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ELECTRONIC CUTTING PLAN FOR GARMENT INDUSTRY

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Abstract: *Textile industry is widely spread worldwide, with important numbers in products volume and number of employees. It is, also, an important consumer in terms of energy, water and raw materials and an important generator of waste. Thus, this industry is not sustainable. A key element in making textile industry a sustainable one is adoption of Industry 4.0 components, among which digitization is a powerful tool. Digitization, which is far from being accomplished, means electronic documents, software implementation in design, manufacturing and distribution. There is a wide space for innovation in the creation of industry-specific databases and software applications. The paper proposes an electronic document, part of a more comprising library, created as order for the cutting department of a garment company. The purpose of the electronic document is to replace paper-based documents and to provide data resulted from automated calculus. The document is designed as a MS Excel spreadsheet, which displays data input by the user and results of different calculations, proving all information needed to cut the fabric in an accurate and efficient manner. The spreadsheet is designed as a template suited for most applications, (it takes into account the usual sizes 32…54) and contains calculation forms for six main markers and five supplementary markers.*

Key words: *electronic documents, textile industry, cutting plan, MS Excel application.*

1. INTRODUCTION

Textile industry is important worldwide, in terms of products volume and number of employees. In Europe, for instance, according to the 2023 European Commission report, based on data provided by EURATEX (The European Apparel and Textile Confederation), [1], the textile sector in the Union recorded a turnover of €147 billion in the previous year, with exports of €58 billion and imports of €106 billion. Production is carried out overwhelmingly in small and medium-sized enterprises (143,000 companies, representing 99.8% of producers), with approximately 1.3 million employees.

Despite the flourishing nature of this industry, especially after the implementation of the fast-fashion model in the 1980s, it is not a sustainable industry, due to the large amount of waste it generates and the high consumption of energy and water.

An important path to sustainability is to introduce Industry 4.0 components, as much as possible, into all stages of production. The most effective component is digitization.

Making a clothing product involves going through several stages, illustrated synthetically in Figure 1.

Digitization allows the replacement of paper-based documents and use of software tools in design of models and patterns. The key documents and software tools are:

- ❒ Synthetic product sheet (fabric type and auxiliary materials, manufacturing instructions, costs and sourcing)
- ❒ Digital design and arrangement of patterns
- ❒ 3D Prototypes and Digital twins
- ❒ Electronic Data Interchange (EDI) - used for automated information exchange between retail partners, suppliers, and manufacturers (electronic purchase orders, invoices, and shipping notices)
- ❒ Digital Product Passport [2, 3].

Fig. 1: *Stages in the process of clothing making*

Digitization has started to work especially in small companies [4], which use subcontractors for different digital tasks.

Digitization enables a sustainable and efficient transformation in the textile industry, improving production processes, minimizing environmental impact, and enhancing supply chain transparency [5], mainly through the adoption of Industry 4.0 technologies.

In Romania, the digital work is mostly represented by CAD generation of patterns [6, 7], performed by means of software applications such as Gemini CAD.

There is a wide space for innovation in the creation of industry-specific databases and software applications. The present paper describes a worksheet created to control the cutting of patterns.

2. CUTTING SHEET – MS EXCEL APPLICATION

At the end of stage 2 (Fig. 1), the fabric is purchased and the markers are generated. The product is going to start being manufactured. The first operation is the cutting of patterns. The order for the cutting department is designed as a spreadsheet, containing all information needed to perform the operation in the most efficient way.

The spreadsheet is designed as a template suited for most applications, (i.e. it takes into account the usual sizes 32…54), contains calculation forms for six main markers and five supplementary markers. Figure 2 presents a general view of the application.

The user enters numerical values for the cells with green filling (the cells with green filling require input data): the number of pieces (a piece contains the patterns needed for a size in the model) per size, the width l and length L of the available fabric, the allocation of sizes to markers, the number of pieces of each size per markers and the number of markers. From the file resulting from the optimization in GeminiCAD, the lengths of the markers, the utilization coefficient per marker, UC marker (with blue filling) are extracted.

Company	
Model code	
Date	

l [m]	L total [m]
1.2	80

			Markers						Supplementary markers				
Sizes	Number of pieces		M1	M2	M3	M4	M5	M6	SM1	SM2	SM3	SM4	SM5
32	0	Sizes	38	40	42	0	0	0	46	40	0	0	0
34	0		46	44	0	0	0	0	0	0	0	0	0
36	0	No.pcs/size/ marker	1	1	2	0	0	0	2	2	0	0	0
38	20		1	1	0	0	0	0	0	0	0	0	0
40	22	No. pcs./ marker	2	2	2	0	0	0	2	2	0	0	0
42	24	Check total pcs.	108										
44	20	L marker [m]	1.21	1.24	1.22	0.00	0.00	0.00	1.26	1.21	0.00	0.00	0.00
46	22	n [markers]	20	20	12	0	0	0	1	1	0	0	0
48	0	Total markers	54										
50	0	Area marker [sm]	29.02	29.76	17.57	0.00	0.00	0.00	1.51	1.45	0.00	0.00	0.00
52	0	UC (marker)	0.83	0.81	0.82	0.00	0.00	0.00	0.82	0.83	0.00	0.00	0.00
54	0												
Total [pcs]	108	UC (total)	0.83										

L util [m]	66.09
Waste [sm]	16.69

***Fig. 2**: Cutting spreadsheet*

The yellow cells are calculated automatically. The application determines the useful length of the material Lutil, the total utilization coefficient UC total and the area of material that is lost, Waste.

For the example presented in Figure 2, three main markers were required, which ensure the cutting of 20 pieces for sizes 38 and 46, 20 pieces for sizes 40 and 44, 12 pieces for size 42 and two additional markers, which ensure the cutting of two pieces of size 46 and, respectively, 40.

The user can check whether all pieces in the batch have been included in the cutting plan. When the data is entered correctly, the value of the Check total pieces cell must match Total [pieces].

The utilization coefficient and waste are calculated as follows:

$$UC_{total} = \Sigma(L_{marker} \cdot n)/L_{total} \cdot 100 \text{ [\%]}, \quad \textbf{(1)}$$

$$Waste = (L_{total} - L_{util}) \cdot l \text{ [sm]}. \quad \textbf{(2)}$$

In the example shown, the material utilization coefficient has a high value of 83%. The chosen model has simple patterns, which fit relatively easily on the sheet, with a high degree of surface filling. The value of this coefficient can be very different if conditions are imposed regarding the thread orientation and/or the presence of a pattern on the fabric.

3. CONCLUSIONS

The spreadsheet replaces paper-based tables and manual calculus. It can be used as a template for any model, ensuring fast, accurate and complete calculus of data needed for the operation of cutting the patterns.

The application is part of an extended library of templates created by the authors for the use of small companies working in garment industry.

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