circumference measurement limitations for A silhouette			
	Waist		Hip	
	Min.	Max	Min.	Max.
23	25.10	28.60	38.35	38.77
24	26.62	29.64	39.37	40.19
25	27.69	30.40	40.27	41.18
26	28.55	31.35	41.04	41.98
27	29.45	32.20	41.87	42.81
28	30.32	33.18	42.96	43.62
29	31.39	34.22	44.05	44.62
30	32.50	35.43	45.24	45.65
31	33.74	37.07	46.81	46.82
32	35.41	39.40	48.36	49.19
33	37.85	44.27	50.64	53.75

Figure 8.4 below shows the $[TC]^2$ sample data cloud waist and hip measurements as plotted with our contributing catalogue Canadian retailer's and three large manufacturer's specifications. One can clearly see that they target different female silhouettes. Whereas our retailer targets an **X** (close to the edge of an **A**) shaped women, as does our manufacturer # 2 (clearly an **X** shape), the other two manufacturers target **A** and **H** silhouettes.

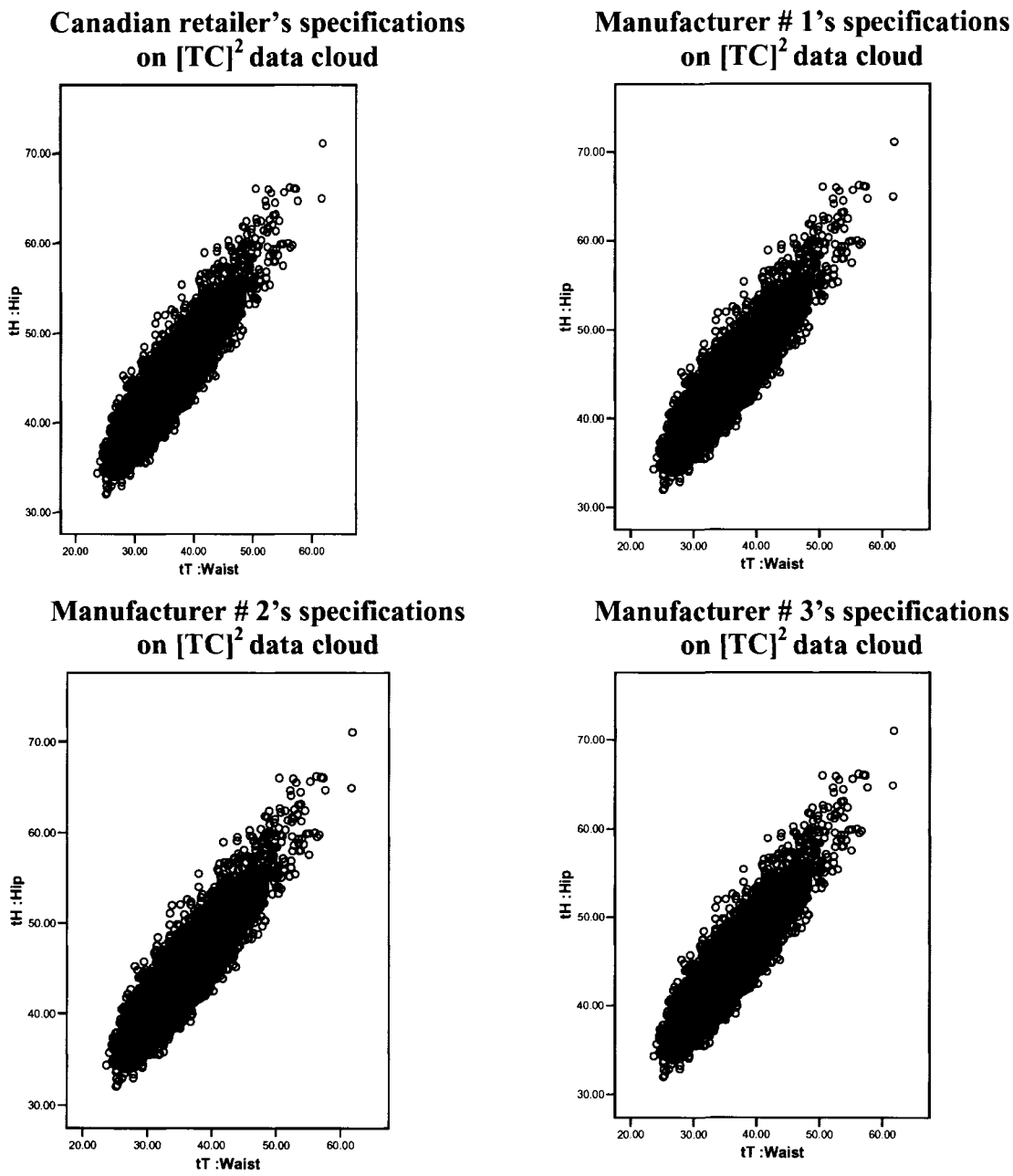

Figure 8.5 : Data cloud of waist and hips measurements with Canadian retailer specifications for sizes 4 to 24 with 18 and 18w (targeting an X shape close to the edge of an A shape), and three manufacturers targeting (1) an A shape, (2) an X shape, and (3) an H shape.

This validates our first hypothesis: garment manufacturers use different measurements and silhouettes to cover the entire female population while still using, to the confusion of the consumer, the existing size labelling system to identify their pants.

8.5.2 Inseam measurements analyzes

Many authors (Beazley, 1998; Rasband & Liechy, 2006) agree with most USA national reports (WMGPC, 1941; CS215-58, 1958; PS42-70, 1970) that women's body measurements should be divided into different height groups such as *short* (or *petite*), *regular* (or average) and *tall* although they not agree on the lower and upper limits to these groups; catalogue distributors who also use different height size categories as well.

O'Brien & Shelton (1941), Rasband & Liechty (2006), as well as the Canadian retailer who contributed to our research agree on the following sizes and limits (Tableau 8.4):

- *petite* refers to women smaller than 5'4";
- *regular* identifies women between 5'4" to 5'7";
- *tall* covers women taller than 5'7".

Tableau 8.4 : Women's height measurements descriptive statistics

	Minimum	Average	Median	Mode	Maximum
Inches"	48,5"	63,9"	64"	64"	82"
Feet'	4'½	5'3 ¾	5'4"	5'4"	6'8"

Figure 8.6 shows height measurements statistics from the [TC]^2 *Size USA, Let's size up America* survey.

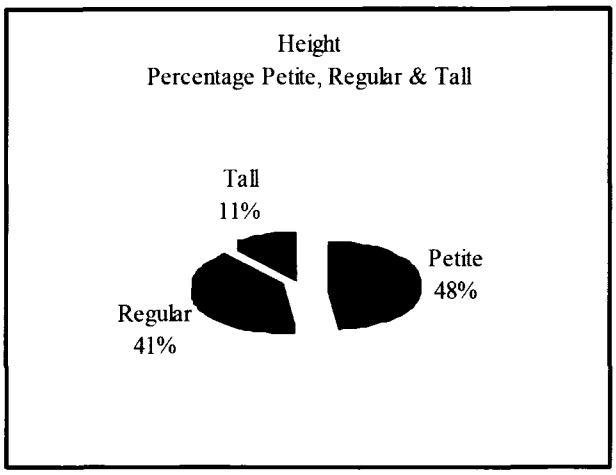

Figure 8.6 : *Petite, regular*, and *tall* percentages of women in [TC]2's survey

Figure 8.6 shows that nearly 50% of [TC]^2's sample falls in the *petite* category while 11 % are taller than 5'7". Table 5 also shows that the highest percentage of *tall* women falls in the 18 to 45 age group while the highest percentage of *petite* can be found in the older women group. One can also see that almost 70% of the Hispano-American and Asian-American and others are shorter than 5'4".

Tableau 8.5 : Percentages of *petite, regular* and *tall* according to the Ethnicity and Age groups.

	Ethnicity				Age groups					
	Caucasian-American	African-American	Hispano-American	Asian-American/ Other	18-25	26-35	36-45	46-55	56-65	66 and over
Petite x < 5'4"	39%	37%	71%	68%	45%	45%	47%	49%	55%	65%
Regular 5'4" ≤ x ≤ 5'7"	47%	47%	25%	27%	43%	43%	41%	41%	36%	27%
Tall x > 5'7"	13,%	15%	3%	4%	11%	11%	11%	9%	8%	7%

Tableau 8.6 shows, as an example, how the women surveyed, once classified as *regular* and *tall,* as defined by O'Brien & Shelton (1941) and Rasband & Liechty (2006) should measure at the inseam according to the CS215-58 standard.

Tableau 8.6 : Example of inseam measurements for women identified as *regular* and *tall* per CS215-58.

Sizing (regular)	8R	10R	12R	14R	16R	18R	20R	22R
Inseam	28-1/2	28-5/8	28-3/4	28-7/8	29	29-1/8	29-1/4	29-3/8
Sizing (tall)		10T	12T	14T	16T	18T	20T	
Inseam		30-7/8	31-1/8	31-1/4	31-3/8	31-1/2		

Although a relationship exists between total height and inseam, one cannot suggest any generalization to the effect that a *regular* or a *tall* (as categorized by overall heights) would need an inseam of such or such a length. One can see in table 7, that more than 75% of Caucasian-American, African-American, Hispano-American and Asian-American women classified in the *regular* size category by height need an inseam between 28.51 and 31.5; more than 15% of the Caucasian-American, Hispano-American and Asian-American women in the *regular* size category need a shorter inseam between 27.01 and 28.5 compared to 3.26% for African-American. On the other hand close to 15% of African-American *regular* need an inseam of between 31.51 and 33 inch compared to less than 3% for Caucasian-American and Asian-American and a little more than 3% for Hispano-American. We also note that young *regular* women's inseams are generally longer than the women inseams of regular sized over 55 years old. Similar results were found in *petite* and *tall.*

Tableau 8.7 : Summary of inseam measurements for *regular* by Ethnicity and Age groups.

Regular inseam: percentage according to the Ethnicity or to the Age groups

	Ethnicity				Age groups					
Inseam measurements	Caucasian American	African-American	Hispano-American	Asian-American/Others	18-25	26-35	36-45	46-55	56-65	66 and over
$x \leq 24$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$24 < x \leq 25½$	0.06	0.00	0.47	0.35	0.00	0.00	0.36	0.00	0.45	0.00
$25½ < x \leq 27$	0.57	0.77	1.90	2.09	0.45	0.63	1.46	1.28	0.00	3.08
$27 < x \leq 28½$	16.89	3.26	18.01	18.47	8.86	11.71	15.88	17.70	26.82	20.00
$28½ < x \leq 30$	49.34	34.17	50.24	50.17	41.59	47.31	47.81	49.68	49.09	44.62
$30 < x \leq 31½$	30.11	47.79	26.07	25.78	39.94	35.60	30.84	26.87	21.82	30.77
$31½ < x \leq 33$	2.97	13.24	3.32	2.79	8.56	4.59	3.65	4.26	1.82	1.54
$33 < x \leq 34½$	0.00	0.77	0.00	0.00	0.45	0.00	0.00	0.21	0.00	0.00
$34½ < x \leq 36$	0.06	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00
$36 < x$	0.00	0.00	0.00	0.35	0.00	0.16	0.00	0.00	0.00	0.00
total	100	100	100	100	100	100	100	100	100	100

In Faust *et al.* (TBP) we presented our measurements on more than 800 pants of different styles from a large Canadian retailer. The pants styles identified as "*D*" and "*E*" came from the same manufacturer and their measurements (waist, high hip, hip, thigh girth, front and back rise) were highly similar.

Tableau **8.8**, from Faust *et al.* (TBP) shows the distance measures of similarity between these two styles.

Tableau 8.8 : Distance measures of similarity between pants *D* and *E*

	1	1	1,5	1,5	2	2	3	3	4	4	5	5
	D-6	E-6	D-8	E-8	D-10	E-10	D-12	E-12	D-14	E-14	D-16	E-16
1 D-6	0	0,1626	1,0075	0,9788	2,2628	2,5382	3,8648	3,6899	5,4423	5,9952	7,7051	8,0188
1 E-6	0,163	0	1,107	1,0435	2,3466	2,6223	3,955	3,7703	5,5259	6,0802	7,7932	8,1063
2 D-8	1,007	1,107	0	0,2624	1,2774	1,5392	2,8611	2,6894	4,4416	4,9907	6,7023	7,0132
2 E-8	0,979	1,0435	0,2624	0	1,3227	1,5868	2,9237	2,7291	4,4876	5,0407	6,758	7,0685
2 D-10	2,263	2,3466	1,2774	1,3227	0	0,3586	1,6296	1,4788	3,1879	3,7535	5,4522	5,7741
2 E-10	2,538	2,6223	1,5392	1,5868	0,3586	0	1,3379	1,1634	2,9068	3,4595	5,1736	5,485
3 D-12	3,865	3,955	2,8611	2,9237	1,6296	1,3379	0	0,3959	1,5924	2,142	3,8425	4,157
3 E-12	3,69	3,7703	2,6894	2,7291	1,4788	1,1634	0,3959	0	1,7877	2,317	4,0524	4,3466
4 D-14	5,442	5,5259	4,4416	4,4876	3,1879	2,9068	1,5924	1,7877	0	0,6106	2,2757	2,5963
4 E-14	5,995	6,0802	4,9907	5,0407	3,7535	3,4595	2,142	2,317	0,6106	0	1,7519	2,0301
5 D-16	7,705	7,7932	6,7023	6,758	5,4522	5,1736	3,8425	4,0524	2,2757	1,7519	0	0,4535
5 E-16	8,019	8,1063	7,0132	7,0685	5,7741	5,485	4,157	4,3466	2,5963	2,0301	0,4535	0

The one important difference between these two pants of the same style and same fabric was in the crotch height or inseam. Neither was labelled as either a *petite* or *tall.* Pants *D*'s inseam for sizes 6 to 16 varied from 31,05 inch to 31,43 inch whereas pants *E*'s inseam varied from 32,78-inch to 33,05-inch. Pants *E*'s inseam exceeded pants *D*'s inseam by at least one inch in every size.

The Canadian retailer who contributed to our research provided us with the list of every single purchase and return for both styles during a 4-month period. Our analysis showed that the return percentages were 7% to 31% higher for pants *E* than for pants *D*: the pants with the longer inseam (generally between 32 and 33-inch as opposed to 31-31,5 for pants *D*).

Tableau 8.9 : Distance measures of similarity of inseam measurements between pants *D* and *E*

Sizes	6		8		10		12		14		16	
Styles	*D*	*E*	*D*	*E*	*D*	*E*	*D*	*E*	*D*	*E*	*D*	*E*
Crotch height or inseam	31.3	32.925	31.25	32.9	31.05	32.775	31.05	32.85	31.275	32.95	31.425	33.05
Difference		1.625		1.65		1.725		1.8		1.675		1.625
% of Returns	54.1	65	44	72	39.6	66.7	29.2	60.3	43.4	50	48.6	55.6

The data obtained from the $[TC]^2$ in the S*ize USA, Let's size up America* survey shows that a 32-inch inseam would generally be much too long for *petite*, long for regular women (especially in this case where the style is not really designed for African-American or young women from 18 to 25) and fairly reasonable for *tall* women (Tableau 8.10).

Tableau 8.10 : Extraction of inseam measurements table for *tall* women by Ethnicity and Age groups with inseam measures close to 32"

Tall inseam: percentage according to the Ethnicity or to the Age groups

	Ethnicity				Age groups					
Inseam measurements in inches	Caucasian American	African-American	Hispano-American	Asian-American/ Other	18-25	26-35	36-45	46-55	56-65	66 and over
30.01 – 31.5	41.91	20.36	23.08	32.50	38.33	32.12	31.25	35.14	48.08	37.50
31.51 - 33	35.70	46.11	34.62	37.50	37.78	38.18	36.88	40.54	36.54	50.00

These results clearly confirm our hypothesis number 2: inseam is important information to either consider in a new size standardization system or to display on pants' size labels if one wishes them to be of help to the consumer. Categorizing sizes based on body height (petite, regular and tall) is not sufficient for accommodating the range of inseam variation within a size category.

8.5.3 Waist and hip measurements

8.5.3.1. Pre-test

Our general hypothesis was that *women would choose pants with waist and hip measurements similar to their body measurements* as the best fitting pants. Our pre-test was conducted with 36 women (all North-American, between the ages of 18 to 75; therefore with no attempt for representativity), *in situ* or *at distance* who were asked to take their body measurements at the waist and hips, as well as the measurements for their self-reported two best fitting pants at the same points (see Figure 8.3).

We used the 33 classes we had previously defined. Each woman's waist and hips measurements served to determine to which class, using both equal amplitude and equal numbers, they belonged. We did the same for each of their best fitting pants measurements. The fact that the current fashion has women wearing pants that closely fit the body (i.e. neither baggy nor pleated) allows us to expect the pants classification to follow the women's body classification. Tableau 8.11 shows an example of the conversion table used and the resulting classification of one of our subjects (body and pants).

Subject LT had a waist circumference measurement of 33 inches and hip circumference measurement of 39 inches. Her best fitting pants for the same key points measured 32 and 38 inches. Both tables (equal amplitude and equal effectives) led to classifying subject LT in class 5. As seen in tables 2 and 3, class 5 corresponds with an **H** silhouette. The pants she identified as fitting (W: 32 inches and H: 38 inches) fall in class 4, again using both tables (also an **H** silhouette yet one class lower, class 4, see Figure 8.11).

Tableau 8.11 : Conversion table: classification results for subject LT.

Rotation	Direct measurements		Rotation	Transform measurements				
Axis	0.707107	0.707107		0.707107	-0.707107			
Mean	34.357900	43.117900	Mean	0	0			
Standard deviation	5.359220	4.985790	Standard deviation	1.3789090	0.3140158			
Min Canandian Retailer	27	37	min	-1.83849	-0.52678			
Max Canadian Retailer	44	54	max	2.81555	0.56720			
Min Size USA	23.642	32.0072	min	-2.78944	-0.94040			
Max Size USA	61.8504	71.0173	max	7.58424	1.32650			
	tT	tH		Axe 1	Axe 2		KA Class	KE Class
LT	33	39	⟶	-0.763183	0.404855	⟶	5	5
Pants	32	38	⟶	-1.036950	0.414737	⟶	4	4

Ex.: (waist measurement-mean)*(axis/standard deviation)+(hip measurement-mean)*(axis/standard deviation)

Subject SD had a waist circumference measurement of 35 inches and a hip circumference measurement of 46 inches while her two pants for the same key points were 36 inches and 48 inches.

Tableau 8.12 : Conversion table: classification results for subject SD

tT	tH		Axe 1	Axe 2		KA class	KE class
35	46	⟶	0.493472	-0.324032	⟶	31	31
36	48	⟶	0.909063	-0.475739	⟶	32	32

In both methods, equal effectives and equal amplitude, the conversion tables show that SD is a class 31 or **A** silhouette while her pants (W: 36 inches and H: 48 inches) fall in class[74] 32 (also an **A** silhouette yet one class higher).

Out of the 36 women, 33 provided us with their body measurements and pants measurements (the three other ones gave us only part of the information). Altogether 64 pants were measured (some of the 33 women measured only one pant). Out of the 33 women: 14 (42%) selected two pants falling in the same class as they were classified in; 6 (18%) selected at least 1 out of the 2 pants in the same class they were classified, the other pants being in a class next to their body measurements; 4 (12%) selected 2 pants falling in a different class (although the same class) next to their own class. Although this does not fully confirm our H_3, the fact that 54% of our sample selected pants belonging to only one class and that another 18% chose pants belonging to adjoining classes enables us to confirm that women are reasonably consistent in their selection.

Although not specifically asked, 9 women (27% of our pretest sample) mentioned that their pants were low waist. This explained the important variations in waist measurements we had noticed between some of the pants they had selected. Whereas hips measurements covered a window from 1.5 inch smaller than body measurement to 2.5 inches larger, the waist measurement fluctuated between 3 inches smaller and 5 inches larger. Women measuring their body waist measurement would generally place the tape at the narrowest part of their waist; the low rise pants fit lower on the body, where the body girth would be larger than at the natural waist. Also, 2 out of these 9 had a waist measurement of less than 27.5 inches (beyond the limits of our 33 classes, corresponding to class #34).

Figure 8.7 shows the differences between the sampled women's (33) waist measurements and their selected pants' (64) waistband measurements. The most important differences are with the low waist pants.

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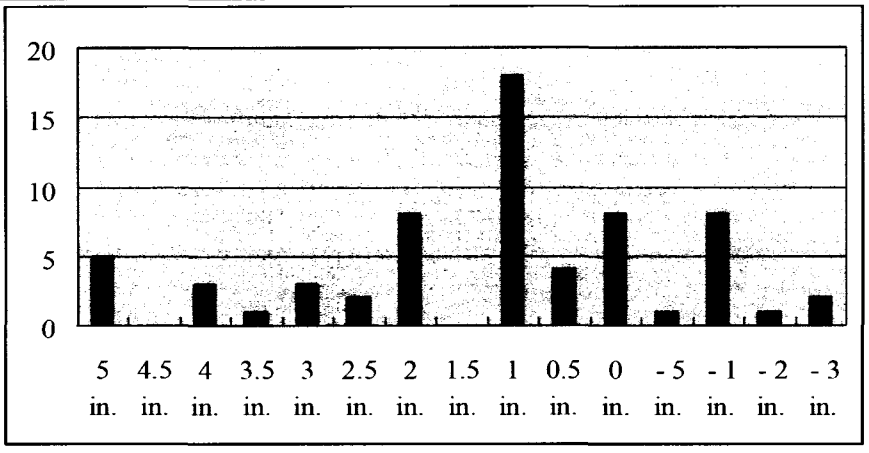
[74] Different class can be size or shape.



Women #	Diff. between body waist & Pant #1	& Pant #2		Women #	Diff. between body waist & Pant #1	& Pant #2
1	0	1		18	0	2*
2	0.5	0.75		19	5*	3.5*
3	-0.5	1		23	0	0
4	-1	-1		24	5*	2.5
5	-3	-2		25	2	3
6	-1	-1		26	1	
7	1	1		27	3	2.5
8	5*	5*		28	1	1
9	1	1		29	4*	4*
10	1	0.5		30	4*	5*
11	0	1		31	2	-1
12	2*	3*		32	0	1
13	1			33	1	1
14	2	2		34	1	1
15	2*	2*		35	-3	-1
16	0	1		36	0	0.5
17	-1	-1				

Figure 8.7 : Differences between sampled women's (33) waist measurements and selected pants' (64) waistband measurements. Pants identified by women as being low waist are identified with an *.

We also asked them how they preferred wearing their pants. Subject LT stated preferring a tight fit. The fact that she was classified as a class 5 yet selected pants falling in class 4 reflects her preferences. Subject SD stated that she is looking for a comfortable loose fit; explaining why she prefers larger class 32 pants although she herself is a class 31.

Based on Anderson *et al.,* (2001) those fit preferences are linked to body cathexis; when asked how they felt about themselves, LT reported thinking that she has a normal good looking body, while SD expressed not being comfortable with her own body[75].

This pre-test did not allow us to validate our last hypothesis (*women prefer wearing a specific type of pants fit (tight, fitted or loose).* Answers to the question on the way women preferred their pants to fit them varied.

Three women informed us that they did not understand how and where exactly to take the requested measurements or reported already inappropriate data. Results of the pre-test showed that some women, among the ones reporting to understand the measurement points and technique, reported a difference between body waist measurement classification and pants waist measurement classification which was mostly due to their low waist pant styles. We therefore had to modify our validation approach for the final validation.

This pre-test, which we originally intended to expand to a larger and more representative sample, rather suggested we modify our strategy and refine our methodology. We decided for our final validation to (1) work with women *in* situ, (2) select and provide pants labelled from different brand names and produced by different manufacturers, (3) use pants with a normal waist (front rise between 10 ¾ and 12 inches) and styles that are usually worn close to the body (i.e. not baggy nor pleated), and (4) select different sizes and underlying body shapes for the test pants.

75 «S D » : « *Tu sais...les femmes ne veulent jamais se voir telles qu'elles le sont...C'est psychologique!* » Translation by the author :"You know, women do not see themselves as they are. This is psychological!"

8.5.3.2. Validation

In order to validate our hypotheses, a total of 103 women (convenience sample of colleagues, friends and university students from 18 to 55 years of age) were interviewed and measured at the waist and hips. We selected 30 pants bearing different brand names, coming from different manufacturers, made of different fabrics (high percentage either of linen, silk, cotton, or a mix with a small percentage of spandex or elastanne), and ranging from sizes 4 to 14 (average of 5 pants per size). All the pants were measured using the same method described in Faust *et al.* (TBP), i.e. on a table facing up, etc. Measurements (hips at the largest point and waist at the edge of the waistband) were recorded on a master sheet and transferred to an Excel file (Tableau 8.13). According to our previous classification method (33 classes + 1), the pants fell in 16 different classes: 7 out of 16 (45%) matched an **X** shape. Our pre-test had shown that some of our subjects may be "smaller" (outside the limits) than the Canadian specifications. We therefore selected a few pants with waist and/or hips measurements beyond those limits.

Tableau 8.13 : Pants number and measurements at the edge of the waistband and hips.

Pant identification		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Measures	Waist	25	25,75	26	26,75	27	27,5	27,5	28	28,5	29,5	30	30	30	30,25	31	31,25	31,5	32	32,5	32,5	32,75	33	33	33,5	34	34,25	34,5	35	35,5	36,5
	Hip	37	42	45,5	39	36	39	41	41	40	40	38,5	39	40	40	39,5	41	41,5	41	41	41,5	42,5	43	44	42,5	42,5	44	44,5	44	45,5	46,5

Our first observation of the data cloud shows that waist and hips measurements of our subjects (circle) as well as the pants' waistband and hips measurements (square) are not linear.

Figure 8.8 above shows a few selected subjects and pants to show the disparity and again that manufacturers cover the size and the shape spectrum. This once again confirms that women have different body silhouettes and that manufacturers produce for different shapes.

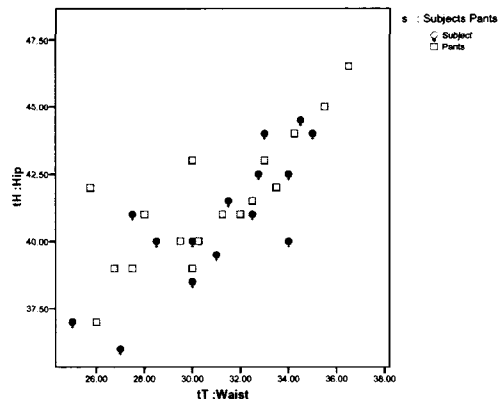


Figure 8.8 : Data cloud of a few women's (circle) and pants' measurements (square).

Each woman was asked to try ten pants on, chosen according to sizes they usually wear or that we believed corresponded to their size (size labels were removed). Each woman was asked to comment on the waist and hip fit with a selection of three possible evaluations: good fit, too large, or too small for both key points.

Tableau 8.14 presents an example of our spreadsheet with women's key body measurements, selected pants' measurements, and fit appreciation for each key point: too small (-1), good fit (0), too large (1). Seven of the 103 subjects were eliminated as either they were outside the size range of the pants (example waist of 27" with hips of 56") or their reporting proved unreliable or one who felt that all the pants fit her equally well).

Tableau 8.14 : Extract of table of comparison between women's body measurements and pants measurements along with fit appreciation.

Women	Body measuremen		Pant 1		Appr.	Appr.	Pant 2		Appr.	Appr.	Pant 3		Appr.	Appr.	Pant 4		Appr.	Appr.	Pant 5		Appr.	Appr.
	Waist	Hip	Waist	Hip	Waist	Hip	Waist	Hip	Waist	Hip	Waist	Hip	Waist	Hip	Waist	Hip	Waist	Hip	Waist	Hip	Waist	Hip
			25	37			25.75	42			26	45.5			26.75	39			27	36		
1	27.5	38	-2.5	-1	-1	-1	-1.75	4	-1	0	-1.5	7.5	-1	1	-0.75	1	-1	0	-0.5	-2	-1	-1
2	28	38	-3	-1	-1	-1	-2.25	4	-1	0	-2	7.5	-1	1	-1.25	1	-1	0	-1	-2	-1	-1
3	30	39.5	-5	-2.5	-1	-1	-4.25	2.5	-1	-1	-4	6	-1	1	-3.25	-0.5	-1	-1	-3	-3.5	-1	-1
4	25	36	0	1	-1	-1	0.75	6	-1	1	1	9.5	0	1	1.75	3	0	0	2	0	1	0

We analyzed pants with a good fit appreciation at both key points (waist = 0 and hips = 0) and rejected those with one good fit only (e.g. good fit at waist yet too small at the hips). Trying 10 pants on, women on average found 2,2917 pants of a good fit (mode and median of 2 and standard deviation of 0.9615).

Seventy-eight of our 96 women (81%) identified 2 pants or more (out of 10 pants) as offering a good fit. Of these 78 women, 41 (52.56%) selected 2 or more pants from the same class as their body class as defined by their measurements, 29 (37.18%) selected 2 or more pants (from their body class and one adjoining class), and 8 (10.26%) selected 3 or more pants from 3 classes (their body class and 2 adjoining classes). Out of the 18 who identified only one fitting pair of pants, 6 (33%) selected it from the same class as their body measurements, 9 (50%) from a class adjoining their measurements, and 3 (16.6%) from 2 classes apart.

This partially confirms our H_3 (*Women always choose pants with waist and hips measurements similar to their body measurements)* with the *caveat* that pants style or textile may impact slightly on the perceived fit. We should specify that women did not wear the pants for 15 minutes, as suggested by Robinette, or a few times as in Goldsberry *et al.* (1996)`s research, but gave their rating after trying them briefly.

Tableau 8.15 : Women's pants selection

	Number out of 78	Percentage
Women selecting, as fitting, pants coming from only one class	41	52.56
Women selecting, as fitting, pants coming from two adjoining classes	29	37.18
Women selecting, as fitting, pants coming from three classes or more	8	10.26

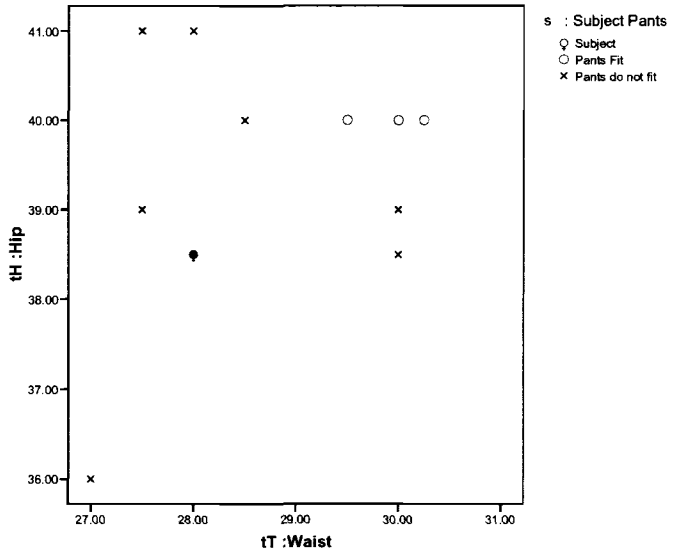


Figure 8.9 : Individual's selections and rejections

Of the 78 women who selected two or more well fitting pants:

- 46 selected two pants: 33 (71.7%) selected pants from one class only and 13 (28.3%) selected pants from 2 different classes (irrespective of their body class);

- 22 selected three pants: 8 (36.4%) selected pants from one same class and 11 (50%) selected pants from 2 different classes whereas 3 (13%) selected pants from 3 different classes;
- 7 selected four pants: 1 (14.3%) selected all pants from the same class and 5 (71.4%) selected pants from 2 different classes whereas 1 (14.3%) selected pants from 3 different classes; and
- 3 selected five pants: 2 (66.6%) selected pants from 2 different classes whereas 1 (33.3%) selected pants from 3 different classes.

Tableau 8.16 presents the sampled women's pants reported as fitting. These results validate our H_4 *(Women prefer wearing a specific type of pants fit (tight, fitted or loose))*. We can see that a majority of women will regularly choose the same class of pants.

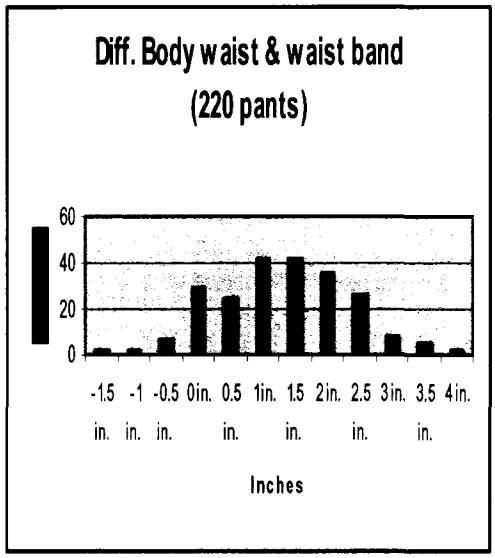
Tableau 8.16 : Percentage of women selecting fit pants selection

	Percentage of women selecting, as fitting, pants from the same class	Percentage of women selecting, as fitting, pants from 2 classes	Percentage of women selecting, as fitting, pants from 3 classes
44 women selected 2 pants	71.7	28.3	n/a
22 women selected 3 pants	36.4	50	13
7 women selected 4 pants	14.3	71.4	14.3
3 selected 5 pants	0	66.6	13.3

Tableau 8.17 presents the average variations between waist measurement (body measurement) and waistband measurement (pants measurements) for pants classified reported to be a good fit.

Tableau 8.17 : Variation between body waist and waist band of all fitting pants.

Inches dist.	Total pants	1st pants	2nd pants	3rd pants	4th pants	5th pants
-1.5 in.	1	1	0	0	0	0
-1 in.	2	0	2	0	0	0
-0.5 in.	6	5	1	0	0	0
0 in.	30	13	8	9	0	0
0.5 in.	25	12	8	3	2	0
1 in.	41	23	14	3	0	1
1.5 in.	41	20	13	7	1	0
2 in.	35	11	18	4	2	0
2.5 in.	26	9	8	5	4	0
3 in.	8	2	2	1	1	2
3.5 in.	4	0	4	0	0	0
4 in.	1	0	1	0	0	0
Total	220	96	79	32	10	3

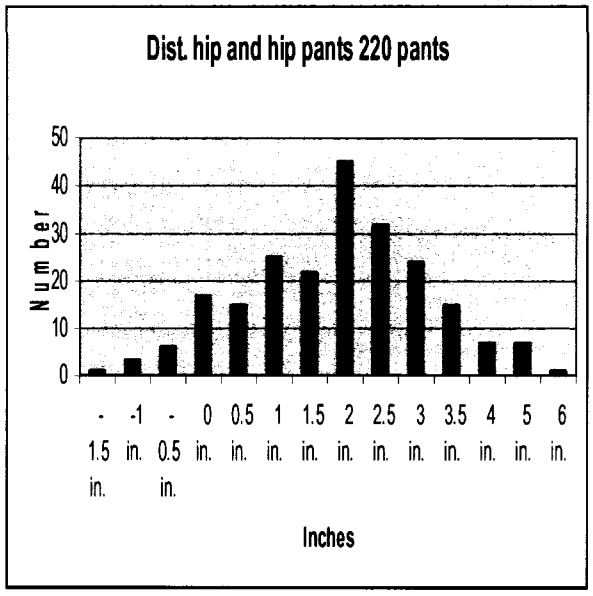


Waist variation for the fitted pants was from -1.5 to 4 inches, with an average of 1,25 inches and a standard deviation of 1.

Tableau 8.18 presents the average variations between hips measurement (body measurements) and pants' hips measurements for pants reported to be a good fit.

Tableau 8.18 : Variation between body hips measurements and pants hips of all fitting pants.

Inches dist.	Total pants	1st pants	2nd pants	3rd pants	4th pants	5th pants
-1.5 in.	1	0	1	0	0	0
-1 in.	3	1	2	0	0	0
-0.5in.	6	3	2	1	0	0
0 in.	17	9	5	3	0	0
0.5 in.	15	8	5	2	0	0
1 in.	25	14	8	1	1	1
1.5 in.	22	9	8	4	1	0
2 in.	45	20	17	5	2	1
2.5 in.	32	14	10	6	2	0
3 in.	24	8	12	4	0	0
3.5 in.	15	4	7	2	1	1
4 in.	7	2	1	2	2	0
5 in.	7	3	1	2	1	0
6 in.	1	1	0	0	0	0
	220	96	79	32	10	3



Hips variation went from -1.5 to 6 inches, with an average of 1,906 inches and a standard deviation of 1.314.

The findings reported in tables above indicate that a label reporting the exact measurements of the pants it is affixed to would be predictive of the consumer's choice and confirms the general hypothesis behind this research: it would facilitate the shopping experience for the consumer and help the distributors and order initiators effectively select and serve their target market.

As previously mentioned, we also took this opportunity to ask women questions to verify their knowledge of their body measurements. None of them, no exception, knew her measurements.

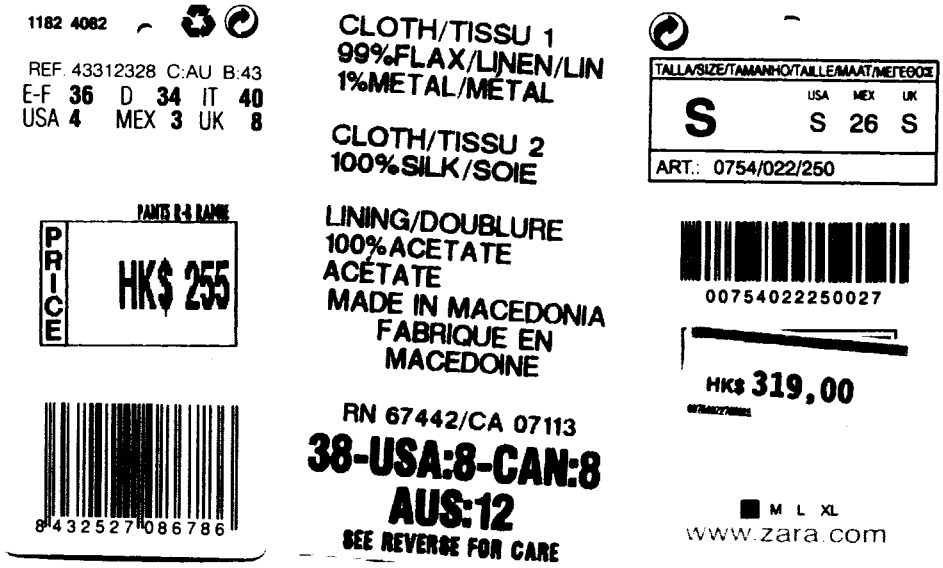
Most argued that they know their weight or have a good idea but none of them could tell her actual waist and hips circumferences (some guessed right for one of the measurement but volunteered that they were only guessing).

We disregarded all comments about color, fabric, or style which women volunteered as they did not serve our purposes. We should note though that some women brought to our attention that the measurement of the front rise or the crotch would constitute additional information to have. We comment on this point in the conclusion.

8.5.4 Potential Label Mini-Survey

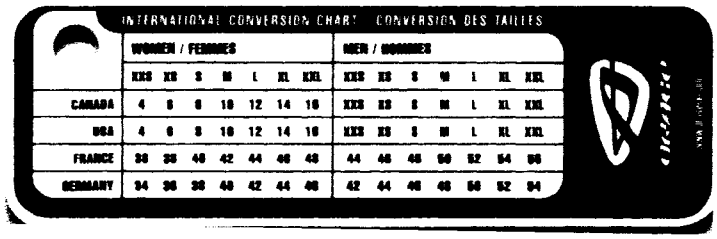
Our literature review showed that women find it difficult to identify a fitting garment with a label using a single number system as their only guide. This problem is amplified by the fact that order initiators adapt the actual measurements corresponding to the standardized set of size numbers to fit their marketing objectives.

We took a few minutes to present the women who participated in our study with seven different potential labels. We showed them three existing size labels from major international ready-to-wear vertically integrated apparel companies (see Figure 8.10) one more commonly seen label from a famous Canadian international apparel company (see Figure 8.11), 5 types of pictograms photocopied from ISO recommendations (see Figure 8.12), and three showing a pictogram of a woman's silhouette (**A**, **X** or **H**) with or without measurements (see Figure 8.13 and FFigure 8.14). We asked them to pick the 3 labels they felt conveyed the most information. As expected, a majority (87%, 29 out of 33 in the pre-test and 78%, (75 out of 96) in the validation test) of subjects chose the label shown in Figure 8.14. Most women appreciated the presence of a silhouette facing pictogram although they questioned the actual use they would personally make of this information since they do not know yet their measurements.



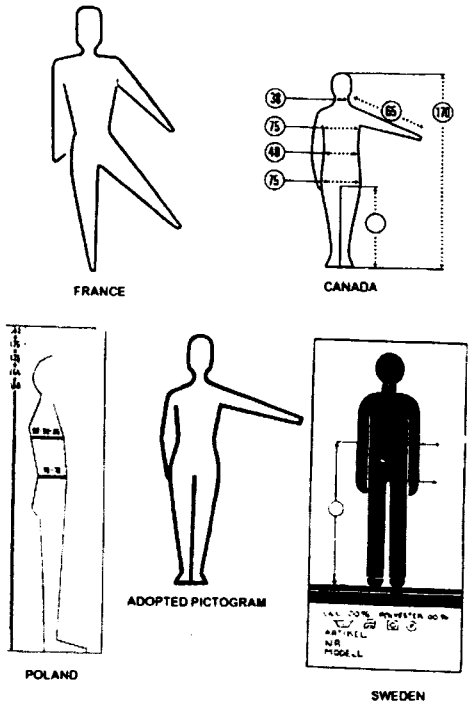
Comment
"Does not help at all".
"Too much information squeeze into one label".

Figure 8.10 : Three existing size labels from major international ready-to-wear vertically integrated apparel companies



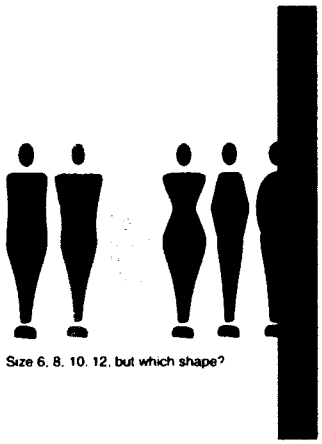
Comment
"Too much is too much. Does a woman who wears size 14 really need to let everyone know that it is equivalent to XL?"

Figure 8.11 : Sample of a more commonly seen size label from a famous Canadian international apparel company

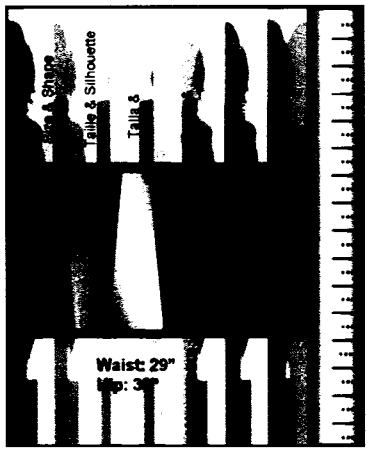


This type of label received no comments at all.

Figure 8.12 : Five types of pictogram photocopied from ISO standard number

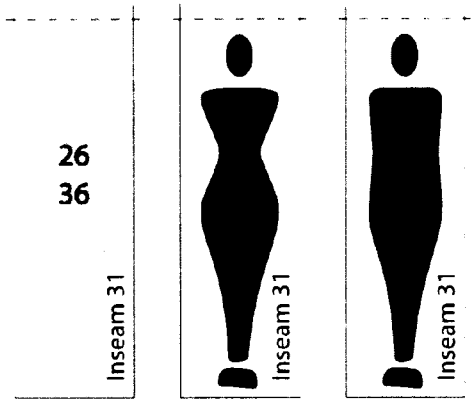


Comment
"If you have a perfect body shape it's interesting but if you don't, you do not need to get the comparison each time you shop."



Comment
"Are the shapes represented by geometric forms? If so interesting! No reference to my real shape. It looks classy".

Figure 8.13 : Sample of global pictures of potential size labels with different shapes



Comment
"We can't compare body shape, although I believed that after a short period of time we won't need to compare since we will know what our own shape is"

Figure 8.14 : Example of a potential size label with facing silhouette and measurements

Although not conclusive this short test certainly indicated that a label showing measurements and silhouette would be preferred to the existing size labels.

8.6 Conclusion

We have first shown that, although they use the existing size labels from standards in their garments, order initiators cover the full spectrum of female silhouettes and sizes. The immediate effect of this state of affairs is that size labels provide the consumer with no useful information. We demonstrated that inseam varies from individual to individual and that the existing height standards (*petite, regular*, and *tall)* do not reflect the reality as women in any one of the existing categories may need a different inseam. As expected, our research has also validated our hypotheses that individual women generally choose same size and silhouette pants. We have also shown that women consistently prefer a tight, regular or loose fit.

Accordingly we can conclude that a size label identifying inseam, waist, and hips measurements and providing a female silhouette identifying the measuring points would not only convey better information but that it would also be highly predictive of the garment (pants in this case) that women would find fits them well.

Not only would this information prove useful for the consumer by reducing he shopping time (or returns and exchanges in the case of distance shopping) but it would also improve distributors' and order initiators' effectiveness and efficiency in enabling them to better target and serve a specific market with reduced inventories. Modifying the appearance and information provided by the size label definitely offers an inexpensive introduction to greater choice for the consumer by ready-to-wear companies as order initiators and manufacturers currently offer a number of variations on size although they do not inform the general consumer population of such.

A number of further research avenues exist. As observed in the discussion other information such as the rise or crotch length could be of use to the consumer and should therefore be tested. Likewise the exact visual presentation of a new size label should be further tested. Our research is limited to the woman's lower body (pants): it would certainly be of interest to look into the possibility of replicating it with the full body or with the male or child population.

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CONCLUSION ET RECOMMANDATIONS

Après avoir étudié le problème de l'étiquetage des tailles des vêtements du prêt-à-porter féminin, nous pouvons tirer quelques conclusions et faire des recommandations dégageant des pistes pour élaborer un étiquetage standard universel. Cette recherche donnait suite à notre essai de maîtrise (2003) qui validait l'essayage obligatoire d'un vêtement prêt-à-porter avant son achat ; la cliente ne disposant d'aucun moyen concret d'évaluer la tenue, le port, ou l'ajustement du vêtement convoité.

Le premier chapitre passe la littérature en revue. La littérature permet de mieux saisir la complexité de l'étiquetage par tailles tant pour les intervenants de l'industrie du prêt-à-porter que pour les consommatrices. L'apparition du prêt-à-porter a mené à l'adoption de standards nationaux qui ont peu servi et semblent aujourd'hui désuets. Nous avons appris aussi comment les donneurs d'ordres identifient les points de mesure et comment on a utilisé certaines méthodes pour établir la gradation.

Des consommatrices, nous apprenions d'une part que l'étiquetage des vêtements par tailles est une «information complémentaire appréciée»[76] et un outil pour les assister dans le choix du vêtement leur seyant le mieux parce que bien ajusté. D'autre part, nous avons validé l'information voulant que les consommatrices soient insatisfaites de l'étiquetage actuel et qu'elles ont peine à trouver la taille qu'elles recherchent à la lecture des chiffres ou des lettres affichés. L'ambigüité de l'étiquetage par tailles et le nombre de facettes soulignées dans la revue de la littérature devant être prises en compte, nous avons séparé notre recherche en différentes composantes traitant chacune d'un aspect particulier.

[76] La Fédération- Département Grande Diffusion, mars 1999, Canada.

Le chapitre 2 décrivait sommairement la méthodologie d'étude de l'étiquetage par tailles. Après la revue de la littérature nous présentions différentes hypothèses liées aux mesures des pantalons. Nous poussions davantage l'analyse des mesures de pantalon en nous interrogeant sur la pertinence des standards adoptés, remettant en cause la pratique des manufacturiers en ce qui a trait aux spécifications des donneurs d'ordres, ainsi que la tolérance associée à ces spécifications.

Nous incluions parallèlement les grandes lignes des analyses faites par la collecte et l'étude des données anthropométriques de la campagne de mensuration américaine de 2003 qui tenait aussi compte des silhouettes féminines corporelles sous-jacentes.

Dans les chapitres 3, 4, 5, 6, 7 et 8, nous avions, sous forme d'articles, exposé certains faits historiques liés aux mesures et à l'étiquetage par tailles. Certaines hypothèses portant sur la gradation et les mesures des vêtements prêt-à-porter étaient exposées et validées. Nous relations les grandes campagnes de mesures, leurs points saillants et les standards qui en ont découlé. Nous analysions enfin les données de la dernière campagne nationale américaine et proposions un nouvel étiquetage de tailles universel pour l'industrie du vêtement prêt-à-porter.

Le premier article (chapitre 3) démontrait une faiblesse dans l'étiquetage par tailles. Nous avions donc formulé et étudié trois hypothèses relatives à l'étiquetage des pantalons. Nos résultats démontraient que l'étude devait être approfondie, l'échantillon étant restreint.

Le deuxième article (chapitre 4) relatait les événements importants ayant guidé l'industrie du prêt-à-porter dans la gradation et l'étiquetage par tailles et en partie la revue de la littérature. Nous soulignions les méthodes de gradation et d'étiquetage par tailles préconisées par l'industrie du prêt-à-porter et le pragmatisme des manufacturiers et des donneurs d'ordres.

Le troisième article (chapitre 5) présentait une analyse approfondie des faits relevés dans la revue de la littérature. Nous avions formulé quatre hypothèses que nous avions testées et validées en test-pilote et à plus grande échelle. Nos résultats démontraient que toutes ces hypothèses devaient être rejetées. Les pantalons étiquetés d'une même grandeur peuvent présenter des mesures différentes. Les manufacturiers ne respectent pas les spécifications de mesures proposées par les donneurs d'ordres. La tolérance acceptée est trop laxiste et ne permet pas de distinguer deux tailles. Un pantalon de taille au delà de la tolérance acceptée se trouve dans une taille contiguë, voire pouvant représenter une silhouette différente du pantalon original. Enfin, les manufacturiers ne suivent pas les mesures proposées par l'Office des normes générales du Canada. Nonobstant la grandeur, ils produisent pour une certaine silhouette type.

L'objectif de cette thèse était non seulement d'approfondir nos connaissances de l'étiquetage par tailles du prêt-à-porter féminin, mais aussi de démontrer que la problématique était en partie due à la désuétude anticipée des standards et que les manufacturiers n'y aavient pas adhéré. Nous voulions aussi proposer un nouvel étiquetage de tailles. Nous devions donc étudier la population à habiller, en l'occurrence, les femmes. Le Canada n'ayant pas eu de campagne de mensuration à l'échelle nationale, nous avons été forcés en partie de nous intéresser aux données de la campagne de mensuration américaine de 2003 qui furent disponibles en 2004.

Le quatrième article (chapitre 6) couvrait spécifiquement la littérature axée sur les études anthropométriques qui ont servi l'industrie du prêt-à-porter. Nous reprenions encore la revue de la littérature mais y ajoutons l'objectif, l'échantillon et la méthode proposée, afin de définir les tailles, les points de mesures les plus importants ainsi que les chartes de mesures issues de ces grandes campagnes de mensurations. Dans ce même article nous présentions aussi trois méthodes de mesure et de gradation préconisées par certains académiciens ou industriels.

Le cinquième article (chapitre 7) présentait la méthodologie, les analyses et les résultats de la dernière campagne américaine de mensuration. Nous démontrions que les femmes peuvent être regroupées selon leurs mesures corporelles et leur silhouette mais qu'il y aurait toujours des femmes moins satisfaites si nous options pour des standards. Néanmoins, nous y affirmions que l'étiquetage par tailles devait être revu.

Enfin, dans le dernier article (chapitre 8), nous proposions un nouvel étiquetage de taille qui tiendrait compte des points de mesures retenus : la longueur de l'entre-jambe ; la circonférence de la taille ; celle des hanches. Nous validions d'abord que les manufacturiers (*l'offre* segmentée de manière empirique) couvre la population (*la demande* segmentée de manière théorique). Ensuite, de manière indirecte nous validions l'hypothèse concernant la mesure de longueur de l'entre-jambe et de manière directe que les mesures de circonférence étaient des éléments indispensables à indiquer sur l'étiquetage par tailles des pantalons. Nous proposions donc une nouvelle étiquette universelle pour le prêt-à-porter avec des points de mesure identifiés. Nous proposions cette nouvelle étiquette car nous sommes convaincus que le besoin existe et croyons qu'en modifiant la façon de présenter l'information, nous améliorerons les échanges commerciaux, diminuerons les retours après achats et réduirons la manipulation et la frustration lors de l'achat.

Nous avons comparé les données anthropométriques aux trois méthodes de mesure et de gradation répertoriées en recension des écrits et avons conclu qu'elles sont toutes discutables et que notre façon de regrouper et de présenter l'information sur l'étiquette est plus intéressante.

Nous sommes persuadés que notre proposition permettra à l'industrie du prêt-à-porter d'offrir un affichage des tailles et des formes pour guider les consommatrices vers le vêtement qui leur sied mieux.

Notre thèse ouvre donc la voie à plusieurs pistes de recherche dans le prêt-à-porter. Elle peut être généralisée aux vêtements pour femmes, hommes et enfants. Elle ouvre les portes à une nouvelle façon de penser « *mass-customization* », sans oublier l'aspect lié au marketing, tel que le « *Vanity sizing* ». Encore une fois, il faut noter que la recension des écrits avait aussi fait ressortir les variables essentielles liées à l'essayage que sont l'esthétique, l'aspect social et le besoin d'être conseillé. Ces variables pourraient être prises en compte lors d'une prochaine analyse.

Les technologies le permettant, il serait enfin intéressant de penser à une étiquette électronique pour les vêtements qui contiendrait plusieurs informations : mesures, silhouette sous-jacente, type d'ajustement, etc., et une carte à puce personnalisée à chaque cliente «stockant» contenant non seulement le profil corporel (silhouette) de la consommatrice, mais aussi son profil d'achat, sa garde-robe et moult informations relatives à sa fidélité d'achat.

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