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A Concept for Identifying and Describing Apparel Structure

Abstract

A genuine concept for graphic description of clothing products is presented. This concept is characterised by the dividing an object into so-called functional groups constituting the customary parts of a product which perform its defined partial functions of usability character. Criteria for identifying these functional groups have been established; at the same time, the latter have been divided into three kinds. These are as follows: the hull and its segments (functional groups of the 1st kind), functional groups situated on the edges of the hull segments (functional groups of the 2nd kind), and functional groups situated on the hull surface or other elements of the product structure (functional groups of the 3rd kind). It has been determined that a structural schematic diagram which constitutes a conventional image of the product and identifies the structural groups that contain seams should be the basic tool for describing the structure of a textile product. It has been demonstrated that catalogues of functional groups of clothing play an important role as databases in the design process. Making use of the catalogue creates possibilities for the effective creation of new wholes on the basis of the existing functional parts. In addition, possibilities have been shown for applying the principles of dividing a textile product into functional groups in creating new tools of describing the clothing based on the graph theory. A form of graph expressing how the elements of the product structure belong to functional groups has been proposed, and the possibility of making a graph of the aggregation of these elements has been indicated. The usefulness of graphs for the assessment of a product's structure with respect to its usability qualities and the feasibility to produce it has been elaborated.

Key words: functional group of clothing, structural schematic diagram of clothing, catalogue of functional groups, graph of clothing.

■ Introduction

In the description of objects, an important role is played by the conventional division into parts (units, mechanisms, modules, etc.). This division can be of different character and may be used for various purposes. In machines or machine systems, parts performing definite partial tasks can be identified, e.g. in transportation a steering system, a power unit, etc. In machine systems, it is generally modules that are identified. There is also a need for a division of apparel which constitutes a spatial (3D) textile object containing seams.

Thus, from the structure of a clothing product it is possible to isolate seams constituting the elementary parts of the apparel, which are formed as a result of the deliberate arrangement of the structure elements by manipulation (positioning, bending, stretching, shortening of an element by concentrating the structure, dividing), and then fixing this condition by using thread or glue techniques in one technological cycle.

In some countries, the term *clothing node* as a part of product grouping seams is used. The ability to isolate nodes from the clothing product structure is undoubtedly useful for standardisation purposes which can be used in making apparel, and in adapting clothing machines for

specialised operations as tools in manufacture processes. However, the isolation of the nodes from the clothing product structure proceeds intuitively due to the absence of a precise definition of this concept, whereas the division itself is fragmentary; this leads to the presence of unidentified parts in the product on the level of nodes.

Thus, it appears sensible to develop principles of complete and unequivocal division of a clothing product into components which perform defined partial functions of a usability character, as they can be used in the process of designing clothing products on the basis of graphic documentation of the structure and processing of apparel as devised at the Department of Clothing Technology of the Technical University of Łódź [1]. Furthermore, the ability to divide a clothing product into components according to some established principles will enable us to improve existing tools for describing the structure and manufacturing processes [1] (a schematic diagram of the product, a graph of the product manufacture, a working drawing), while enabling us to introduce new tools into the description and design of apparel, such as a catalogue of functional components, of apparel and the corresponding working drawings, thus rationalising the design process. It will also be possible to prepare a graph determining the correspondence

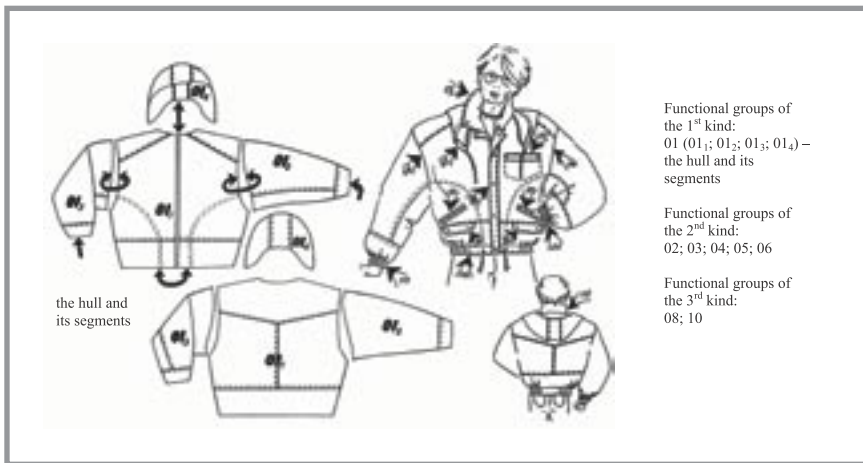


Figure 1. Model drawing of a clothing product with its division into functional groups, and its respective hull.

of components of the product structure to the isolated components which perform the established partial functions.

Functional Group of Clothing. Division of the Product into Functional Groups

It is suggested that the components of a clothing product performing partial functions of a usability character be referred to as functional groups. The concept of a functional group of clothing can be defined in the following way: a functional group of an item of clothing is any component part which comprises the seam, and so fulfils at least an elementary partial role in producing the article of clothing. Thus, the functional qualities of the clothing product constitute a sum of features belonging to the functional groups, while the term partial function on an elementary level of a functional group points to the presence of this group in the product, regardless of design solution. As a result, clothing products can be identified on the basis of the characteristics of the functional groups and their inter-relationships in the product.

It is proposed that three kinds of functional groups be isolated from the clothing product structure (Figure 1):

- **functional groups of the 1st kind:** the hull, i.e. the part without which a clothing product cannot exist, and which first of all performs a screening function. The hull can be divided into segments corresponding to definite segments of the human body (the torso, head, hands, legs). Thus, it is possible to identify one-segment hulls (e.g. a waistcoat, trousers), two-seg-

ment hulls (products without sleeves, but with a hood), three-segment hulls (products with sleeves) and four-segment hulls (products with sleeves and a hood);

- **functional groups of the 2nd kind:** located on the edges of the hull (its segments), ensuring first of all the required service life of the product, and sometimes constituting a suspension of the product;
- **functional groups of the 3rd kind:** located on the hull surface, creating additional functional properties of the clothing product, e.g. pockets, creating the function of a storage space, improving the freedom of movement (slits), facilitating putting on the product (closing).

The set of classical textile products can be divided into three types:

- type A - products suspended from the arms (Figure 1);
- type B - products suspended from the hips;
- type C - a combination of type A and B.

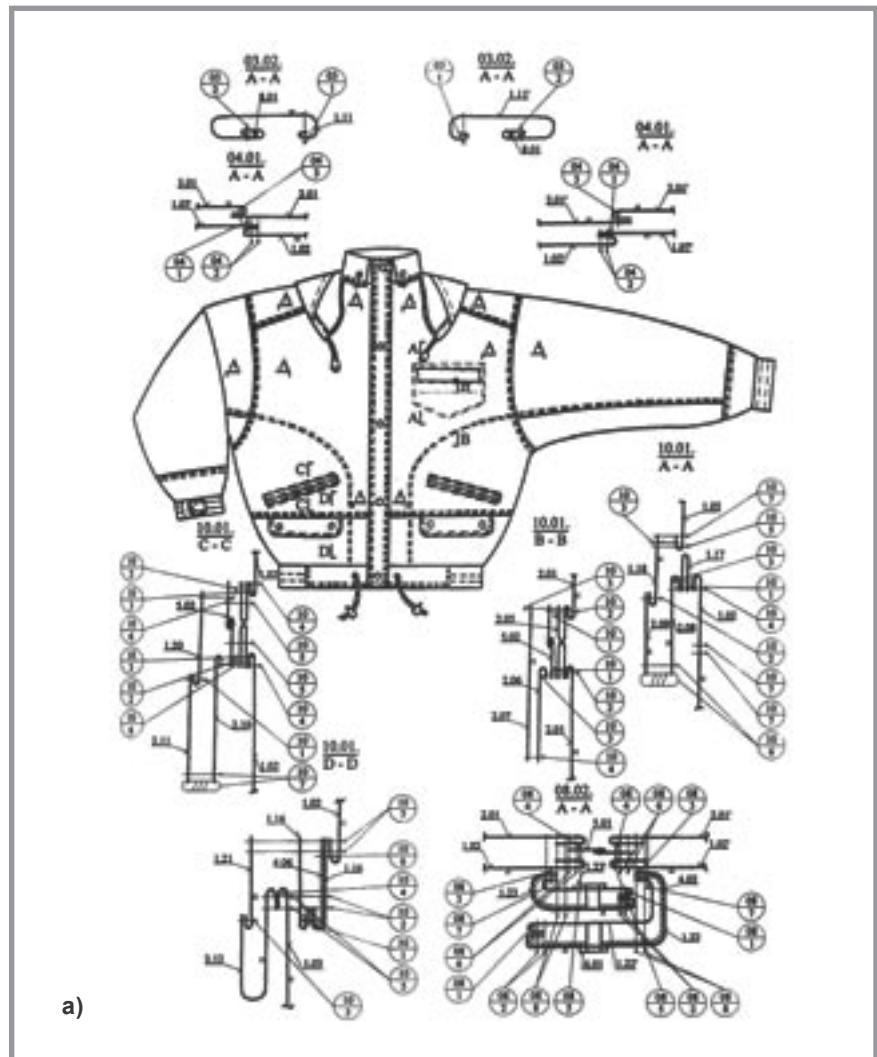


Figure 2. a) Example of structural schematic diagram of a clothing product considering its division into functional groups; front over.

The analysis of these products has led to the identification of the following functional groups:

- **in the set of functional groups of the 2nd kind:** the finishing of the edges of the hull in the area of the neck, the finishing of the edges of the hood, the finishing of the edges of the hull in the area of the arm, the finishing of the lower part of the sleeve, the finishing of the lower part of the product, and the finishing of the upper part of the product (refers to products of types B or C);
- **in the functional groups of the 3rd kind:** closing of the product, slits, pocket.

The consequence of the principles of dividing the clothing product into functional groups is a modified form of the structural schematic diagram of the product. So far [1], the schematic diagram of a clothing product has been

defined as its conventional image, illustrating the joints of the elements of the product structure by means of seams. Now, the definition of the structural schematic diagram of a clothing product can be transformed into the form: a structural schematic diagram of clothing is its conventional image, identifying the structural groups constituting parts of the product, which perform established partial functions of a functional character.

A sample structural schematic diagram of a clothing product (type A - products suspended from the arms) corresponding to the latter definition is shown in Figure 2. The form of the schematic diagram used hitherto [1] has comprised a view and the cross-sections illustrating the structure and connection of the seams, as expressed by means of conventional symbols denoting the following: the type of stitch or a glue binder, the type of transformation

of the seam structure element (bending, the shortening of an element by concentrating the structure, stretching) and its orientation with respect to the path of the binder (thread joint, glue joint). The schematic diagram in Figure 2 is characterised by the limitation of the cross-section to a functional group and marking the seams with respect to their belonging to a functional group. The adoption of such a solution creates conditions for making catalogues of functional groups as databases, which in turn leads to the rationalisation of the design process. The catalogue of functional groups can be supplemented with the sets of technological operations necessary for forming these groups in a clothing product.

Formation of Catalogues of Functional Groups of Clothing

The application of the concept of the block structure to the design of clothing means the presence of common elements in the design clothing products allows catalogues of functional groups to be made on the basis of graphic forms, which can also be treated as sets containing common elements of clothing products. This creates possibilities of forming new wholes basing on the existing parts. This is somewhat reminiscent of the familiar concept of building with LEGO blocks. On the basis of this concept, a series of catalogues of functional groups were made at the Department of Clothing Technology of the Technical University of Łódź. Some of them, such as the 'Shirt' catalogue, were saved in the Access 2000 computer program. The structure of the catalogue takes into account the division of functional groups according to class, subclass, design solution, variant of design solution, and the structure of patterns, and is based on the following general assumptions:

- the clothing product is characterised by divisibility into functional groups, but the division is not identical with the lines of joints of the product's structure elements;
- the elementary partial function of the product is the basis for identifying a functional group;
- the structure of the catalogue and the manner of encoding of the functional group creates possibilities of introducing new solutions without having to

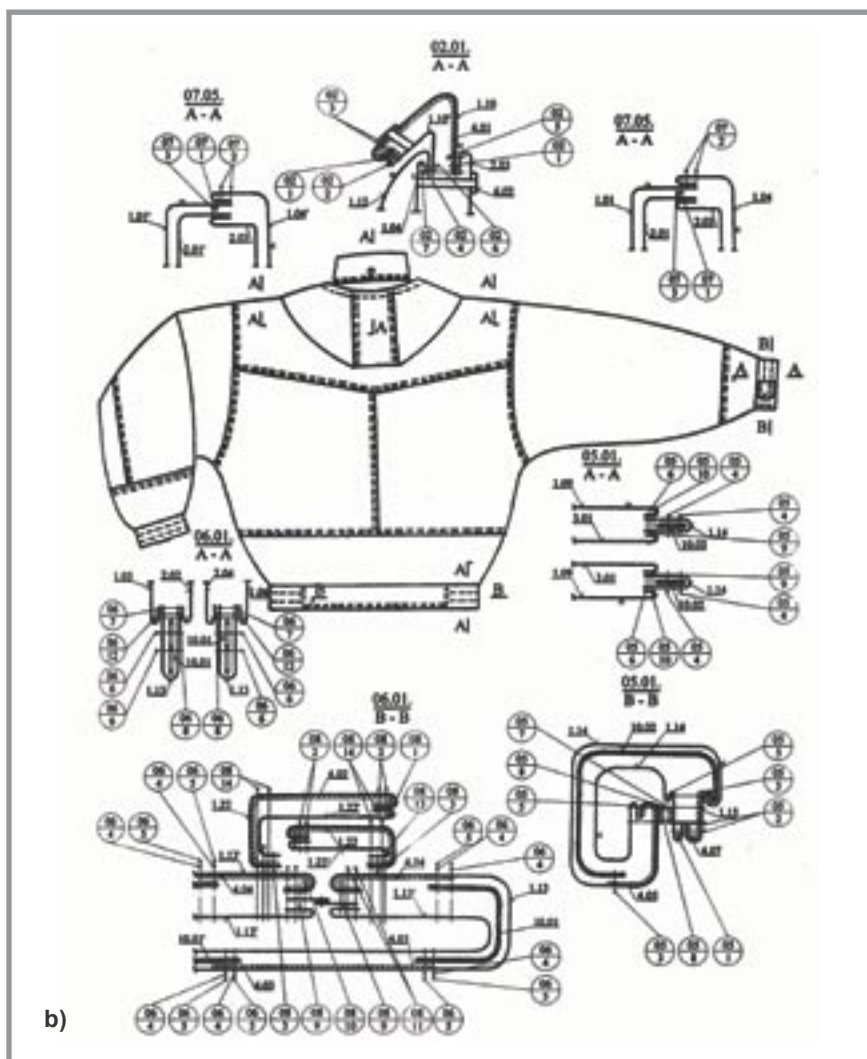


Figure 2. b) Example of structural schematic diagram of a clothing product considering its division into functional groups; back over.

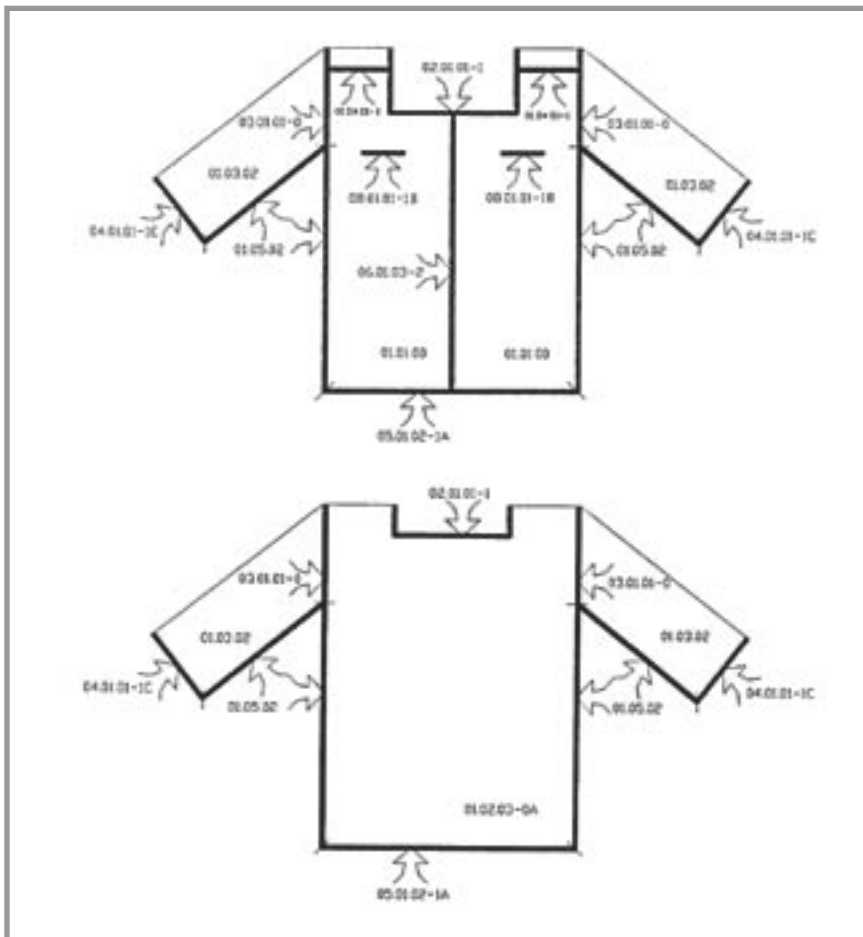


Figure 3. Example of a catalogue schematic diagram of a clothing product (shirt) based on a model drawing and a catalogue of functional groups.

re-build the catalogue (open character of the catalogue).

Figure 3 illustrates a so-called catalogue schematic diagram of a clothing product based on a model drawing and a cata-

logue of functional groups. It constitutes a simplified (geometric) form of the view of the product, taking into consideration the topography of the functional groups and the corresponding codes taken from the catalogue. A sample computer print-

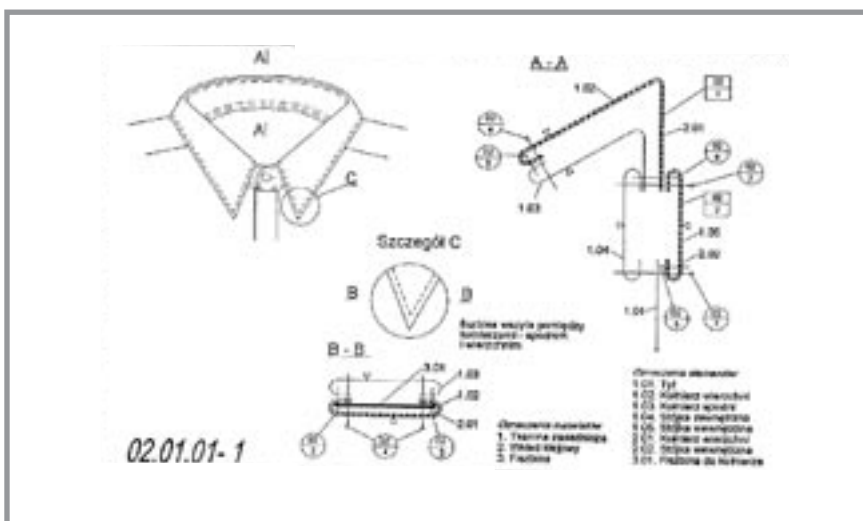


Figure 4. Example of a schematic diagram of a functional group (computer print-out from the 'Shirt' catalogue published in Polish). 1, 2, 3 - material components of collar; 1.01 - 1.05, 2.01, 2.02, 3.01 - elements of collar.

out of a functional group is shown in Figure 4. The drawing contains the view of a functional group, the required cross-sections illustrating the structure and connection of the seams, the symbols denoting elements of the seams' structure, and the correspondence of the seams to the functional group. Figures 3 and 4 refer to the assortment of shirts in which the following functional groups were identified: 01 - the hull of the product, 02 - the finishing of the edges of the hull in the area of the neck, 03 - the finishing of the edges of the hull segments in the area of the arm, 04 - the finishing of the lower part of the sleeve as a segment of the hull, 05 - the finishing of the lower part of the main segment of the hull, 06 - the closing of the product, 07 - the slit, 08 - the pocket. The digital codes used above correspond to the division of the functional groups into classes, and constitute the first part of the digital code in Figure 3.

Graphs in the Description of the Clothing Structure

Graphs play a significant role in the description of the structure of objects and the corresponding manufacturing processes. A simple consequence of the adopted division of a clothing product into functional groups is a graph of the correspondence of the product structure elements to functional groups. The proposed form of the graph, illustrated in Figure 5, makes it possible to identify elements typical of graphs, i.e. nodes, arcs and loops. The nodes symbolise the presence of functional groups, including the division into the hull which distinguishes its segments, the functional groups situated on the edges of the hull and the functional groups localised on its surface. The arcs, illustrating common elements of the functional groups (patterns and other elements of the product structure), point to the correspondence of these elements to the functional groups, as well as to the order in which the functional groups are joined to the main segment of the hull. The loops illustrate specific elements of the clothing product's structure. These are referred to as autonomous elements, which belong solely to one functional group.

The analysis of the graph of the product structure elements' correspondence to functional groups allows properties of the product to be revealed which are important from the point of view of

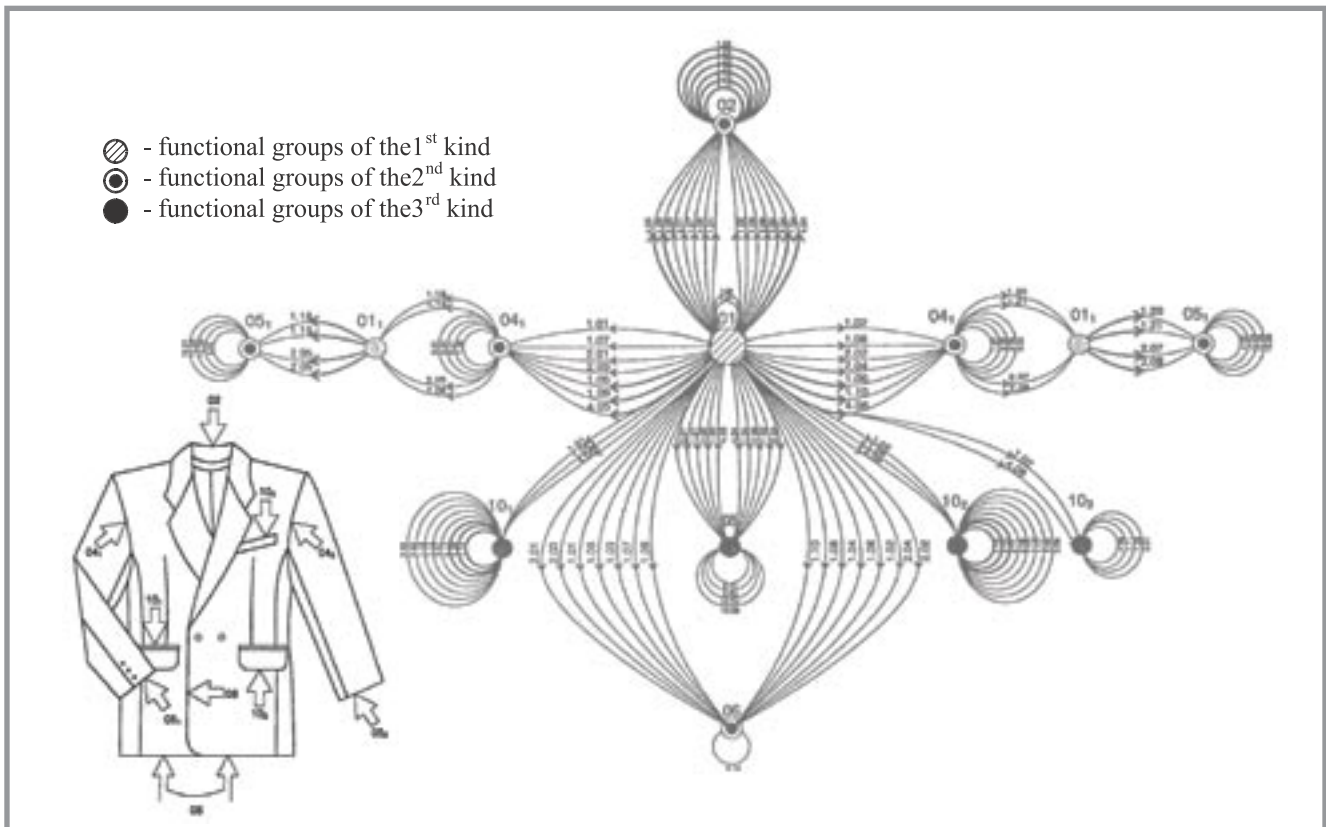


Figure 5. Example of a graph of the correspondance of the product structure elements to functional groups.

perceiving functional qualities as well as manufacturing processes, especially in industrial conditions.

Another interesting form of clothing graph is a graph of *aggregation of a product*, that highlights the required multi-stage character of manufacturing processes resulting from the possibility of combining the product structure elements into elementary groups called seams. Aggregation takes place if at least one element of the product structure is joined to another element or a group of elements for the first time, while the degree of aggregation is determined by the greatest multiplicity of participation of the element in the aggregation process. In the graph aggregation of a product, its parts corresponding to functional groups can be identified. This makes it possible to analyse the product with respect to the cohesion of these parts of the graph, which is of great importance for manufacturing processes.

Finally, the graph of aggregation of a product can be developed into the form of a graph of production, in which all the technological operations required would be included. The graph thus formed satisfies the conditions of the limiting graph,

which enables the so-called critical path to be determined and assessed.

Conclusions

- The key role in describing the clothing structure, particularly on the basis of graphic forms, is played by dividing a clothing product into so-called functional groups which constitute the conventional components of the product, performing definite partial functions of functional character.
- The principles of identifying the functional groups of a clothing product which are adopted make it possible to divide them into three kinds:
 - functional groups of the 1st kind - the hull and its segments;
 - functional groups of the 2nd kind - located on the edges of the hull (and its segments);
 - functional groups of the 3rd kind - located on the hull surface or other elements of the product structure.
- A structural schematic diagram, that is, a conventional image of the product identifying functional groups containing seams, is the basic tool for describing the clothing product's structure.

- An important role in the clothing design process is played by catalogues of functional groups, since they create possibilities of efficiently creating new wholes on the basis of the existing (known) parts.
- The following are interesting tools for describing the clothing structure: a graph of the product structure elements' correspondence to functional groups, and a graph of aggregation of the product structure elements. The forms of graphs which we have adopted create possibilities of revealing properties of the product which are important from the point of view of functional qualities and the making-up process.

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