Journal of Positive School Psychology http://journalppw.com
2022, Vol. 6, No. 6, 5884-5888

CREATION OF ELASTIC KNITTED FABRICS WITH SHAPE RESISTANCE INDICATORS

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Annotation. A method of end-to-end design and manufacture of knitted products is proposed, which allows obtaining one-piece knitted products from elastic knitted fabric with different stretching zones corresponding to the location of certain structural sections in the finished product.
Keywords. Form stability, knitwear, Lycra, fabric, deformation, construction, life cycle, volume, products, yarn.

Introduction. Form stability is a complex indicator reflecting the operational and technological properties of knitted fabrics. This property is necessary not only as a characteristic of knitwear, but also as the main factor of knitted fabrics intended for the production of elastic garments.

The relevance of research. In this regard, the study of the technology of knitting shape-stable knitted fabric is an important and urgent scientific and technical problem in the production of knitwear.

During operation, knitted fabrics have a very low dimensional stability, this is a consequence of deformations that occur during wear. It is for this reason that it is very important not only to create, but also to firmly fix the resulting volumetric shapes of products. And this can be achieved using various methods, which are grouped taking into account all stages of the life cycle of the production of knitted garments.

Object and subject of research. It is possible to increase dimensional stability mainly during the manufacture of knitwear, as well as during the finishing process by adding Lycra to the threads. This allows knitted fabrics to improve wear and create an elastic effect.

If they are significant, they usually lead to changes in the shape and size of individual parts, and it is necessary to introduce additional units into the structure to increase its rigidity. For the dimensional stability of the knitted fabric, it is advisable to finish it, however, not on all surfaces of the parts, but locally, taking into account the distribution of deformations during the wear of the product.

In addition, it should be noted that stable fixing of deformations of knitted fabrics, due to which the volumetric shapes of products are actually preserved, is possible when fixing changes in the structure of threads, fibers or the fabric as a whole.

The use of lycra yarn in knitwear production expands the possibility of developing new types of knitted fabrics with elastic properties. Products made from them will meet the requirements of dimensional stability, stimulate the development of various types of functional clothing for everyday use, for sports, medicine and outdoor activities.

A method of end-to-end design and manufacture of knitted products is proposed, which allows obtaining one-piece knitted products from elastic knitted fabric with various stretching zones of the fabric, corresponding to the location of certain structural sections in the finished product. The resulting fabrics differ from traditional knitwear in a qualitatively new fabric texture, increased elasticity, a kind of bulk and relief of the pattern [1].

The desired shape of a one-piece knitted product is achieved not due to traditional design methods (darts, reliefs, additional divisions, etc.), but by alternating zones of different extensibility. In this case, the shape of the product is determined by the design of allowances of various sizes for free fitting in certain areas of the structure. In the places of the most stable fit of the product to the human body, negative increases of a large value are provided, but the properties of the material must be taken into account [1].

Research results. Based on the results of the analysis of the literature, studying the experience of design and production of knitted products, as well as using the mathematical apparatus of systems theory, a generalized structural model of the processes of end-to-end design and production of knitted products

within the product life cycle (LC) has been developed (Fig. 1).

The model of end-to-end design, in contrast to traditional methods, provides for the production of a knitted product with a different stretch zone and surface density. In this case, the life cycle is considered as a system, and its structural elements are stages as subsystems that characterize the process from the moment the needs for a given product are identified, until these needs are met and the product is disposed of, which corresponds to generally accepted ideas about the life cycle of an object [1].

From the point of view of the systematic approach, the life cycle is a system that is a set A:

A = {ai}; i = ¯1,8, where ai - life cycle stages.

Moreover, in accordance with Fig. 1: a1 - pre-design stage, a2 - sketch design stage, a3 - preparation stage of mixed yarn and threads, a4 - stage of obtaining mixed elastic fabric, a5 - finishing stage of mixed fabric, a6 - design and technological preparation stage for model production, a7 - production stage, a8 - post-production stage. In turn, each of the stages of the life cycle also represents a set of organizational and technological stages:

$a_i = \{a_{i,j,}\}$; $j_1 = 3$, $j_2 = 4$, $j_3 = 2$, $j_4 = 3$, $j_5 = 3$, $j_6 = 9$, $j_7 = 3$, $j_8 = 5$.

where ai, j are the life cycle stages related to the i-th stage (see Fig. 1).

Moreover, as a system, the end-to-end design model includes not only the stages of pre-project research, but also all other stages of the life cycle in terms of the information component that ensures their interaction. This is due to the fact that the input information for the preparatory stage is formed within other subsystems, and the information that is output in relation to this subsystem becomes input for them. This statement can be presented as follows:

$$a_2 \supset \{a_{2,j}, a_1, a_3, a_4, a_5, a_6, a_7, a_8\}$$

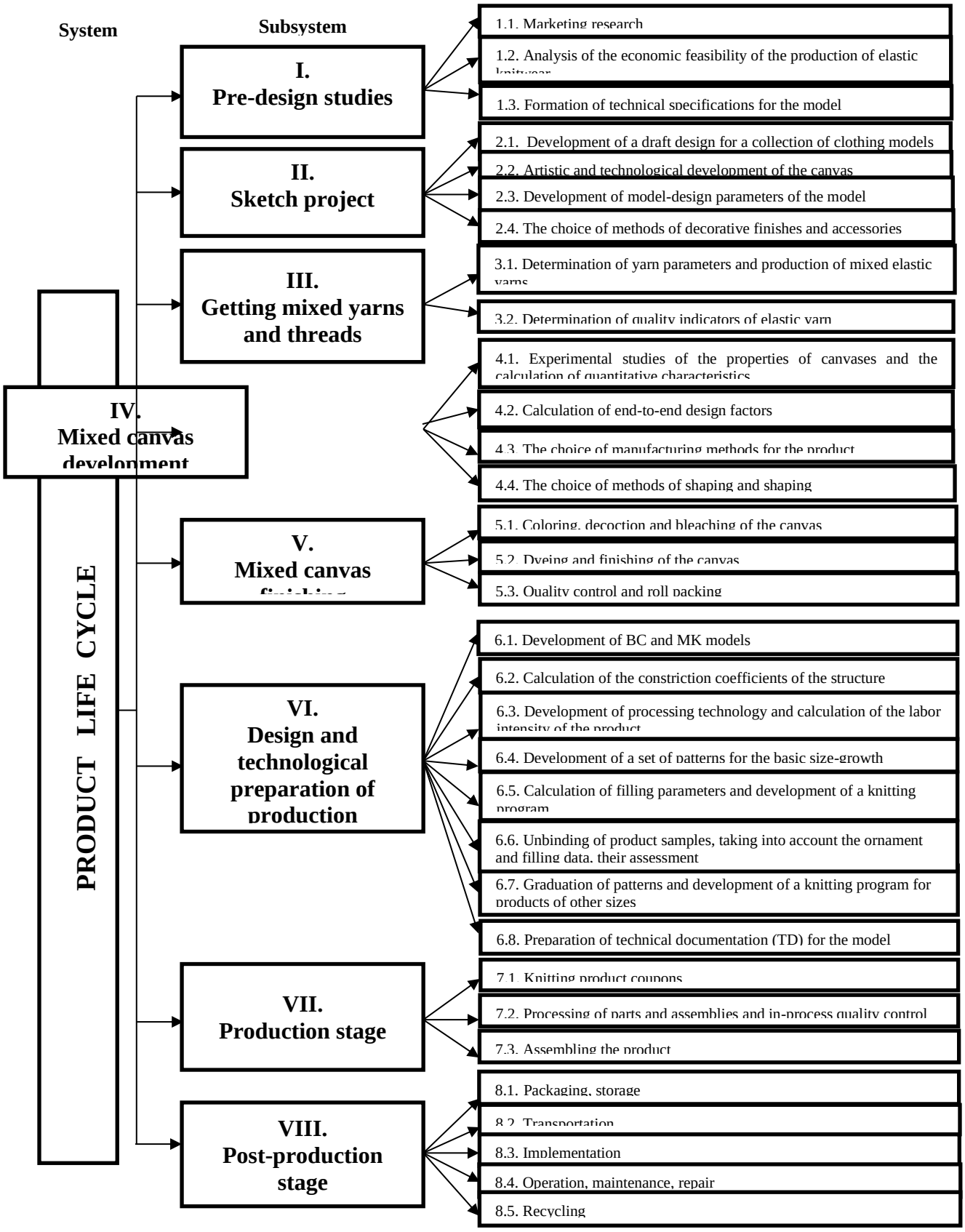

Fig. 1. Generalized model of end-to-end design and production of knitwear

Below is the content of the stages of the process of end-to-end design of knitwear

[2,3,4]. The pre-design stage includes marketing and pre-design studies, at the entrance of which are located such objects as consumers, interests and capabilities of the enterprise, as well as information objects [1].

The design project of a functional jersey is a creative process that includes the development of sketches of models, model-constructive parameters, methods of decorative finishing and accessories, as well as artistic and technological development of samples of canvases, taking into account ornament, weaving and all filling characteristics.

The life cycle of knitted products also includes the stages of designing the parameters of blended yarns (third) and fabrics (fourth), which determine the quality indicators of the future product [5,6,7].

From the point of view of the end-to-end design of knitwear and technological processes for their manufacture, the stage of pre-design studies, draft (design) project, preparation and production of blended yarns and threads, knitting of fabric samples, design and technological preparation can be combined to the preparatory stage of model production. The purpose of the preparatory stages is the development of technical documentation necessary for the introduction of products into production. The informational component of these stages is very high and important from the point of view of decision support in the production process.

The production stage includes the process of knitting coupons, processing parts and assemblies, as well as the actual manufacture of the product, when the object of transformation is the canvas. In accordance with the principle of feedback, the life cycle of knitwear ends with the stage of operation of sportswear made of highly elastic materials [8,9,10]. At the same time, we study the results of experimental wear in various conditions (at competitions, training, outdoors in different weather) and develop recommendations for the care of the product. The latter is due to the particularly important value of experienced socks for increasing the durability and reliability of a sports product due to the influence of factors of intense physical activity of an athlete (heat generated, sweat, active movements performed) and the external environment (air temperature, humidity, wind, precipitation, sunlight, etc.) on the indicators of comfort [1].

Discussion of results and conclusions. The developed structural model of the life cycle of knitted fabrics allows you to analyze the content of its stages. However, in order to conduct a complete analysis of the information-logical interaction of processes within the framework of the functioning of the life cycle system as a whole, it is necessary to develop the structure and content of all stages as a subsystem of the life cycle, defining the types and essence of the work performed, the volume, content of input and output information, and also to establish paths and directions of movement information between design and production operations. Thus, it is necessary to develop a conceptual model of information interaction between design and production and preparatory processes, which is a rational sequence (execution route) of the stages of end-to-end design of knitted fabrics set in the form of an algorithm [1].

Depending on the purpose of the knitted fabric and the conditions of its operation, indicators are selected to characterize its structure and life cycle [11].

A flexible structure of the processes of end-to-end design and manufacture of knitted products, universal for all types of assortment of outer knitwear, produced on flat knitting equipment, is proposed. New design procedures, criteria for choosing design solutions, the composition of the initial information used, which determine the rationality and novelty of the created model of the process of end-to-end development of knitwear, have been introduced. Based on the principles of a systematic approach, the process of end-to-end design of products from knitted fabrics is formalized. Using the mathematical apparatus of systems theory, the objective functions of the end-to-end design system as a whole and its main operations are described.

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