DEVELOPMENT OF THE PRODUCTION MODEL OF SCALING UNIFORMITY OF THE ASSORTMENT COMPLEX CLOTHING FAMILY LOOK

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Abstract: *The problem of combining the image system with the image types of social order for a new line of fashion trends has been investigated. A methodology for generating a productive model of systematic database selection using numerical methods for solving scaling problems has been developed. The mechanism of typing of similarity on the basis of compositional homogeneity of models in patterns of consumer demand has been investigated. An algorithm for determining the coefficients of proportionality of the constructions of the range of complexes has been developed, taking into account the gender, age and style features. It has been established that the production model of scale of control measurements provides technical conditions of quality control of design documentation.*

Keywords: *image, product range, production model, scale, similarity types, homogeneity, proportionality factor, control measurements, design documentation.*

1 INTRODUCTION

The priority area for the development of computer technologies in the second decade of the 21st century is the development of methods of complex assessment of the quality of objects based on the theory of "pattern recognition". One of the components of flexible production is to take into account the social status of behavior of the modern consumer of clothing, which eliminates such classification features as assortment, gender, age, place of residence, type of employment in the characteristics of preferences [1, 2]. The technical and economic benefits of automatic resizing according to the morphological classification of figure types include saving development costs in the long run [3]. The influence of marketing on the social dimension of the development of symbolic associations of fashion trends does not take into account the influence of environmental factors. The new line in fashion is often defined by the image types of social order for copyright inspiration in a fundamentally new combination of the image system, in particular, for the promotion of family values. A family-friendly outfit - Family Look is becoming a new trend, which creates a shared family style and shows that this family is one. The usefulness, reliability, benefit of using the tandem of paired clothing of parents and children is manifested in the homogeneity of the morphological structure of products, which corresponds to the characteristics of the classical fixing unification of the main forming parts by means of proportional scaling.

The relevance of the competitive equilibrium of the targeted demand for the functional orientation of the use of "exactly" in the sub-brand of Family Look positions the image level of motivation. This is confirmed by studies in the field of competitive advantages of targeted demand for homogeneity of composite decisions of the family wardrobe [4-7].

The use of the cost-savings method on the principle of "combine what already exists" involves the development of group design documents to regulate the flexibility of production design preparation.

2 DISCUSSING IDEAS

Buying clothes goes from a physical domain into a virtual domain, and mass customization becomes the only way to win and retain a buyer [8, 9]. Virtual fittings for 3D clothing modeling [10] provide the flexibility to use scanned anthropometric data in the automatic design of clothing at a higher level [11, 12]. The role model of consumption, in which children view parents as role models, is based on the transition from qualitative to quantitative methodology [13]. Empirical studies of communications in the competitive advantages of price groups among consumers determine the direction of experimental design in the formation of a hypothetical image of models of the range [14, 15]. A hierarchical regression of the relationship between fashion innovation, consumer's behavior and information sources involves the use of a genetic algorithm to evaluate goods [16]. Fuzzy Clustering methods (FCM) [17] take into account the systematic selection of part of the database

by the functional orientation of the Family Look assortment. The methodology for identifying the relationship between the content of the process of designing clothing and its abstract description in the form of context diagrams, presented in [18], does not take into account the gender status in a particular range. The method of forming the capsule of the assortment complex [19] involves the application of relations of geometric similarity on the basis of uniformity of structural belts in the lines of transition of sections of the product, which will ensure the preservation of the compositional properties of the form. It is proposed to perform the transformation of the spatial characteristics of the capsule design objects by the methods of metric transformation. This approach positions in the gender and age standard set the modernized stylization of microstyle "Family Casual", for models of the product group "City Casual" on the basis of duplication of styles, materials, colors and processing.

3 METHODS

The trendy pattern recognition strategy for young, low-budget consumers is aimed at consuming pret-a-porter clothing in virtual domains. The quantitative research methodology is based on the method of statistical analysis of the homogeneity of groups of classification features of consumer demand patterns [20-22].

Initial data for such developments are existing photos of existing in the world wide web of models of clothing of brand “Family Look”.

The homogeneity of self-expression of a person in society is characterized by the assortment group "Basa" (65%), whose hypothetical image does not change for 3-4 years.

The positioning of regular customers and the stability of production for the target audience is characterized by the “Basis” group (55%). It defines the basic range for research. The diversification strategy of the composition of models of the City - Casual product group determines the advantages of the Bestseller group, the types of which are relevant for at least 4-5 years.

From the point of view of consumers who want to impress others and follow the fashion, this group is called "conformists" (65%). The basic values of novelty are the answers to the question "What did I buy?" Thus, the model of the hypothetical image of consumer preferences in the conformists group describes the range of the Bestseller group (80%) with a sufficiently high degree of homogeneity [23]. This corresponds to the creation of identical images with the same Family Look style clothing [24].

The social status of the consumer group is described by tandems: parents - children, father - mother, brother - sister. Gender: father - son, mother - daughter, brothers - sisters. Gender and age differences in body characteristics are subordinated to anthropometric features and affect the identification of the appearance of the product.

The regulatory documents (Table 1) contain the specifications and methods of anthropometric measurements of the size of the human body for the clothing design. The degree of technical perfection of the product design in proportion determines the methods of designing clothes. Calculation and graphical design techniques that determine the contour of a typical product detail with different approximation accuracy are based on the discrete measurements of figures, increases and typical articulations of parts. Numerical methods of calculation in industrial methods, in particular, CRIGI (Central Research Institute of the Garment Industry), UMDC CMEA (unified method of designing clothes of the CMEA) contain analytical substantiation of the use of body measurements for determination of the main structural points of the contour taking into account the tectonic functionality of the part [18].

The range of modern calculation tools, combined with the rapidly increasing computing power of CAD, make it possible not only to calculate any design document, but also to take into account the typing principles of the similarity properties in the target portfolio of Family Look models. To recognize the hypothetical image of the assortment kind, it is advisable to apply the method of typing quantitative indicators of the appearance of the model.

Table 1 Regulatory documentation for the design and manufacture of clothing

Standard number	Application
DSTU 3321: 2003	Terms and definitions of basic concepts in the system of design documentation
DSTU GOST 25294: 2005: 2006	Technical conditions of production of the dress-blouse assortment
DSTU ISO/TR 10652: 2006	Standard dimensioning system
DSTU ISO 8559: 2006	Anthropometric measurement of human body size for clothing design
DSTU GOST 31396: 2011	Means and methods of measurement. Classification of typical women’s figures
DSTU ISO3635: 2004	Determination and removal of measurements by the standard method
GOST 17522-72	Dimensional features of typical women’s figures for designing clothes
GOST 17917-86	Dimensional features of typical boys’ figures for clothing design
GOST 17916-86	Dimensional features of typical girls’ figures for clothing design

DSTU - State standards of Ukraine; GOST - State standard

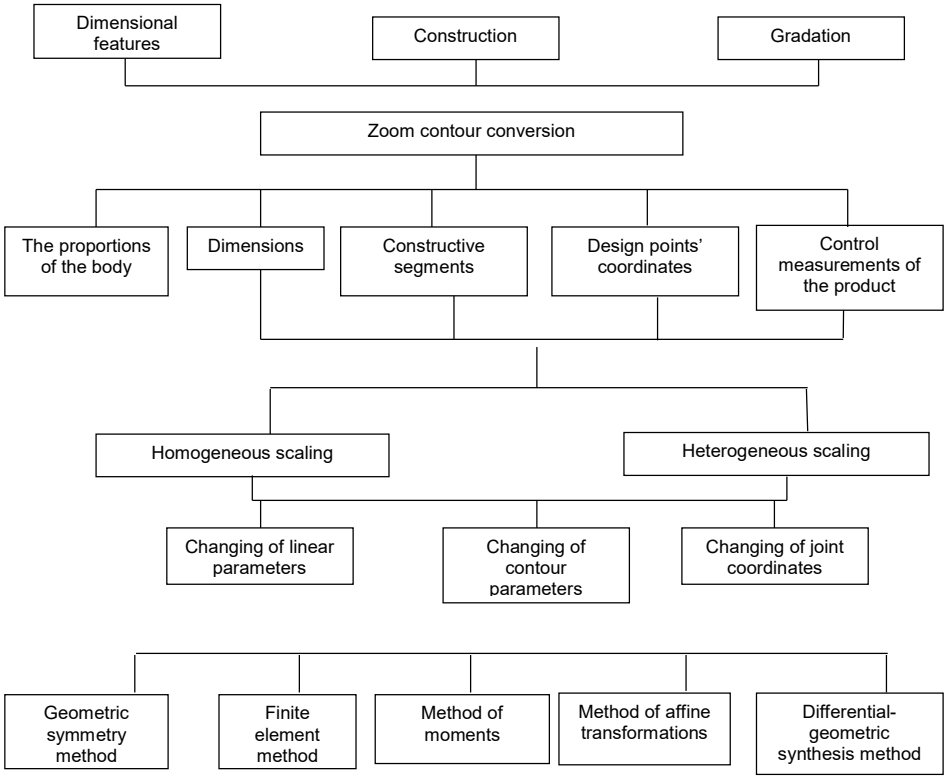

Figure 1 Classification of numerical methods for solving scaling problems

The production model of the generalized characteristic is based on the typing rules in the form "If (condition) then (action)". To select typical compositional features, this figure is equal to more than 45% [23].

The strategy of diversifying the composition of models to positioning of consumer's demand involves the choice of patterns of stylization on the basis of homogeneity. The summer wardrobe of the product group "City - Casual" is characterized by the academic stylization of elements of classical style on the basis of isomerization of many objects of the same composition, but of different structure. Accordingly, the Family - Casual microstyle is manifested in the form of a pattern of modernized stylization [24].

Therefore, design features are dominant for typological analysis of the homogeneity of groups in the matrix of the market-model capabilities on the basis of competitive equilibrium of target demand. Maintaining proportions is a prerequisite for sizing Family Look products which is done by scaling the object.

Scaling is a special case of affine transformations, which in computer graphics is regarded as stretching/contracting along the coordinate axes and described by the following equation (1):

$$x_1=ax, \quad y_1=dy \tag{1}$$

where, *a* and *d* are the scaling factors.

Mathematical models of proportionality are represented by a set of formulas for calculating the coordinates of the structural points of the detail's design and the scaling factors equation (2) [26]:

$$Kx = \frac{\sum_{i=1}^{n} a_i}{n};\ Ky = \frac{\sum_{i=1}^{m} d_i}{m} \tag{2}$$

where, $a = \frac{x_1}{x_0}$ - is the scaling factor along the *X* axis for the i-th constructive point; $d = \frac{y_1}{y_0}$ - is the scaling factor along the Y axis for the i-th construct point; *n(m)* - is the number of design points lying in the direction of the scaling axis *X*, (*Y*).

To simplify the mathematical calculations, a Cartesian coordinate system with a center at the intersection of the diagonals of a rectangle constructed according to the control dimensions of the dimensions of the structure of the parts has been chosen. The polar radii are drawn through the main design points of the contour of the detail. The scaling factors along the X and Y axes are calculated as the average of the coefficients of the same name. As a special case of scaling is a way of grading patterns. The gradation of the pattern implies the displacement of the structural points by a value that is determined proportionally. Auto CAD has a built-in zoom feature. The block is a part that is broken down into parts for scaling.

The mathematical formulation of the problem of compliance with the requirements of homogeneity

of typing in the system of models of Family Look is provided by the condition *{3n} = C* [18]. Each type of proportionality should include at least two alternatives for the transformation of the spatial structure by the principle of orientation of the proportions of the product. Numerical methods for solving scaling tasks using the proportional guidance method are shown in Figure 1.

$$M_m \supseteq M_{m1} \cup M_{m2} \cup M_{m3} \cup M_{m4} \cup M_{m5} \quad (3)$$

where, M_{m1} is the method of moments for splitting a contour into a finite number of elements in a polar coordinate system; M_{m2} is the geometric symmetry method for maintaining the symmetry of the quadrants of the polar coordinate system of the design points of the detail's contour; M_{m3} is the finite element method for taking into account the variability of dimensional features; M_{m4} is the method of affine transformations for proportional contraction / stretching of coordinates of constructive points of a contour; M_{m1} is a method of differential geometric synthesis for grading design documents.

4 EXPERIMENTAL

The process of developing a model of proportionality to preserve compositional homogeneity on the basis of "exactly the same" in group of design documents describes the algorithm for the study of typing similarity: tectonics' form - contour details - design document [23]. Form tectonics is determined by the stage of introducing anthropometric planes into the scheme, which describe anthropometric features. The contour of the part is characterized by the constructed structure by empirical calculations of the main nodal points. A design document in the form of a gradation characterizes a drawing of parts for the required dimensions of the product. The model of cross-certification of consumer demand is based on the concept of typing the classification features of stylization patterns within the consumer's psychographic portrait (Table 2).

The study of the artistic aspect of the targeting of Family Look models is made on the basis of similarity of the main basis and aesthetic expressiveness of composite decisions for the assortment complex women's dress - dress for girls of preschool group - shirt for a boy of nursery group. The three objectives of the task are defined by age group status, namely, the dominant role of the mother in the behavior of preschool children.

As a general idea for a hypothetical object is accepted characteristic: product group - classic dresses and shirts, consumer type - conformist, shape symbol - rectangle, associative style symbol - "softened" academic stylization City Casual [24].

A mathematical description of the morphological changes of the range in patterns of consumer's demand is represented by the operations of combining and crossing sets of personal and social factors of consumer's behavior to form a generalizing idea:

$$\begin{aligned} &\text{Zone A} \quad \text{Basis} \subset T \subset K2 \cap K3 \cup C2 \cup M1 \cup B3 \cap B5 \\ &\text{Zone B} \quad \text{Fashion} \subset M \cap C \subset K4 \cup C1 \cap C5 \cup M4 \cup B2 \\ &\text{Zone C} \quad \text{Bestseller} \subset T \cap C \subset K5 \cup C1 \cap C4 \cup M2 \cup B1 \end{aligned} \quad (4)$$

Statistical studies of descriptions of the figurative solution of models contain four variants of the psychological portrait of the consumer that correspond to the "4C" marketing system: Consumer, Cost of Expectation, Convenience, Communication.

A hierarchical regression of the relationship between age, gender, and environmental factors confirms the presence of brand symbolism impact on children from the age of 2 years and it increases throughout the preschool years [25].

Formation of profiles of structural and compositional characteristics of the hypothetical image of the Family Look product range is accomplished by systematization of quantitative indices of occurrence, in particular, typing, stylization, and similarities of structural modification (Figure 2, Table 3).

Table 2 Cross stratification matrix of consumer demand patterns

Fashion zones		A - conceptual model of competitive properties	B - fashionable range of trends of the season
Type of marketing strategy		I - cost savings for the basic range of the target audience Basis	II - Fashion Microstyle Diversification
Consumer demand pattern	**Type of stylization**	Academic styling	Upgraded styling
	Group novelties	Typical – T	Fashionable - F, Contemporary – C
Psychographic portrait of a consumer	**Class**	Pragmatist - C1; Traditionalist - C2; Materialist - C3;	
	Categories of values	Social status - V1; Material interest - V2; Career Achievements - V3; Personal development - V4; Image - V5	
	The level of motivation	Targeting - M1; Copying - M2; Limited reach - M3 Stylishness - M4	
	Selection criteria	Prestige - S1; Originality - S2; Conceptuality - S3; Availability - S4; Acceptability - S5	

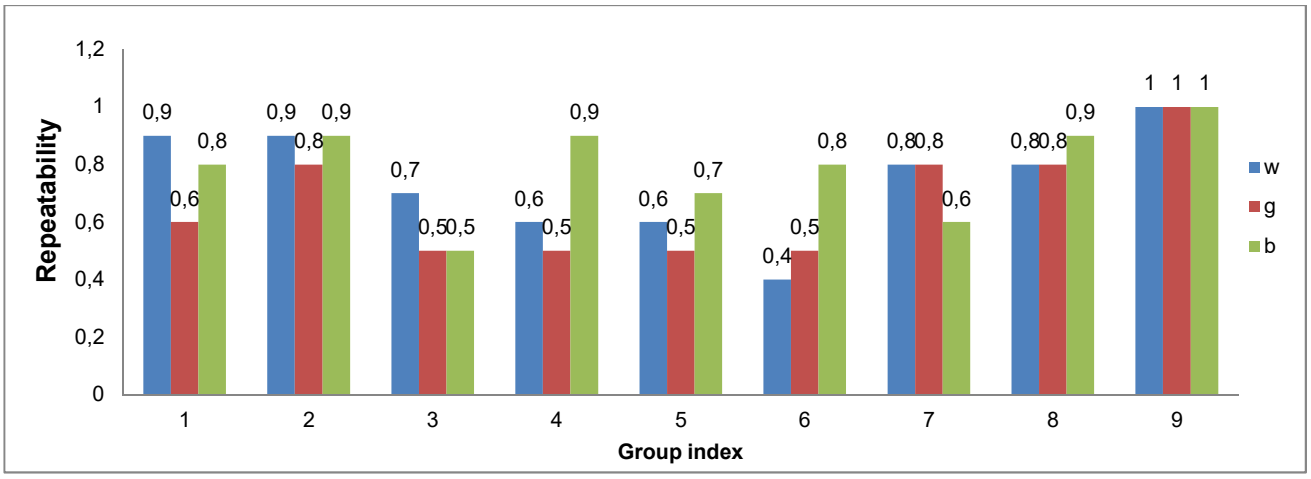

Figure 2 Diagram of the repeatability of typical elements in the range of models

Table 3 Indexing of typical elements of structural and composite solutions of models of assortment complex

Group index	Item name	Kind of element
1	Sleeve	Sewn with length transformation
2	Longitudinal partitioning	Constructive seams
3	Cross partitioning	Structural and decorative seams
4	Clasp	On-Board Buttons
5	Neck	Round with collar
6	Pocket	Attached 1 or 2
7	Nuance	Folded skirt shape
8	Symmetry	Mirror, similarity of elements
9	Scalability	Proportional metric order

The use of a matrix of search of a systematic set of classification features of hypothetical images of an assortment complex by combination 1 (yes), 0 (no) in the automated layout of elements allowed to obtain 24 variants of combinations of group classification features.

The morphological characteristics of consumer figures for Family Look clothing take into account age, proportion type, body type, posture, baseline dimensions. The age of the mother of the family corresponds to the adult first period of 21-35 years, which is included in the younger group. The girl is included in the length of the 3-7 years age, which corresponds to the first period of childhood and to the group of preschool age. The boy is included in the length of the age period of 1-3 years, which corresponds to the period of early childhood and nursery group.

The type of body figure which is female one by B. Scherley is uniform, with a moderate fat accumulation, the type of posture is normal (*Pk* = 6.2 ± 1.0 cm, *VP* = 5.9 ± 0.75 cm).

Type of proportions according to the classification V. Bunaka is mesomorphic with an average ratio of trunk to limb lengths.

Most children under the age of 7 are kept straight because the spine has not yet acquired the usual curvature: forward - lordosis (cervical and lumbar), back - kyphosis (thoracic and sacral). Lordotic type LIII posture is considered normal.

Studies of basic body sizes for model development and clothing design have confirmed an identical degree of compliance with national and international anthropometric standards in Table 1. Female - 164-96-104 (96 MS); girl 110-56-51 (110-56); boy 92-52 (92-54).

To ensure operational comfort, the tectonic integrity of models of the Family Look range has been investigated by scaling by the method of proportional three-dimensional clothing in the light of family-style fashion trends (Figure 3).

The proportional ratio of the shape of the bodice and the skirt has been determined by the ratio of the proportional measurements of heights for the three specified age groups. In particular, the height of the waist line is 7, the height of the knee line is 9, and the height of the base of the neck is 10.

For the bodice, the difference of dimensions (10-7) is taken into account, for the skirt (7-9), which are divided in pairs in the age groups of the basic size: woman - girl (WG), girl - boy (GB).

The proportionality coefficients of the ratios of the upper and lower parts relative to the waist line are calculated by the equation (5):

$$C_{pr} = \frac{B_i}{B_j} \quad (5)$$

where, B_i is the projection measurement of the output height in pairs; B_j is the projection measurement of the second height in a pair.

W-G (bod) Cpr^1 = 1.5;

W-G (skirt) Cpr^2 = 1.58;

G-B (bod) Cpr^3 = 1.16.

The average proportionality factor projection measurements for a pair of W-G is 1.54, which suggests that the approximation to the harmony of the golden section (for women, 1.6).

Typical proportions of body measurements form a stable morphological structure of the body section in typical designs of three products.

The study of maintaining the proportionality of the body in the design of the product has been performed on the structures constructed by the method of the CRIGI, which is used in the industrial production of clothing.

Dimensions of typical figures of the selected group of consumers of clothing for the study of the proportions of horizontal (X) and vertical (Y) measurements (woman 164-96-104, girl 110-56-54, boy 92-52-48) are shown in Table 4.

The proportionality factor calculations are made in pairs of the same numbers by the ratio of larger to smaller by the compression principle: W-G; G-B. Since the design of the bodice by the type of members is homogeneous for all the designs of the range of the Family Look complex, studies of the changes in the basic structures have been performed with the help of scaling by equation (2). For this purpose, the design of the parts of the body (back and forepart) is introduced into the system of cylindrical coordinates relative to the center of scaling O (Figure 4). The structural points of the contours of the parts for the three investigated structures are the points of intersection with polar radii drawn from the center of scaling and are the origin to determine the coordinates basic the structural points (Figure 5, Table 5).

Figure 3 Family Style fashion trends

Table 4 Anthropometric database for determining the proportionality of figures for Family Look style

Measurement plane	Ti number by size standard	W 164-96-104 GOST 17522–72	G 110-56-54 GOST 17916-86	B 92-52-48 GOST 17917-86	Cpr W-G	Cpr G-B
X	13	18.5	13.3	12.2	1.39	1.09
X	15	50.4	29.25	26.5	1.72	1.10
X	18	38.0	25.5	25.0	1.49	1.02
X	19	52.0	31.75	28.7	1.64	1.10
X	45	17.3	10.9	10.8	1.59	1.01
Y	43	43.3	28.7	26.2	1.51	1.09
Y	40	40.3	26.3	25.0	1.63	1.052
Y	61	44.0	27.2	26.0	1.61	1.038
Y	39	17.9	13.1	12.1	1.37	1.08
Y	41	43.6	28.9	26.1	1.51	1.11
X	47	18.3	12.5	10.3	1.47	1.19
X	31	13.3	9.8	7.0	1.36	1.4
∑	-	399.6	257.2	236.4	1.56	1.088

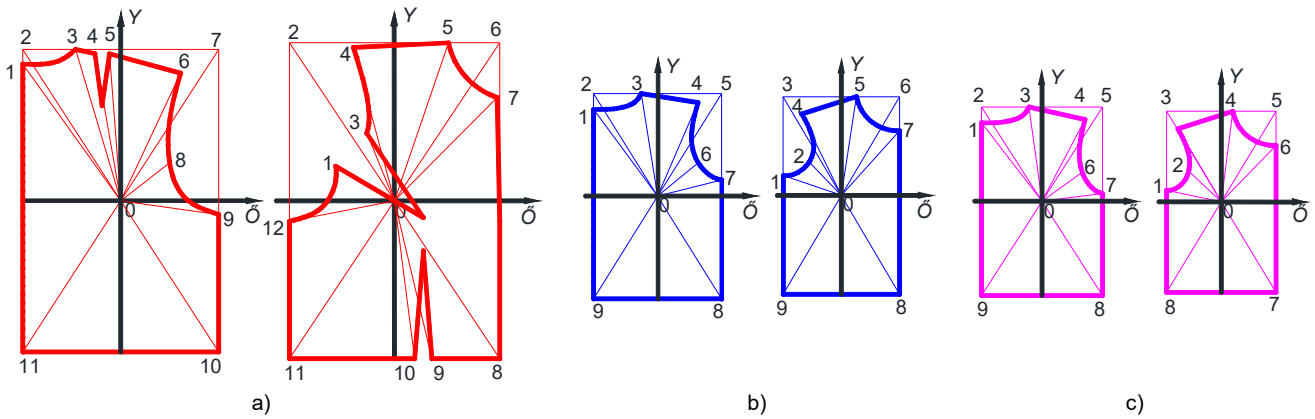

Figure 4 Experimental designs for back and forepart for scaling: a) for women; b) for a girl; c) for a boy

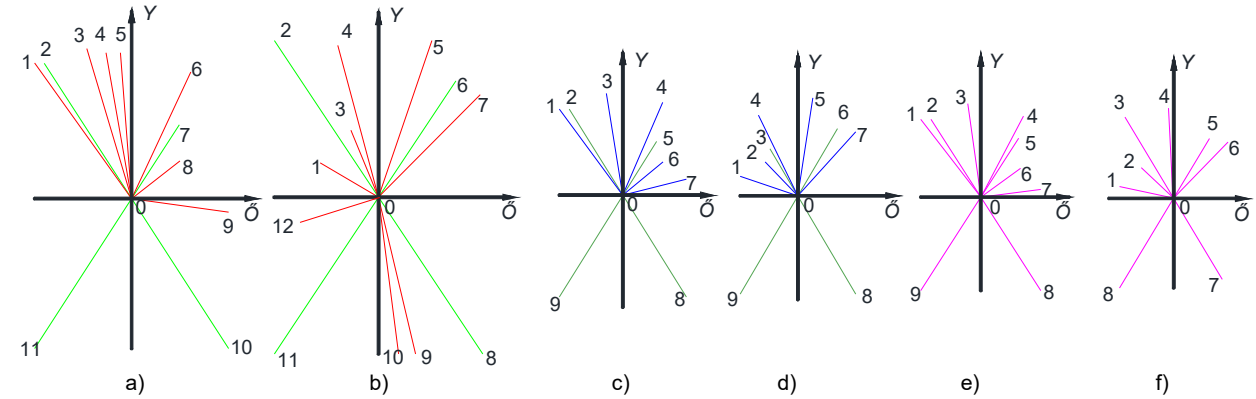

Figure 5 Polar radii of the structural points of the parts of the back and forepart to determine the coordinates X, Y: a) c) e) back (W, G, B); b) d) f) forepart (W, G, B)

Table 5 Coordinate database for determining the proportionality of the major contour points for the Family Look trend [cm]

The contour point number of the detail	Woman				Girl				Boy			
	back		*forepart*		*back*		*forepart*		*back*		*forepart*	
	X	***Y***	***X***	***Y***	***X***	***Y***	***X***	***Y***	***X***	***Y***	***X***	***Y***
1	-13.6	19.0	-8.2	4.8	-8.2	14.1	-7.6	-8.4	8.0	12.0	-8.0	-8.5
2	-12.3	18.9	-14.6	21.9	-8.2	12.5	-5.5	-1.3	8.0	13.0	-4.0	-1.5
3	-6.3	21	-3.9	9.4	-3.5	14.1	8.0	14.4	-4.0	13.0	-6.8	12.5
4	-3.6	20.4	-5.7	21.3	6.8	12.1	3.0	14.5	3.6	11.0	-4.5	10.0
5	-1.6	20.4	7.5	21.9	8.0	14.1	8.0	14.5	8.0	13.0	3.1	12.5
6	8.3	17.7	10.8	16.3	5.2	2.2	8.0	7.8	4.5	1.3	6.9	12.5
7	6.7	10.3	14.3	14.4	8.0	8.4	8.0	14.0	8.0	4.5	6.9	7.1
8	6.8	6.3	14.6	-2.2	8.0	14.7	8.0	14.0	-8.0	-13.5	6.9	-13.0
9	13.6	-1.9	5.2	-2.2	8.0	14.7	-	-	-8.0	-13.5	-6.9	13.0
10	13.6	-21.0	2.8	-22.3	-	-	-	-	-	-	-	-
11	-13.6	-21.0	-14.6	-22.0	-	-	-	-	-	-	-	-
∑|*X*|, ∑|*Y*|	100	177.9	102.2	198.3	63.9	106.9	56.1	88.9	60.1	94.3	54.0	90.6

*Note: Absolute values ∑|*X*|, ∑|*Y*| fixes the area bounded by the contour of the detail (see Figure 4)

The contour point numbering captures the sequence of determining the main design points of the experimental design in the polar coordinate system relative to the center of the details' area.

The symmetry of the quadrants of the rectangle of the part relative to the center 0 fixes the coordinates of the polar radii to study the scaling of the details (Figure 5).

Significant differences ∑|X| and ∑|Y| are explained by the presence of the undercuts in the designs of the back and forepart for women: back - points 4.5 (shoulder recess), forepart - points 1.3 (breast recess), points 9.10 (thallium recess). These coordinates can be excluded from proportionality studies because they determine the shape of the detail's surface in the product. For the backrest ∑|X| + ∑|Y| points 4.5 is equal to 46 cm, for the forepart ∑|X| + ∑|Y| points 1, 3, 9, 10 is equal to 78.6 cm.

To typify the space of control measurements of the assortment complex, a study of the proportionality of the leading dimensional features and the system of control measurements of the dimensions of the experimental structures has been performed. The estimated proportionality coefficients of the leading dimensions (height, girth) for the baseline sizes are as following: a woman - 164:96 = 1.71, a girl - 110:56 = 1.96, a boy 92:52 = 1.77, indicating the dominant vertical measurements for body development. For growth, the proportionality coefficients in the studied pairs are: W-G – 164 : 110 = 1.49; G-B – 110 : 92 = 1.19, which, within the margin of error, coincide with the compositional proportionality of the dimensions of the bodice shape.

In the calculations of the coefficients of proportionality (formula 5) pairs of measurements X and Y are involved (Figure 6).

For W-G:

Cpr_X^b = 27.2:16.8 = 1.62; Cpr_Y^b = 40.9:28.7 = 1.43

Cpr_X^f = 29.2:15.2 = 1.92; Cpr_Y^f = 43.9:27.2 = 1.62

For G-B:

Cpr_X^b = 16.8:15.8 = 1.063; Cpr_Y^b = 28.7:26.2 =1.095

Cpr_X^f = 15.2:14.2 = 1.07; Cpr_Y^f = 27.2:26.0 = 1.046

The scheme of control measurements of the dimensions of the experimental designs of the body parts in the assortment complex dress-shirt confirms the possibility of scaling the designs of the girl's waist in the design of the boy's shirt, since the width of the product in the design differs by the amount of indifference interval of 2 cm.

In addition, the calculated proportionality coefficients for the designs of the back and the waist of the pair G-B create the preconditions for scaling by the method of gradation by the magnitudes of increments Δy, Δx at design points.

System of proportionality coefficients, defined according to Table 4 and 5, provides a description the uneven scaling of the details' contours (Table 6).

5 RESULTS

Finding proportional ratios for the Family look range in variations of the design's dimensional features (see Table 6) provides a qualitative assessment of the compositional features of product similarity.

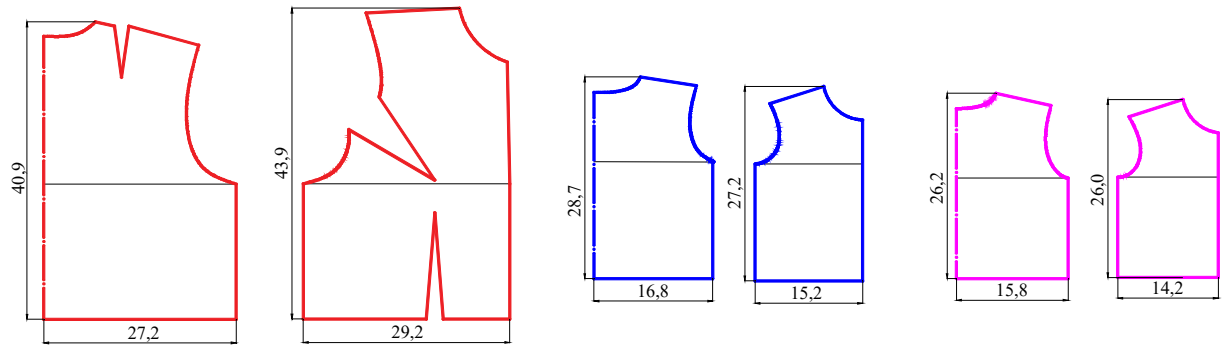

Figure 6 Scheme of control measurements of the dimensions of the experimental designs of the back and forepart of the Family Look range: a) woman; b) girl; c) boy

Table 6 Anthropometric base coefficients for the designs of the Family Look assortment

Scaling option	Anthropometric database					
	1 - dimensional features		*2 - construction*		*3 - gradation*	
	W-G	*G-B*	*W-G*	*G-B*	*W-G*	*G-B*
The proportionality of the body	1.50	1.170	1.50	1.050	1.210	1.150
Product dimensions	1.56	1.088	1.64	1.069	1.078	1.020
Measurements of the basis of construction	1.61	1.072	1.59	1.060	1.098	1.020
Design basis coordinates	1.51	1.020	1.83	1.056	1.075	1.085
Averaged outline	*1.55*	*1.088*	*1.56*	*1.051*	*1.092*	*1.054*

The proportionality coefficients body and dimensions of the product in the pair W-G provide homogeneity of the typical construction of the bodice: $C_{pr_1}^{av} = 1.55$, $C_{pr_2}^{av} = 1.56$ with the property of nuance. The proportionality coefficients averaged outline in the pair G-B $C_{pr}^{av} = 1.088$, $C_{pr_2}^{av} = 1.051$ confirm the uniformity of the structures of the bodice and the property of the identity of the composite means in the design of details. $C_{pr_3}^{av} = 1.92$ та $C_{pr_3}^{av} = 1.054$ in typical schemes of grading patterns have a discrepancy of 2%, which confirms the reliability of the method of proportionality in the procedures of pattern's scaling. Complex drawings of the coordinate system of rectangles of overall dimensions of the back and forepart are shown in Figure 7.

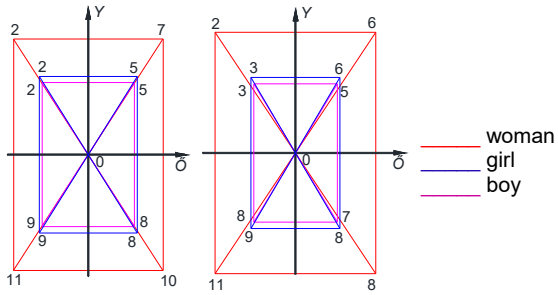

Figure 7 Complex system of polar coordinates of dimensions of products of the assortment complex: a) back; b) forepart

The algorithm for the method of determining the similarity of models of the range of Family Look range contains the following sequence of steps:

- Choosing a prototype of the base structure on the basis of "exactly the same" (see Figure 2).
- Division of the structure into sections in the polar coordinate system (see Figures 6, 7).
- Calculation of proportionality coefficients.
- Validation of the production scaling model.

Comprehensive blueprints for combining the details of back and forepart for W-G and G-B pairs in the polar coordinate system are presented in Figure 8.

To determine the increments in the structural points of the contours of the parts, a diagram of polar radii and angles (rads) relative to the center of scaling (Figure 9) has been created.

The system of transformations in the production model of the use of gender-age and style features of the assortment complex is subject to the proportionality estimation according to the scheme: dimensional features - design - scaling.

A production model for estimating the proportionality of control measurements is presented in Table 7. A graphical interpretation of the proportionality coefficients, depending on the stage of application of the control measurements, is shown in Figure 10 (see Table 6).

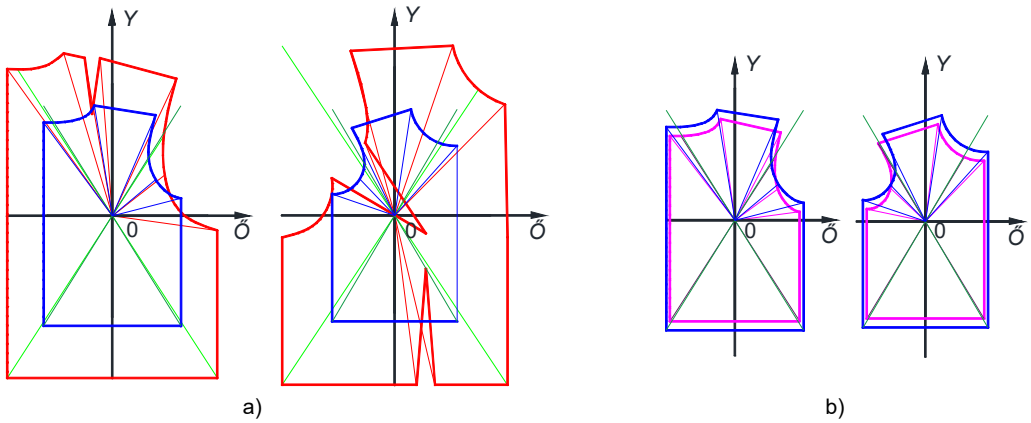

Figure 8 Complex drawings of the main details of the bodice: a) W-G; b) G-B

Table 7 Summary matrix of the production model of the proportionality of the control measurements of the complex drawing of pairs W-G, G-B

Control measurements		W-G				G-B			
		back		*forepart*		*back*		*forepart*	
		X	***Y***	***X***	***Y***	***X***	***Y***	***X***	***Y***
1	Dimensional features	1.46	1.53	1.59	1.59	1.21	1.052	1.01	1.01
2	Gradation coefficients	1.0	1.0	1.4	1.0	1.0	1.0	1.5	1.3
3	Measurements from the technical description	1.62	1.43	1.92	1.62	1.06	1.095	1.07	1.046
4	Dimensions of the drawing	1.55	1.43	1.54	1.61	1.056	1.095	1.24	1.046
5	Coordinates of diagonal endpoints	1.43	1.27	1.41	1.43	1.006	1.057	1.16	1.105
6	Length of diagonal	-	1.423	-	1.65	-	1.13	-	1.12
7	Polar angle [°]	1.088	-	1.091	-	1.048	-	1.033	-

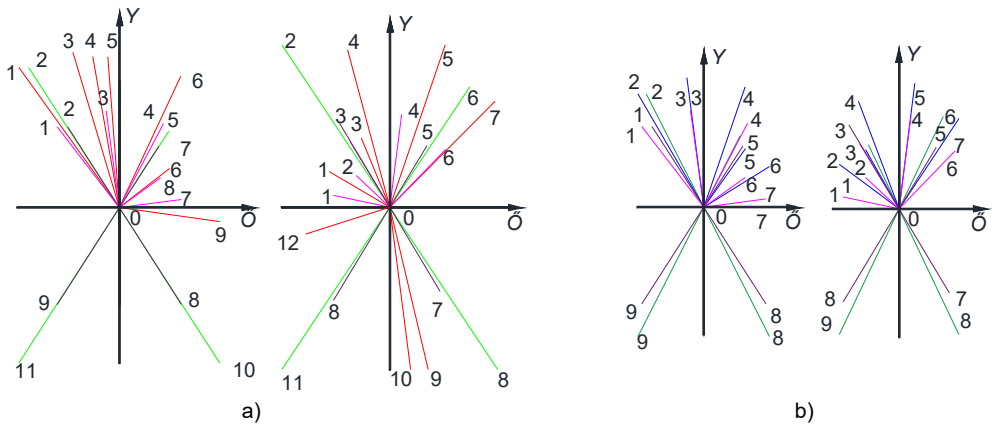

Figure 9 Diagram of the polar radii of the design points of the parts of the back and the forepart: a) W-G; b) G-B

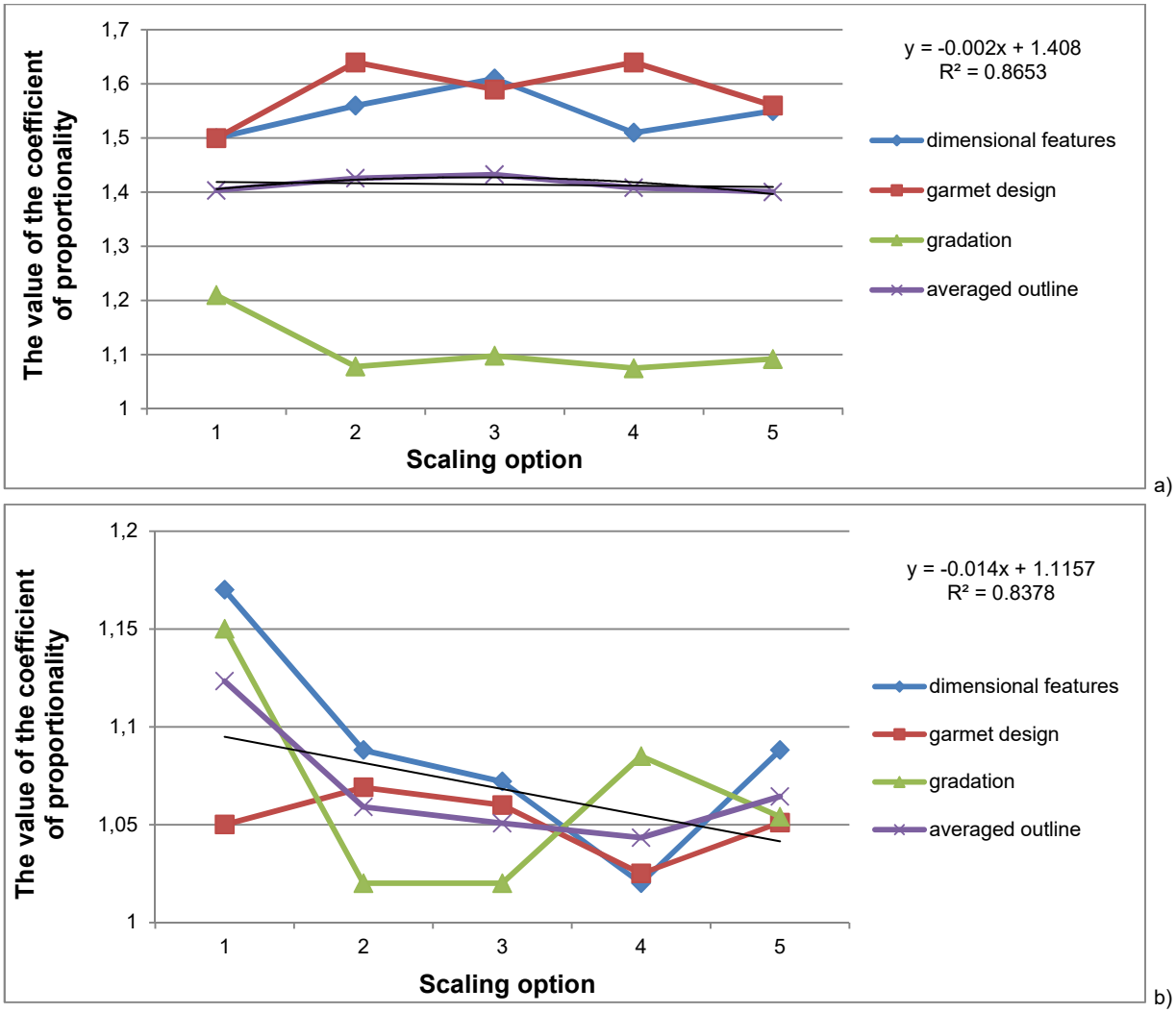

Figure 10 Dependences of Cpr on control measurements from scaling stages a) W-G; b) G-B

The linear regression equations averaged outline (Figure 10) correspond to the unified mathematical models of subordinate control measurements in stepwise quality control of design documentation for compliance with standards (see Table 1). The obtained mathematical models are adequate because $R^2 \rightarrow 1$. Comparative analysis of the proportionality coefficients of measurements

from the technical description and the experimental designs shows that the percentage of deviations for the pair of W-G is 7.3%, for the pair G-B is 2.7%. Such a deviation for the pair of W-G confirms that the scaling is performed in close compliance with the proportions of the golden section. Matching the silhouette is achieved by adjusting the waist line level.

6 CONCLUSIONS

In determining the effectiveness of the algorithm for calculating the proportionality of structural measurements, it is natural to use software products of graphic graphics, which follows from the levels of typing numerical methods for solving problems in simulation modeling (Figure 1). It should be noted that graphic editors do not provide a mechanism of similarity in the design of details. In this sense, it is advisable to use the method of control measurements in the scaling stages.

To prove this statement, a method for systematically selecting a database for the functional orientation of cross stratification of consumer demand patterns is proposed (Table 2). This is not at odds with the practical data known from [21, 22], which characterize the structure of the parameterization of design patterns in the comfort of women's clothing. The classification of numerical methods for solving scaling problems (Figure 1), in contrast to the results of studies published [16, 26, 27], allows us to state the following:

- the main regulator of the collection of scaling parameters in the transforms of the contour of the part is not so much the complexity of the composition of the model, but the proportionality of body sizes by the genetic algorithm of preservation of similarity;
- for trendy assortment of complexes, using the example of Family Look it is expedient to use formalization of control measurements in Cartesian coordinate system. This allows you to balance the proportionality of the details in the range of proportional changes, which is important for recognizing the trendy image in the capsule of the range.

Structuring of the outer contour through the heterogeneous scaling of the coordinates of the joints by the method of moments on the principle of affine transformations has a significant influence on the internal filling of a typical structure by affine transformations.

In some polar sections of the contour of the part in the complex drawing (Figure 8) the principle of parallel transfer of lines of control measurements of dimensions is maintained. Such conclusions may be considered practical from the point of view of applying increments of polar radii in the form of a diagram to select a graphical scaling editor.

From a theoretical point of view, using the diagram of the polar radii of the design points, it is possible to estimate the proportionality of the model according to the scheme: dimensional features - design - scaling.

The proposed production model provides for the formation of a matrix of proportionality coefficients of the system of control measurements with the prediction of the assessment of composite features of similarity of products in pairs of gender and age characteristics. This greatly reduces the time required to process primary samples of clothing and ensures the uniformity of standard designs.

However, it should be noted that the principle of similarity in the production model of data depends on the property of identity of the composite means and indicates the ambiguous influence of indicators of proportionality of the body. Such uncertainty imposes certain limitations on the use of scaling software modules, which may be interpreted as a drawback of this research. A potentially interesting direction for further studies may be focused on a critical approach to brand symbolism based on the unification of forms for the scaling design method.

7 REFERENCES

1. Krzywinski S. Siegmund J.: 3D product development for loose-fitting garments based on parametric human models, IOP Conference Series: Materials Science and Engineering 254(15), 2017, pp. 1-5, https://doi.org/10.1088/1757-899X/254/15/152006
2. Kim Y.-K., Sullivan P.: Emotional branding speaks to consumers' heart: the case of fashion brands, Fashion and Textiles 6(2), 2019, pp. 1-16, https://doi.org/10.1186/s40691-018-0164-y
3. Slavinska A., Syrotenko O., Dombrovska O., Mytsa V.: Simulation model of the morphological field of data for constructing a universal design of trousers, Eastern-European Journal of Enterprise Technologies 1(1), 2020, pp. 52-61, https://doi.org/10.15587/1729-4061.2020.192590
4. Family Look Sets (electronic resource), available from http://newsdaily.com.ua/garderob/dlya-zhinok/4855-simejni-komplekti-odyagu-family-look.html, accessed: 2020-02-25
5. Family Look: a Trend that Brings Together (electronic resource), available from http://blog.shafa.ua/family-look-trend-kotoryiy-obedinyaet, accessed: 2020-02-18
6. Yaroshenko D.: Family Look: One for All (electronic resource), available from http://www.cablook.com/fashion/family-look-odin-za-vseh, accessed: 2020-02-12
7. Sagakova E.: 4 Options of How to Dress the Whole Family in the Style of Family Look (electronic resource), available from https://letidor.ru/moda/4-varianta-kak-odetsya-vsey-semey-v-stile-family-look.htm, accessed: 2020-02-22

8. Traumann A., Peets T., Dabolina I., Lapkovska E.: Analysis of 3-D body measurements to determine trousers sizes of military combat clothing, Textile & Leather Review 2(1), 2019, pp. 6-14, https://doi.org/10.31881/TLR.2019.2
9. Nayak R., Padhye R., Wang L., Chatterjee K., Gupta S.: The role of mass customisation in the apparel industry, International Journal of Fashion Design, Technology and Education 8(2), 2015, pp. 162-172, https://doi.org/10.1080/17543266.2015.1045041
10. Porterfield A., Lamar T.A.M.: Examining the effectiveness of virtual fitting with 3D garment simulation, International Journal of Fashion Design, Technology and Education 10(3), 2017, pp. 320-330, https://doi.org/10.1080/17543266.2016.1250290
11. Hong Y., Bruniaux P., Zeng X., Liu K., Curteza A.: Visual-simulation-based personalized garment block design method for physically disabled people with scoliosis (PDPS), AUTEX Research Journal 18(1), 2018, pp. 35-45, https://doi.org/10.1515/aut-2017-0001
12. Hong Y., Curteza A., Zeng X., Bruniaux P., Chen Y.: Sensory evaluation based fuzzy AHP approach for material selection in customized garment design and development process, IOP Conference Series: Materials Science and Engineering Vol. 133, International Conference on Innovative Research - ICIR Euroinvent 2016 19–20 May 2016, Iasi, Romania, pp. 450, https://doi.org/10.1088/1757-899X/133/1/012058
13. Gavish Y., Shoham A., Ruvio A.: A qualitative study of mother-adolescent daughter-vicarious role model consumption interactions, Journal of Consumer Marketing 27(1), 2010, pp. 43-56, https://doi.org/10.1108/07363761011012949
14. Slavinska A.: Model for adjusting the stages of design preparation for the production of garments of different price ranges, Bulletin of the Khmelnytskyi National University 3(261), 2018, pp. 102-108 (in Ukrainian)
15. Clare G., Uddin S.: Corporate image and competitive advantage for apparel companies, Trends in Textile Engineering & Fashion Technology 5(4), 2019, pp. 663-671, DOI**:** 10.31031/TTEFT.2019. 05.000618
16. Rahman O., Kharb D.: Fashion innovativeness in India: shopping behaviour, clothing evaluation and fashion information sources, International Journal of Fashion Design, Technology and Education 11(3), 2018, pp. 287-298, https://doi.org/10.1080/17543266.2018.1429498
17. Zarezade T., Payvandy P.: 3D garment design using interactive genetic algorithm and clustering, Trends in Textile Engineering & Fashion Technology 5(1), 2019, pp. 594-597, DOI: 10.31031/TTEFT.2019.05.000604
18. Slavinska A.: Method of optimization of structural and technological features of a systematic types of series of models of garments, Bulletin of Khmelnytskyi National University 2(223), 2015, pp. 45-49 (in Ukrainian)
19. Slavinska A.: Technological aspect of the multifunctionality of operation of the transformer product, Bulletin of Khmelnytskyi National University 1(269), 2019, pp. 53-62 (in Ukrainian)
20. Baker R., Yu U.-J., Gam H. J., Banning J.: Identifying tween fashion consumers' profile concerning fashion innovativeness, opinion leadership, internet use for apparel shopping, interest in online co-design involvement, and brand commitment, Fashion and Textiles 6(8), 2019, pp. 1-17, DOI: 10.1186/s40691-018-0158-9
21. Guo M., Kuzmichev V.E., Adolphe D.C.: Human-friendly design of virtual system "female body-dress, Autex Research Journal 15(1), 2015, pp.19-29, https://doi.org/10.2478/aut-2014-0033
22. Saharova N.A., Zang N.: Prediction of three-dimensional shape features of female dresses according to the pattern block design, Technology of Textile Industry 346(4), 2013, pp. 92-99 (in Russian)
23. Slavinskaya A.L.: Design-program for identification of structural-technological modules of products in the structure of the technological process, Bulletin of the Khmelnytskyi National University 5(229), 2015, pp. 134-140 (in Ukrainian)
24. Slavinskaya A.L, Ivanova M.A, Kotsyuk O. Yu.: Verification system of clothing model portfolio according to consumer preferences scenario, Proceedings of International Conference of Young Scientists & Students on Resource-Saving Technologies of Apparel, Textile & Food Industry, Khmelnytskyi, October 2019, Khmelnytskyi National University, Khmelnytsky, 2019, pp. 18-19, accessed: 2020-02-27, available from http://tksv.khnu.km.ua/inetconf/2019/slavinska_ivanova_kocjuk.pdf, (in Ukrainian)
25. Watkins L., Aitken R., Thyne M., Robertson K., Borzekowski D.: Environmental influences on pre-schooler's understanding of brand symbolism, Marketing Intelligence & Planning 35(7), 2017, pp. 907-922, https://doi.org/10.1108/MIP-11-2016-0211
26. Zakharkevich O.V., Kuleshova S.G.: Development of the method of scaling patterns and virtual garments forms, Vlakna a textile (Fibres and Textiles) 24(4), 2017, pp. 34-40
27. Mok P.Y., Xu J., Wu Y.Y.: 9 - Fashion design using evolutionary algorithms and fuzzy set theory - a case to realize skirt design customizations, Woodhead Publishing, 2016, pp. 163-197, https://doi.org/10.1016/B978-0-08-100571-2.00009-9