An Analysis of Sizing USA 3D Scan Data for Developing Menswear Sizing Systems

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The menswear industry, an important segment of the U.S. apparel business, has been growing in recent years. According to American Apparel Manufacturers Association (2000), consumer expenditures in 1999 for men’s and boy’s clothing and accessories were about $70 billion. The business has been dominated by large firms at the manufacturing level. Most market segments are based on style differences. The five main market segments in menswear are: tailored clothing, sportswear, active wear, contemporary apparel, and bridge apparel (Stone, 2007). The current population growth and lifestyle changes effect changes in all segments of the menswear industry. Even though men remain less willing than women to accept radical fashion changes, men’s attitudes toward their bodies have been changing with the interest in athletics. This increases the demand for sportswear. Menswear, led by the booming sportswear segment, represents a $49.18 billion market. At the same time, men’s tailored clothing has changed to reflect the interest in fit bodies. A tailored suit is structured, or three- dimensional, which gives it a shape even when it is not worn. The menswear industry uses a sizing system that is based on the invert triangle figure. According to Dickerson (2003), men’s Shoulders are wider, waists are narrower, and the drops (the difference between the Chest measurement and the waist measurement) have increased. In the past, the drop was six inches, but current manufacturers are changing their specifications to seven or eight inches (Dickerson, 2003).

Menswear sizing systems are very important since men’s apparel required a more precise fit than women’s clothes. The menswear sizing systems are more complicated than women’s. One of the sizing systems, a dual sizing system is a further factor on making production procedures slow. Men’s tailored clothing is produced in the following proportioned sizes, with the number ranges representing Chest measurements: Short, Regular, Long, Extra long, Portly short, and Large (Stone, 2007).

Garment fit problems were commonly found from the previous studies about clothing sizes (Connell, et al., 2002; Kim, 2003; and Shin & Istook, 2006). There have been a number of attempts during the last decade to gather anthropometric data that would allow a better understanding of the adult population. CAESAR (Civilian American and European Surface Anthropometric Resource), SizeUK, SizeKorea, and SizeUSA have all been conducted to gain much needed information about the adult consumer. The SizeUSA study was led by [TC]², located in Cary, NC, USA. The SizeUSA national sizing survey was conducted between 2002 and 2003, using a 3D body scanner. The SizeUSA survey recorded a representative sample of the entire U.S. population by scanning about 10,000 people in 13 cities. There are some efforts to define body shapes of female by analyzing a data set from 3D body scans. The Body Shape
Analysis Scale (BSAS©) was developed in a National Textile Center (NTC) project (Connell, et al., 2002). Alexander, et al (2003) analyzed a data set of body scans using the Body Shape Analysis Scale (BSAS©) to define whole and component body shapes of females. Shape identification software, Female Figure Identification Technique© (FFIT), was developed to analyze current female body shapes so that more correct sizing systems could be developed (Istook, et.al, 2002). Using SizeUSA data and the FFIT software, Istook (2006) determined that approximately 46% of women were classified as a rectangular figure. Fit problems were found that the apparel sizing systems had been ignoring demographic factors and various body shapes in the United States (Shin & Istook, 2006). There are still significant menswear markets with fit issues that need to be evaluated and modeled. However, no research has been done for menswear sizing systems, analyzing a 3D body scan data set.

The purpose of this study was to investigate and analyze factors for developing menswear sizing systems. A data set of men scanned from the previous SizeUSA national sizing survey was used for this study. The data set of men was provided by Dillard’s Services. Subjects, 3691 males, were scanned during the SizeUSA national sizing survey. When we grouped by their ethnicity and ages, 47.30% of the male subjects were Caucasian and the remaining were African Americans (19.21%), Hispanics (17.31%), and Asians (16.17%). In age, 26.96% of the sample was the age group 18-25, and the rest of age groups included 26-35 (21.35%), 36-45 (22.70%), 46-55 (16.96%), and 56-65 (7.64%), and 66+ (4.39%).

In the first step, the characteristics of the men’s body shapes were evaluated based on the 34 body dimensions and 4 computed values. The computed values included 1) the difference between Hip and Chest girth, 2) the difference between Hip and Waist girth, 3) the difference between Chest and Waist girth, and 4) body mass index (BMI). The BMI was used for a measure of body fat based on height and weight that applies to adult men. The equation and interpretation of the BMI categories were based on National Institute of Health’s body mass index (National Institute of Health, 2006). In this study, the mean value of BMI was 27.33. According the mean value of the BMI, overall men in the United States were in overweight category.

The drop values and BMI in the computed values were very useful to define the men’s body shapes. When men were grouped by the Chest girth groups based on the ASTM standards, the average of the Chest girth was 42.64 inch. The average drop value that is the difference between the chest girth and the waist girth was 5.78 inches (Standard Deviation: 2.41, range from -5.50 to 14.09 inches). In the previous study, Dickerson (2003) mentioned that today’s manufacturers are changing their specifications to 7 or 8 inches. However, in this study, 7 or 8 inches were shown in only high percentile groups (90 percentile: 8.73 and 75 percentile: 7.41).

In the second step, a single factor analysis of variance (ANOVA) was used to investigate if there were significant differences of body dimensions among age groups and among ethnicities. When the body dimension differences were found among groups through ANOVA procedures, a Duncan test was used for multiple comparisons to determine which groups were different in the significance level set at $\alpha=0.05$.

In the results, significant body dimension differences among age groups were found in this study. For example, Chest ($F= 58.96, p<.05$), Hips ($F= 15.95, p<.05$), Waist ($F= 83.15$,...
p<.05) were significantly different among age groups. According to the analysis of variance and multiple comparison tests, there were significant body differences among age groups by rejecting the null hypotheses with a significance level set at α=0.05. Age 18-25 was distinguished from older age groups (age 26-65). For example, the average of the age 18-25 group’s Chest, waist, and hip (Chest Age 18 mean = 40.79; Waist Age 18 mean = 34.44; Hip Age 18 mean = 40.60) were smaller than older groups. When the drops were compared among age groups, the older age groups had smaller drops than younger age groups (Drops Age 18 mean = 6.35; Drops Age 26 mean = 6.04; Drops Age 36 mean = 5.9; Drops Age 46 mean = 5.4; Drops Age 56 mean = 4.63; Drops Age 66+ mean = 3.73). This indicates that body shapes are associated with ages.

When we analyzed the data by ethnicities, significant body dimension differences among ethnic groups were shown in this study. For example, Height (F= 177.36, p<.05), Weight (F= 53.28, p<.05), and BMI (F= 16.7, p<.05) were significantly different among ethnicities. Asians (Height avg =171.67; Weight avg =77; BMI avg =26.12) were shorter and lighter than the other groups, while Caucasians and African Americans were taller and heavier than Hispanics. Hispanics (Height avg =170.2; Weight avg =81.22; BMI avg =28) were short like Asians but heavier than Asians. Waist, Hips, and Chest (F= 25.52; F= 29.28; F= 31.91, p<.05) were significantly different among ethnics. According to the multiple comparison test, the group similarities and differences were found in significance level at α=0.05. Asian men have significantly different sizes of the waist, hips, and Chest. Asian men were the smallest body sizes among ethnic groups (Waist avg =89.89; Hip avg =40.25; Chest avg =104.45), while Caucasian men and African men had larger body dimensions (Waist avg =95.12; Hip avg =42; Chest avg =109). According to the multiple comparison tests, Hispanic men had similar sizes of the Chest and Waist to Caucasians and African Americans. However, Hispanics’ shoulder slopes (Shoulder slope Hispanic = 22.78) were shorter than Caucasians (Shoulder slope Caucasians = 23.29) and African Americans (Shoulder slope African Americans = 24.11).

When the drops were compared among ethnic groups, African Americans had the largest drops but other groups were smaller than traditional drop sizes, 6 inches (Drops African Americans= 6.22; Drops Hispanic =-5.79; Drops Asian= 5.73; Drops Caucasians= 5.61). However, when the values of the differences between hip and Chest girths were compared, overall men had an inverted triangle body shape. Hispanic men had the biggest difference between hip and Chest, while African American men had not much difference in the value (Hip-Chest Hispanic = -1.52; Hip-Chest Caucasians = -1.13; Hip-Chest Asian= -0.87; Hip-Chest African Americans = -0.76.).

In summary, overall men in the United States were heavier and possessed a slightly inverted triangular body shape. The average drop size was still remained in the 6 inch ranges. Men’s body shapes, like various women’s body shapes, were affected by the demographic factors in the U.S. population. Men’s body shapes were associated with ages and ethnicities. Young men were in the athletic category, having a tall and inverted triangle body shape. The older groups’ drop sizes were smaller, and it was increasingly difficult to define body shapes of their body torsos. In the ethnic groups, African Americans and Caucasians had a tall and heavy body figure while Asians had a short body figure with smaller drop sizes. Hispanics had a shorter and heavier figure than other groups. The African Americans had larger drop sizes than other groups, but the rest groups had even less drop sizes than traditional, 6 inches. These results indicate clearly that men’s body shapes are related to their ages and ethnicities. Therefore,
apparel manufacturers should consider current demographic factors. Further study should be
done for defining men’s body figures to develop menswear sizing systems.

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