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**THE USE OF GRAPHIC LIBRARIES TO DIVERSIFY THE ASSORTMENT OF
FUNCTIONAL CLOTHING**

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Abstract: Currently, worldwide, there is a significant increase in the use of computer systems and various information technologies, both in the production system and in education. The use of information technologies leads to an increase in work and productivity efficiency, in a short period of time. The paper, presents a method of diversifying clothing product models, using graphic libraries, created by using Corel Draw software, which can be used as a teaching tool in education, for the course "Computer aided design", as well as within the discipline "Designing series and model systems". The presented concept is structured and as e-learning educational materials, in order to improve the acquisition of the methodology for developing new models of clothing products. The method presented in the paper is based on an advanced study, theoretical and practical, of developing new models for designing clothing products in series and industrial systems. The method is based on the requirements imposed by the wearers. Also, this method may be introduced in the initial stage of creating new models, both within companies and in specialized institutions. The graphic library allows the use, modification and completion with new constructive-functional elements. As a further direction of development, it is proposed to complete the graphic library with functional-constructive elements that would allow obtaining new product model systems. Also here can be created 2D sketches, known as a technical drawing, which is an essential element of the garment. This method is suitable for any person working in the field of clothing design. She allows reducing the time for designing and manufacturing product series, reducing of costs for materials and work and increasing of flexibility and adaptability capacity of the design and manufacturing system, to changes in product requirements.

Keywords: model system, module, software, e-learning, educational materials, product sketch

INTRODUCTION

In the current economic conditions, one of the vital problems for garment companies is the development and diversification of the clothing models assortment. Diversification must be done in conditions of quality assurance, optimization of production costs and efficient use of technical means.

Compared to the design sectors in other branches of industry in which the number of models created annually reaches the orders of tens, throughout the garment industry, the design sectors solve hundreds and even thousands of models annually [1, 2, 3].

Also, the educational institutions, which train specialists for the fashion field, require the permanent creation of a new product model, which should correspond to the requirements of the wearers.

A possible solution to these problems, optimal in terms of advantages, is the widespread use of the principles of design of industrial systems of clothing product models combined with information technologies.

This allows the diversification of new models of clothing products, in accordance with fashion trends, individual or group requirements of potential consumers, imposed on a certain range, destination and size, taking into account the technological possibilities.

This paper presents an e-learning tutorial on how to use the functions and tools of Corel Draw software to develop and diversify clothing product models using information technologies. Using the steps explained, the student will be able to create original collections in the course "Computer aided design" as well as within the discipline "Design of series and model systems", study program "0723.1 Technology and design of garments".

The paper is designed as a teaching tool for students and provides the transition to online education. The methodology of using the presented tools, aims to make the product sketches and the necessary collection within the disciplines. It can be accessed on the university's moodle platform (<http://moodle.utm.md/course/view.php?id=141>).

I. THEORETICAL ASPECTS

Within the modular design principle, the constructive module is considered as an elementary structure. The constructive mode is a sector of the standardized construction which is characterized by a functional and informational interdependence and which is unified by the design principle [1,2, 5, 6].

The use of the principles of modular design of clothing products involves the development of final products from a number of unified components, while respecting the correspondence between them, in terms of functional, constructive and aesthetic parameters. The modulation ensures the possibility of structuring a product from a small number of standardized elements, which possess totally or partially, similar geometric and functional characteristics, elaborated in stages (figure 1).



Figure 1. The levels of the process of clothing diversification

Modularized design is based on the elementary structural unit - the constructive module - with the following definition: "standardized element of independent functional and informational construction that is unified according to the principle of realization". The module as an element of the construction is characterized by the following characteristics:

- *autonomy*: the geometric characteristics of the module can be modified independently of the change of the characteristics of the other elements with the observance of the combination conditions;
- *complex hierarchical structure*;
- *the field of use* depending on the structural complexity: a construction can be divided into a limited number of lower order construction modules, and a complex structure of the module determines a lower possibility of application.

The use of the principles of modularization in the design process of clothing products leads to increasing the degree of constructive and technological homogeneity of products, with a positive impact on raising the efficiency of the design process and increasing labor productivity.

II. APPLICATION OF MODULAR DESIGN TO THE DEVELOPMENT OF A SERIES OF NEW MODELS OF PRODUCTS INTENDED FOR PEOPLE WITH LOWER LIMB AMPUTEES

The method of designing series of clothing models by applying modular design becomes effective if a number of requirements are met [1, 7]:

- 1) The series of models of the same type must include 8-10 models;
- 2) The constructive-decorative elements, the variants of the basic landmarks and the additional ones must be stable for a wide range of models.

Initially, the types of modules for the chosen assortment are identified. Then the initial assembly units are identified - product body, sleeve, collar, waistband; which is presented on the flat image. The third stage consists in identifying the fragments of the derived assembly units - which present the information about the processing elements of the closing systems, of the parts terminations, of the pockets, as well as for the design of the basic parts variants. All the elaborated fragments are coded, and by overlapping the fragments of the technical drawings on the technical drawing of the basic assembly unit, the technical drawing of the new model is formed.

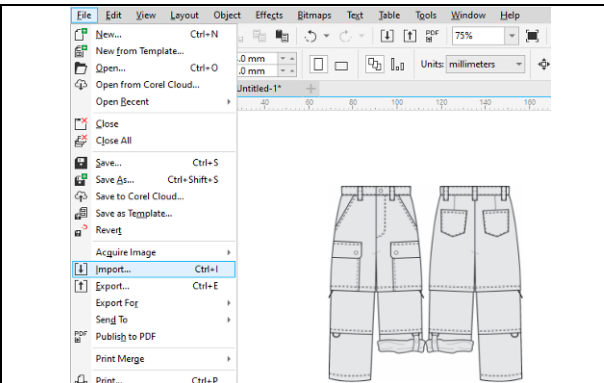
The first stage of work involved establishing the initial data: product range, initial assembly units and derived assembly units (Table 1).

Table 1. Establishment of the initial data needed to develop the series of models for people with lower limb amputations

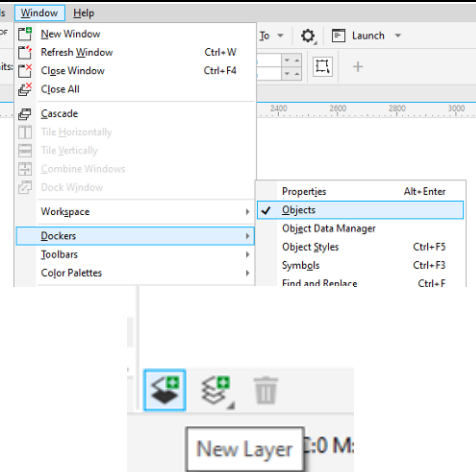
Selection criteria	Elements
Assortment	Pants for people with lower limb amputation
Initial assembly units	Product body Waistband
Derived assembly units	Product length Main locking system Functionally constructive divisions Auxiliary locking system Pockets placed on the front Pockets placed on the back Detachable elements Folds, tweezers ETC.

Two elements were established as initial assembly units: the product body and the product belt. The steps of elaborating the elements are presented to the students in electronic format. Table 2 shows the sequence of elaboration of the product body.

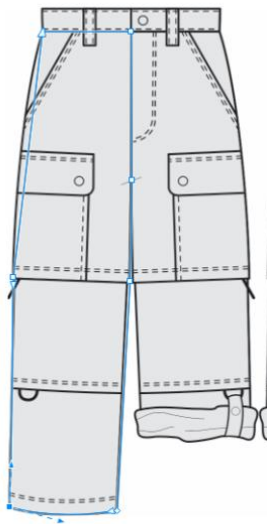
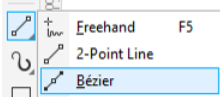
Table 2. The sequence of elaboration of the product body

Execution steps	
1. The launch of the Corel Draw application	
2. Identification and import of the standard template, used as a basis for taking over the proportions: File → Import	

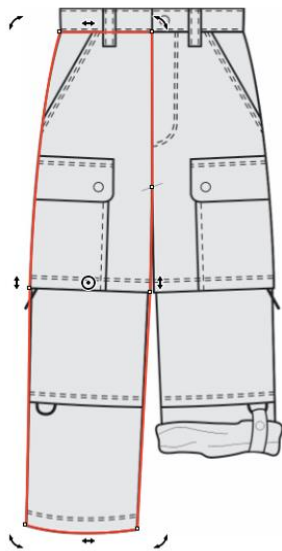
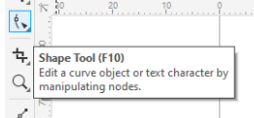
2. Creating an additional layer for the first element – product body: **Window** → **Dockers** → **Object** → **New Layer**



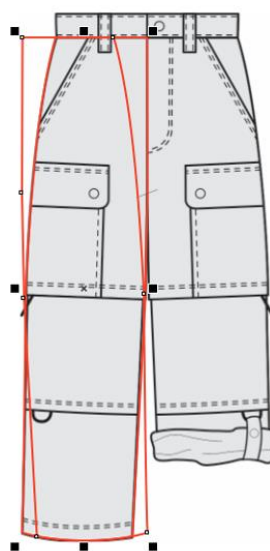
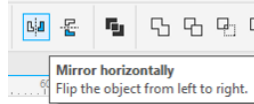
3. Drawing the element (**Bezier**)



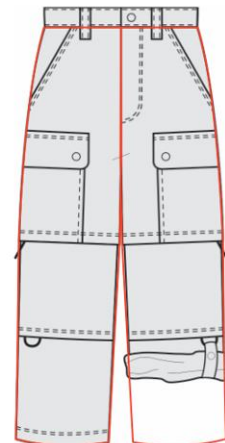
4. Editing (**Shape Tool**)



5. Copy (**Ctrl+C** and **CTRL+V**) and mirror (**Mirror horizontally**)



6. Arranging (**Pick Tool**) and grouping into a product (**Grup**)



7. Locate and encode the item and save the document **File** → **Save** sau **Save As**

The product body has 3 silhouettes: straight, semi-adjusted and adjusted silhouette (figure 2).

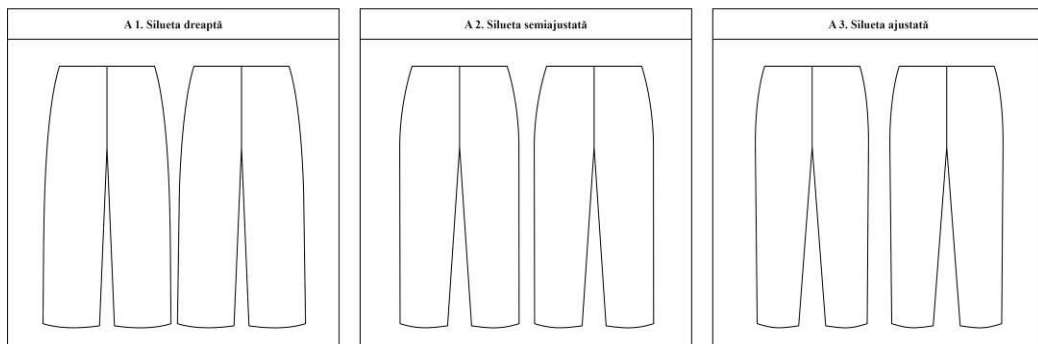


Figure 2. Initial assembly unit - product body

The trousers product belt is a functional-constructive element, which can also present decorative elements. The following sketches were developed to diversify the model system (figure 3).

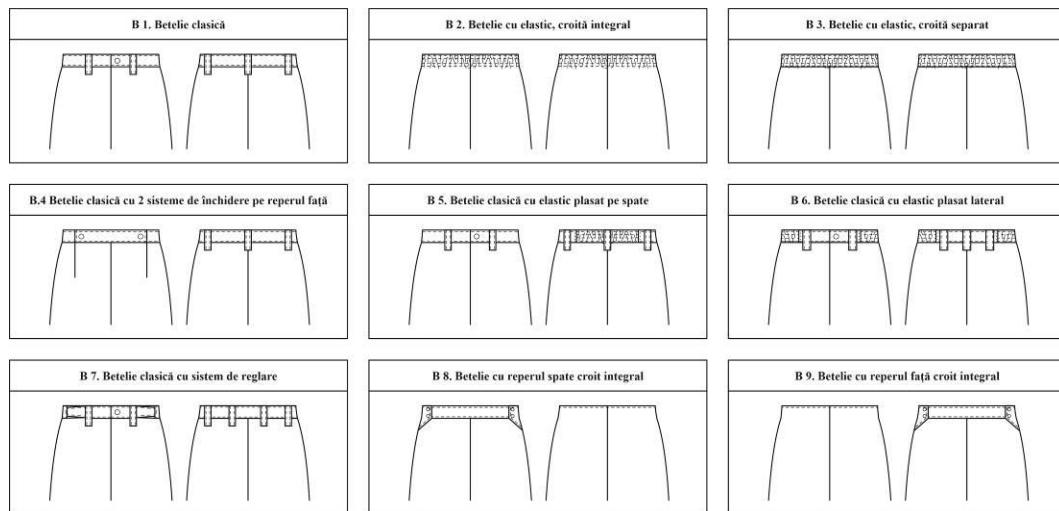


Figure 3. Initial assembly unit - waistband

These two units form the main contour of the product sketch, on which the derived assembly units will be placed.

Derivative assembly units have been highly developed taking into account the needs of the wearer and fashion trends. Their graphical representation can be seen in table 3.

Table 3. Derived assembly units

Name and graphic representation of the assembly element	
1	2
Product length	<div style="display: flex; justify-content: space-between;"> <div style="width: 22%;"> <p>C 1. Lungimea produsului la nivelul punctului catranian</p> </div> <div style="width: 22%;"> <p>C 2. Lungimea produsului la nivelul liniei de mijloc a gambii</p> </div> <div style="width: 22%;"> <p>C 3. Lungimea produsului la nivelul liniei genunchilor</p> </div> <div style="width: 22%;"> <p>C 4. Lungimea produsului la nivelul liniei de mijloc a soldurilor</p> </div> </div>
Main locking system	<div style="display: flex; justify-content: space-between;"> <div style="width: 22%;"> <p>D 1. Sistem de închidere plasat în linia de simetrie a feței</p> </div> <div style="width: 22%;"> <p>D 2. Sistem de închidere plasat în cusătura laterală</p> </div> <div style="width: 22%;"> <p>D 3. Sistem de închidere plasat în linia de simetrie a spatelui</p> </div> <div style="width: 22%;"> <p>D 4. Sistem de închidere plasat pe reperul față</p> </div> </div>
Functionally constructive divisions	<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"> <p>E 1. Divizare orizontală</p> </div> <div style="width: 30%;"> <p>E 2. Divizare verticală</p> </div> <div style="width: 30%;"> <p>E 5. Divizare de formă complexă</p> </div> </div>

Auxiliary locking system					
Pockets placed on the front					
Pockets placed on the back					
Detachable elements					
Superimposed and sewn materials, folds, creases					

Using this method, with the help of information technologies, a graphic library of functional-constructive elements was developed, in accordance with the needs of people with lower limb amputations (Figure 4).

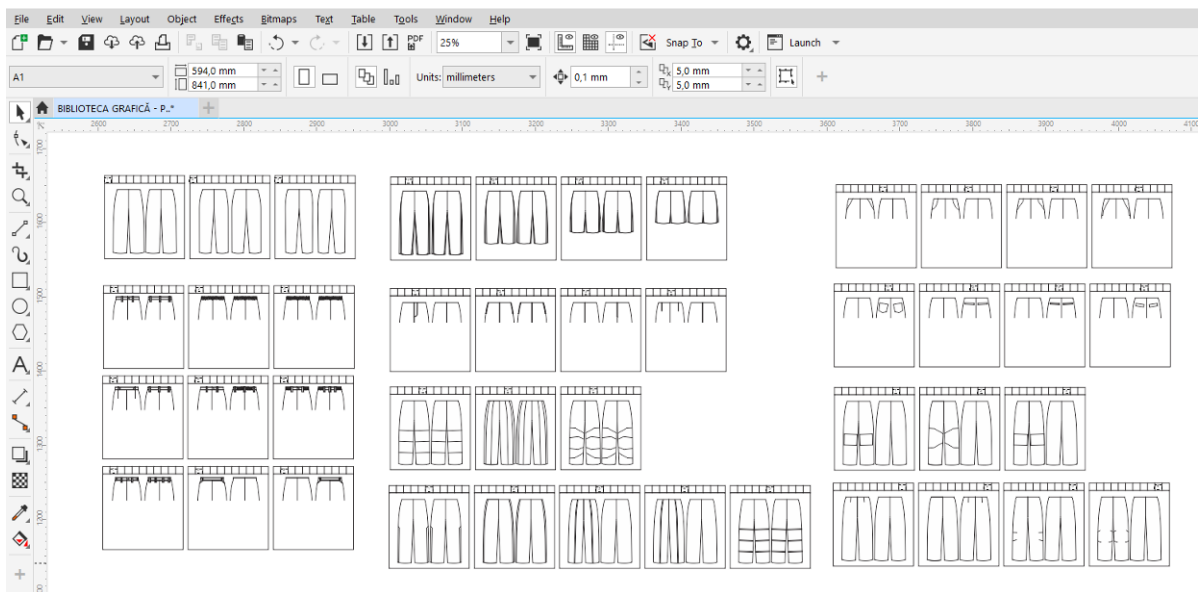


Figure 4. Graphic library of functional-constructive elements

The formation of models by aggregating the necessary elements allows in a short period of time to obtain the sketch of the product pants, for women or men, who have various locomotor disabilities. Each model has a sketch and an identification code.

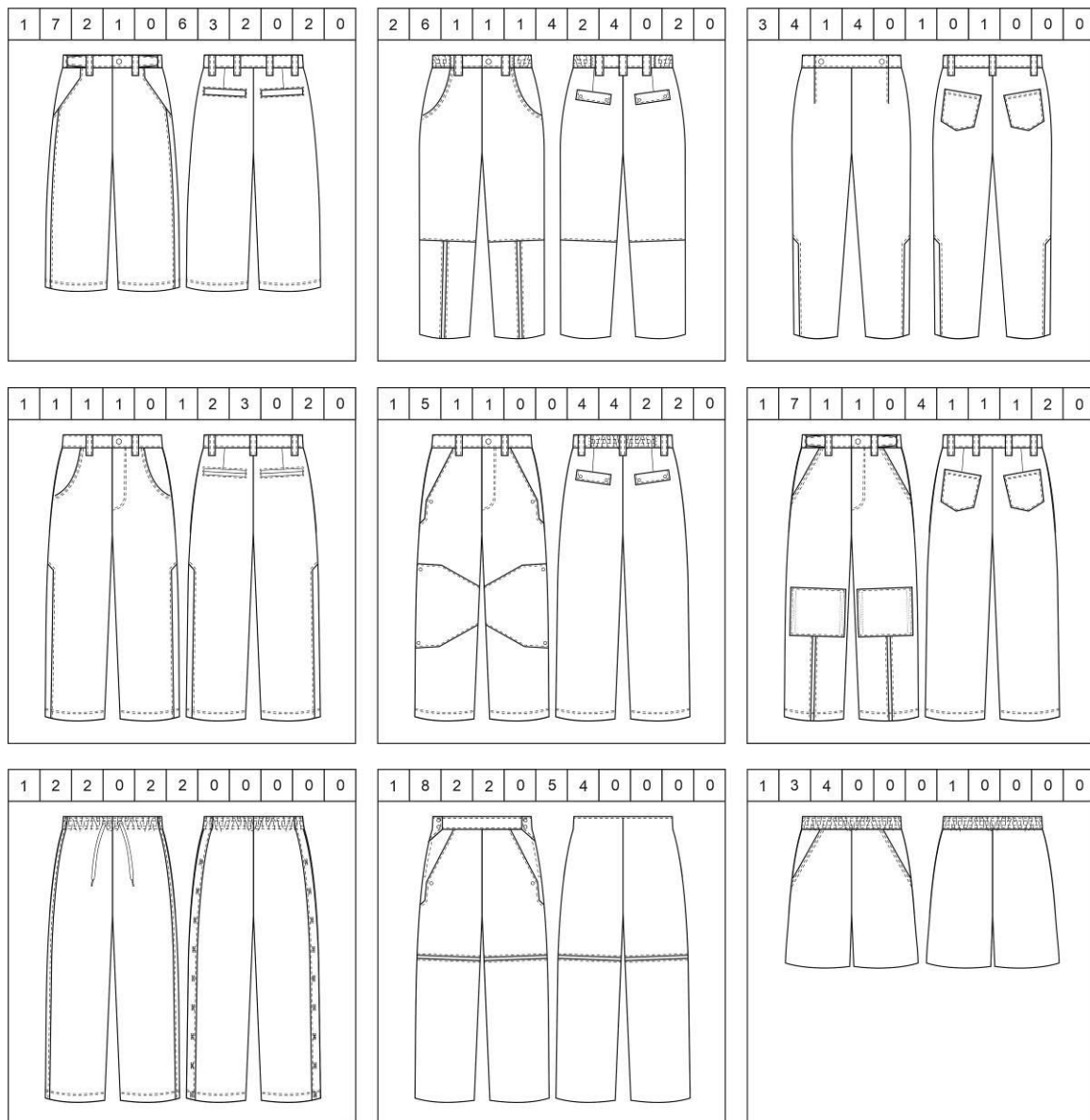


Figure 5. System models developed by modular design

Figure 5 shows the sketches of 9 product models, formed by overlapping assembly units. The first 3 product sketches are intended for people with leg amputations. They feature various types of closure systems that provide access to the prosthesis and abutment.

The following 3 sketches are intended for people with knee amputations. Detachable and semi-detachable elements at the knee line are expected here, which offers convenience in the operation process. Closure systems placed in the side line with a length longer than the location of the prosthesis allow access to the prosthesis.

The last 3 sketches are intended for people with hip amputations. The models feature locking systems along the entire side length of the product, which allows the product to be worn / undressed without removing the prosthesis / footwear. The length of the product up to the middle of the midline of the hips, allows trouble-free access to the prosthesis / abutment. Horizontal splits allow the pants to be transformed into shorts.

III. CONCLUSIONS

In present, the information technology is an indispensable part of life, appearing as a necessity both in the production process and in the process of training and didactic research.

Also, the pandemic triggered in March 2020 requires multiple changes in the study process by implementing the online or mixed study system. This has led to the need to use E-learning because it allows distance learning, flexibility of learning hours, accessibility to educational resources, etc.

The creation of graphic libraries by applying the principles of modularized design with the help of information technologies allows:

- reducing the time for designing and manufacturing product series;
- reducing of costs for materials and work
- increasing of flexibility and adaptability capacity of the design and manufacturing system, to changes in product requirements.

As another direction for the development of this work it is proposed to develop a design software application.

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