STUDY OF CZECH MALE BODY DIMENSION AND EVALUATION OF MEN´S TROUSERS PATTERNMAKING METHODS

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Abstract: *This study deals with the effect of different male somatotypes and different pattern making methods on the men´s trousers pattern design. First, the research is focused on the analysis of the 200 Czech men anthropometric data in order to define Czech somatotypes. The definition of the Czech somatotypes is according to the rules of the standard "EN 13402–3: Measurements and Intervals". Six men´s trousers pattern drafting methods including two Czech, German, English, Italian and Swedish were analysed. The result indicates that the trousers patterns are mostly drawn by using a constant numerical value for generating the design dimensions instead of using a regression equation for value calculation. These pattern making methods are totally inadequate for pattern drafting in order to fit a wide range of men's bodies (male morphology). To solve this problem, this paper examines a proposal for a pattern making method for men´s trousers that uses the result of regression formula of Czech pattern making method called NVS to match the pattern design parameters. This method will increase the efficiency of construction parameters and thus to automate the pattern grading process of the trousers pattern in a wide range of sizing.*

Keywords: *Czech male somatotype, male trousers pattern making method, size designation.*

1 INTRODUCTION

Research activities in frame of the garment mass-production are generally associated with the idea that the quality of fitting of the garment depends on a relatively high degree of our knowledge of the body dimensions of the target wearers [1].

This case reveals the need for study the population body silhouette and body proportions as well as selects the size changes possible to implement in clothing construction modifications.

This also reveals that the problem of improper fitting may be due to not only the body sizes but also the inappropriate pattern drafting methods [2].

For this reason, it is meaningful to deal with an effect of the anatomical changes in the human body on the clothing pattern design and to study the body proportions as well as to analyse their properties by means of statistical methods [3].

Using results from the regression analysis of anthropometric data of target population in the clothing design methodologies seems to be very effective. Resulting regression equations can be simply used for determination of clothing pattern design parameters using value of corresponding part of body measurement. Thus a dependent value of one clothing pattern dimension is calculated as a percentage of an independent value of a body measurement or of other pattern dimension.

In order to size mass-produced clothes, the body size of the intended wearer has to be defined and identified with the nearest size on a table of standard sizes. The tables of measures as described in the document EN 13402 "Size designation of clothes" [4] constitute the grouping of body sizes appropriate to the European population. The somatotype is defined by the appropriate primary and, where necessary, secondary dimensions. The nearest whole number in the tables for that dimension is used for purposes of size designation. As the results of the sizing surveys of the different countries vary, the tables in this document provide the required flexibility.

In order to accommodate variations in body measurements by country/company, a system with defined intervals is standardized, which means that a country/company may select any number from the tables with a range that may be extended to the left and right of Tables [4].

The aim of this research is:

- to obtain the accurate definition of the Czech male somatotypes;
- to define the body sizes of the Czech somatotype by the appropriate primary and secondary dimensions;
- to set accurate tables of the grouping of body sizes according to the rules of the standard

"EN 13402–3: Measurements and Intervals" appropriate to the target Czech wearers;

- to find out the appropriate pattern design method of an effective construction algorithm suitable for mass-produced men´s trousers for the Czech male customers.

2 EXPERIMENTAL METHOD AND OBJECTIVES

2.1 Subjects and observed anthropometrical data

The basis for this study is the anthropometric data of 200 Czech men aged 18-60, which were measured in the survey conducted by TUL Department of Clothing in 2006. The measured population was divided into three age categories and percentage of the measured subjects was determined according to the Czech population structure in that period: 51 subjects aged 18-29; 77 subjects aged 30-44; 72 subjects aged 45-60 [5].

The observed data set was reduced. It contains 130 male subjects. It is determined according to criteria of the most sold sizes of the BUSHMAN brand trousers for the Czech male customers: 48, 50, 52 and 54. These somatotypes are defined by the standardized primary body dimension of the waist girth (Waist) and by secondary dimension of the Height [6].

2.2 Analysis of the men´s trousers pattern drafting methods

In this study six Men´s trousers pattern making methods are evaluated. Two Czech methods: NVS [7] and UNIKON plus [8], Italian method: Fernando Burgo [9], German method: M.Müller & Sohn [10], English method: Winifred Aldrich [11], Swedish method: Inger Öberg [12].

3 RESULTS AND DISCUSION

3.1 Analysis of the Czech male body measurement data

The European standard EN 13402-2 defines for trousers one primary dimension (PD). This is the Waist according to which the product must be labelled. For some types of trousers, a single measure may not be sufficient to select the right product. In these cases, one or two secondary dimensions (SD) can be added to the label. In case of trousers, it is Height or Inside Leg Length [4].

With the goal to study the relationship between those characteristic body dimensions the considerable research of the Czech male body measurement data was carried out [5].

Figure 1 represents the mean value of Height and Waist in each age category 18-29; 30-44; 45-60 and 18-60 (entire range), respectively. We can see the increasing trend of the girth dimension Waist (PD), in connection of increasing age, unlike of decreasing trend in case of Height (SD).

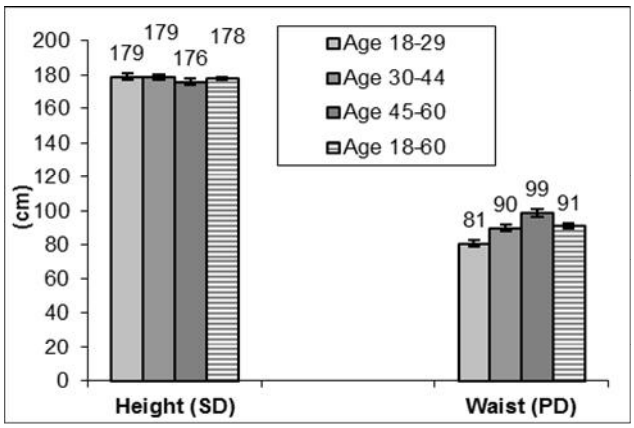

Figure 1 Comparison of body dimensions: height and waist

These results are beneficial to study the proportional relationships between the width and length of the trousers. They reveal the need to study body proportions of a target customers inside each age category as well as. Then body size changes can be to implement into a trousers construction.

3.2 Statistical analysis of the Czech anthropometrical data

These findings are an interesting output of statistical analysis of Czech male anthropometrical data: The large differences between the waist girth (measurement was taken in the lowered waist level by 4 cm from origin waist) and the hip girth. The difference amounted to more than 10 cm in 41% of the observed subjects. However, the results of examining the differences in the given dimensions suggest that even in the male population there is a more marked difference between the dimensions mentioned, as is in the case of the female body shape [6]. Due to the fact that the design parameter of the hip girth (Hip) determines the resulting shape of the trousers, it is important to test these body disproportions.

The Hip is not a typical male standardized dimension, and also is not listed in the label states of characteristic dimensions within the EN 13402-2 [4]. There is one more idea, to add the Hip in the size marking pictogram as the important secondary dimension and thus to perfectly inform the customer about a dimension in hip area.

3.3 Evaluation of the men´s trousers pattern drafting methods

The analysis of the Men's trousers pattern drafting method was focused to find out a suitable pattern making methodology for mass-production for target national customers. It is supposed that the design line segments are mostly expressed using a regression equation of the type (1).

$$\overline{ABi} = K_{D1(ABi)} * D_1 + K_{D2(ABi)} * D_2 + A_{ABi} + e_i \quad (1)$$

where: $\overline{ABi}$ is a dependent variable - computed *i*-design dimension, $K_{D1(ABi)}$, $K_{D2(ABi)}$ egression coefficients, D_1, D_2 is an independent variable –body measurements, A_{Abi} absolute value, e_i ease allowances

That is a good way how to use a relationship between a dependent variable (a main body dimension) and one or more independent variables (subordinate pattern design parameters). This method allows an application of anthropometric changes of body proportion of any population to the shape of a trousers construction within the whole sizing range. Unlike the way of design line segments are expressed by setting a numerical value for all sizes, regardless of different shape of a body.

For experimental evaluation there are the same selected design line segments and pattern drafting formulas in the set of those observed men´s trousers pattern making methods: 13 segments for front trousers block and 11 segments for back trousers block.

Quantitative analysis of these observed methods shows: The largest number of the design line segments is expressed using regression formula within the Czech method NVS. More details we can see on Figure 2.

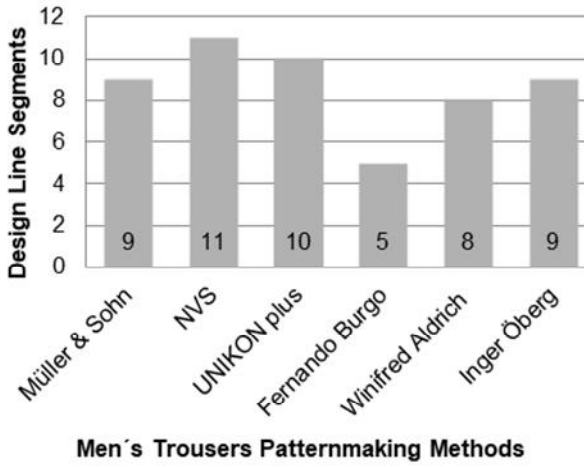

Figure 2 The number of the design line segments which are expressed using regression equation

3.4 Evaluation of the trousers design block procedure

There is an analogy between the above mentioned trousers patternmaking methodologies. Similarities are evident as in the design of construction net as well as in tracing lines of the shapes of the cutting edges.

In the Figure 3 there is the trousers block. The part of trousers block that covers the pelvic part of a body is described. The distances between the individual design points that correspond with the anatomical surface points delimit the design line segments.

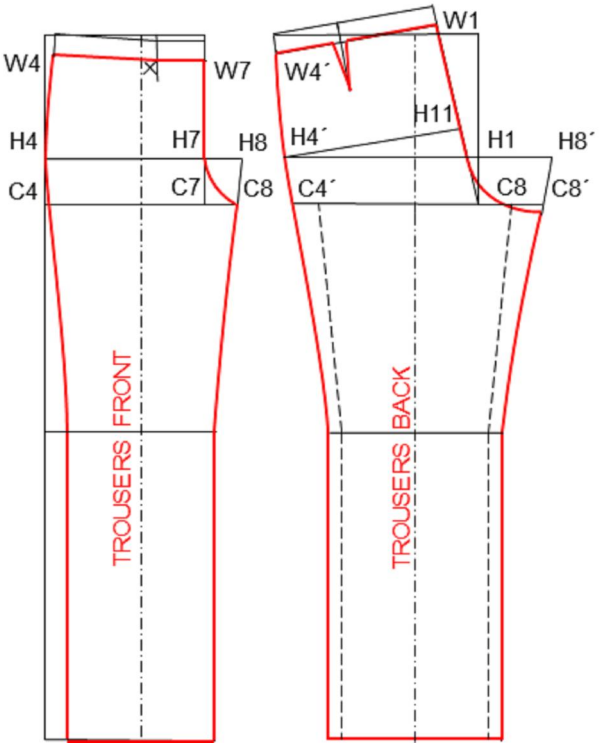

Figure 3 The male trousers block

On Trousers Front there are: C4 – H4 (Hip Height); H4 – H7 (Hip Width); H7 – H8 (Part of Hip Width); C7 – C8 (Part of Crotch Width); W4 – W7 (Waist Width).

On Trousers Back there are: H4´ – H11 ((Hip Width); H1 – H8´ (Part of Hip Width); C8 – C8´ (Part of Crotch Width); W1 – W4´ (Waist Width).

The resulting cut shape for this area is affected by the mutual proportions between the waist and the hip circumferences and what way is used to implement proportions into the design process.

The comparison of the values of the selected design line segments of Male Trousers Block are listed in Table1.

To determinate these values the male subject is selected for the body measurements: Waist = 88 cm and Hip = 104 cm. He is a represent ant of the most numerous group of observed subjects in middle age category in the Czech male body measurement data: Age 30-44.

Although the input design parameters of the basic trousers block are of the same body measurements of same male subject, the values of the line segments are different, as we can see in Table 1.

Table 1 The values of the selected design line segments of male trousers

Line	Dimensions [cm] within pattern drafting methods					
	Müller & Sohn	*NVS*	*UNIKON plus*	*Fernando Burgo*	*Winifred Aldrich*	*Inger Öberg*
Design line segments of trousers front						
C4 – H4	8.2	7.2	-	-	6.5	7.5
H4 – H7	26	25	23.7	27	28	27.3
H7 – H8	6.2	-	6.9	-	-	-
C7 – C8	-	5.1	-	5.2	7	4.7
W4 – W7	22	22.5	21	21	24.5	26.5
Design line segments of trousers back						
H4 – H11	29.5	28	26.8	28	29	27.5
H1 – H8´	13.9	-	13	-	-	-
C8 – C8´	-	4.6	-	-	3.8	-
W1 – W4´	24	25	24	24	26.5	24.5

3.5 Fitting test of the tailored trousers

The fit of trousers which was made according to the shape of the cut created using the experimental tested pattern making method NVS was checked. The master patterns of the male trousers were drawn using the algorithm, which include linear distances and curves from this method, using individual male body dimensions. The subject of the size 52 was selected. He is the customer in middle age and wearer of the BUSHMAN brand products. He represents one of the most numerous group of tested subjects and his body dimensions are: Height = 182 cm, Waist = 94cm, Hip = 108 cm. Under the standard EN 13402 [5] this subject is the somatotype "J" which is defined with the help of Drop = waist girth − hip girth = - 14 cm.

Consequently, the men trousers were tailored and test-fitted to five individual customers whose body dimensions correspond to the Czech somatotype of the size 52. All trousers were made of the same 100% cotton woven fabric without any elastic textile material. The fitting test results confirmed that the patterns drafted using the NVS patternmaking method provide adequate fit. Figure 4a) and 4b) shows a fit testing procedure.

a b

Figure 4 a) Front view [6] and 4b) side view [6]

3.6 The definition of the Czech male sizes according to the rules of the standard "EN 13402–3: Measurements and intervals"

The tables - scales with intervals in at least of the primary dimension for each garment type are listed in standard EN 13402–3 [4]. Size intervals define the differences between two adjoining body measurements (primary and secondary dimension).

There must be a proportional relationship between these dimensions that corresponds to certain somatotypes. Where a somatotype i.e. body shape is characterised by a number of girth dimensions and height. The nearest whole number inside of interval in the tables for these dimensions is used for purposes of size designation.

This research constitutes an attempt at the definition of somatotype appropriate to the Czech male population. It consists of the steps:

- to study the sizing tables of measures as described in the EN 13 402-3 [4] constitute the grouping of body sizes appropriate to the European population. The intervals listed in the tables in case of Waist and Hip girth measurements for men – garments for lower body.
- to define the range of intervals of the Waist measurements for Czech male customers.

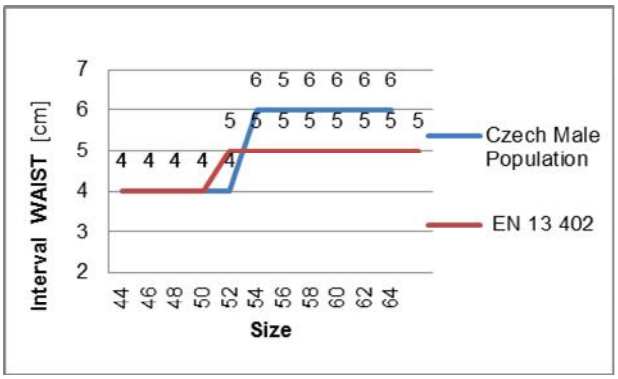

Figure 5 The range of intervals of the waist in EN13 402-3 and the range of the intervals of the Czech male customers of the BUSHMAN brand products

For this study, the somatotypes of the EU size of the range from size 44 to size 64 were selected. The male subject of EU size 52 was a reference - basic size of the open system with inbuilt flexibility of standard EN 13402-3. Interval ranges for smaller

sizes and larger sizes were evaluated. The interval of the 4 cm is applied to size range of somatotypes till the appropriate EU size 50 of the mean value of Waist = 90 cm (range 88 - 93 cm) including. The interval of the 5 cm starts from appropriate EU size 52 of the mean value of Waist = 95 cm (range 93-98cm), see Figure 5.

This was proven by tests of the fitting of already made trousers by cutting method NVS and in frame of these sizes hanging on the EU interval of the Waist, see Figure 5. The results showed the disproportion on the cut of the trousers in area which corresponding to upper hip part of body. This caused discomfort to wearers. Therefore, the size interval of the Waist has been changed.

Based on results of a study of the body proportion of the Czech male population the interval of the 4 cm was applied to size range till the appropriate size 52 of the mean value of Waist = 95 cm (range 93-98 cm) including.

The interval of the 6 cm starts from size 54 of the mean value of Waist = 100 cm (range 98-103 cm), see Figure 5.

Recommended interval of the 5 cm due to the standard EN 13402-3 was not suitable for Czech somatotypes in size range 54-64.

4 CONCLUSION

Being successful in frame of garment mass-production is generally associated with the goal to produce product in high quality. This means using both the high-quality of textile materials and attends to the needs of the comfortable fit of garment for the target wearers.

To clearly label a clothing according to valid standards so that the size symbol of the given clothing should be corresponding with the body proportions of the target wearer.

This study can provide solutions for garment production companies to precisely carry out the men´s trousers pattern construction for target Czech male population.

We can describe these partial conclusions and recommendations:

- to provide the systematic research of anthropometric data which allows to update information of the body proportions of target population as well as to define the body size changes possible to systematically implement into clothing pattern design procedure. For this purpose, to take body dimensions separately in each country due to significant ethnic differences in body silhouettes that prevents the transfer of European data to specific countries.
- to use pattern construction algorithms of the design line segments to be at the most of them calculated using regression formulas. This method will increase the efficiency of construction parameters and thus to automate the pattern grading process of the trousers pattern in a wide range of sizing.

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