OPTIMIZATION OF TECHNOLOGICAL PROCESS OF CUTTING BY USE OF SOFTWARE APPLICATIONS FOR CUT ORDER PLANNING

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ABSTRACT

In today's highly competitive global market, manufacturers are faced with a constant pressure to reduce costs, offer greater product selection, and faster product delivery. The focus of efficiency in the apparel industry is to reduce the material costs, which often reach up to 75% of total production costs. The technique of processing cutting orders and planning economic cutting lays are of utmost importance for better utilization of materials and for increasing the efficiency of cutting process. This paper analyses the influence of the level of applied technology on the percentage of generated textile waste and overall material costs.

INTRODUCTION

During the last decade, the clothing manufacturing companies have being exposed to high competition from the low labor countries and to constant increasing of production costs. This in turn, for the manufacturing companies aiming to increase competitiveness and profitability, imposes the issue of better utilization of the existing resources. The focus of efficiency in the apparel industry is to reduce the cost of raw materials (material costs), which often reach up to 75% of total production costs. In the recent years we witness continuous increasing of the price of textile materials, so any higher percentage of utilization of materials achieved directly affects the overall production costs [1]. The technique of processing cutting orders and planning economic cutting lays are of utmost importance for better utilization of materials and for increasing the efficiency of cutting process.

Today there are number of software programs for solving problems associated with Cut Order (COP), which provide the optimum solution in record time. CAD/CAM systems for nesting/marking and CNC automated cutting equipment have proven effective in increasing the efficiency of the individual cutting operation. But the greatest opportunity for savings in overall time and material costs remains more effectively optimizing the overall cutting process – from order through cutting [2]. The cut order planning process, spreading and cutting process in the cutting department, determine the utilization of textile materials. Great importance in increasing the efficient use of materials is the planning the conversion work orders in cutting plans.

The purpose of this research is to investigate the influence of the level of applied technology on the percentage of generated textile waste and overall material costs. The aim of this work is to provide additional information regarding the automatic planning of cutting orders, reducing of generated textile waste and overall production costs in apparel industry.

THEORY

Cut order planning is the activity of planning the order for cutting, as an input into the marker making stage so that the cutting room receives complete spreading and cutting instructions [3]. The cut order planning process is a dynamic function that must respond to the ever - changing status of many critical factors such as sales, inventory levels, raw materials, and availability of labor and equipment. The variety of sizes, styles, fabrics and colors induces significant complexity into the problem. Adding to the complexity, and thus potentially increasing total production costs, are setup the changeover costs, the question of appropriate sizes, and the necessity to meet customers' demands competitively [4].

The cutting room has a greater effect on excessive manufacturing costs than any other department concerned with the actual production of garments. Current industry approaches for performing cut order planning range from manual ad hoc procedures to customized proprietary software. Many apparel manufacturing facilities are still using much unsophisticated methods, depending on the expertise of one individual who has the necessary data and decision making tools only in his or her memory. Commercial software for cut order planning has been developed, but effective application requires extensive customization and the necessary hardware for implementation [5].

Today it is advisable to use CAD/CAM systems wherever it is economically justified [6]. Handmade markers are time consuming, and if you change your mind about the layout you have to start over from the beginning. Making patterns on a CAD system allows very precise drafting and measurements. But the real advantage is that each pattern is stored on the computer and adjustments can be made very quickly and easily. CAD systems allow the marker maker to play with the pieces until it gets a good layout that minimizes waste. Reduced labor costs and faster production are the benefits. The better the layout is, the less fabric we have to buy on the first place, and much less textile waste is generated [7]. The revolution in the garment industry took place as a result of the introduction of CAD/CAM techniques. CAD/CAM systems are becoming more affordable during the whole time. The implementation of advanced information technology makes it possible to achieve even greater material savings.

EXPERIMENT

In one representative clothing manufacturing company, designated A, the function of processing three work orders has been analyzed and the real percentage of generated textile waste and overall material costs has been identified. Manual and automatic optimizations of cut order plan are performed to demonstrate the possibilities for further reducing the overall material costs on work orders.

Production Company A is a modern and dynamic company with main activity in the field of textile and logistic on the European and world level. The company founders are occupied with this work since 2001. Their production palette includes men, women and children's denim collections and they monthly export between 20000 and 30000 units. The production company A has got a computer design system CAD. The cutting department is fitted with 4 cutting tables for spreading with a length of 8,5 m, 1 spreading machine, 3 band knife and 5 straight knife cutting machines.

In table 1 the structure of analyzed work orders is presented. The tables clearly show that the work orders have different structure and differ in terms of the model, sizes, quantity etc.

The analysis of work orders was performed in several steps:

- monitoring of the development of cut order plan according to the structure of analyzed work order
- monitoring of the computer marker making using Gerber Accumark system;
- an analysis of the basic data required for cut markers;
- monitoring the process of spreading piles and forming cut layers;
- following the order of spreading fabric rolls;
- measuring lengths, m and mass, kg of remnants of used fabric rolls;
- measurement of surface mass of samples from textile material with dimensions (10 x 10) cm, using a laboratory scale, g/m^2;
- calculating the actual percentage of generated textile waste in the cutting process from each layer, m^2, and its expression in kg;
- determination of the total time required for processing of the work order, min and calculating the total labor costs, €.

Table 1. Structure of the analyzed work orders in the production company A

Work order	**Production company A**									
1 (Children's pants)	Size	**4**	**6**	**8**	**10**	**11**	**12**	**14**	**16**	**Total**
	Quantity	34	23	23	36	23	36	36	21	232
2 (Men's pants)	Size	**38**	**40**	**42**	**44**	**46**	**48**	**48B**		**Total**
	Quantity	23	54	62	60	53	18	4		274
3 (Men's pants)	Size	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**38**	**Total**
	Quantity	80	100	160	140	200	100	120	60	960

Completely automatic optimization of planning of the technological process of cutting of the work orders is made by applying Cut Plan software, while preserving parameters and limitations that have been previously used in manual optimization. The markers needed for cutting the analysed work orders are made using the

software program Gerber AccuNest. In manual optimization required markers are made using Gerber Accumark system.

Cut Plan software applications are the link between the design room and the cutting room. It provides fast and high quality automatic or interactive optimization for the spreading and cutting operations. Cut plan application can automatically generate the most efficient plan for product grouping and distribution, so a minimal number of markers and lays are needed to obtain the ordered quantities. The basic concept of these software programs is to get the most optimal solution for the processing of a given work order, especially in terms of lower material costs. This automatic operation lasts for 1-2 minutes. The user may choose among several automatic strategies of lay planning, as well as manual or semiautomatic methods, so the best results are obtained every time.

Gerber AccuNest automatically generates costing and production markers for accurate and fast material calculations. With AccuNest software, we can automatically generate nests 24 hours a day without human intervention to meet peak production demands without additional labor costs.

FINDINGS

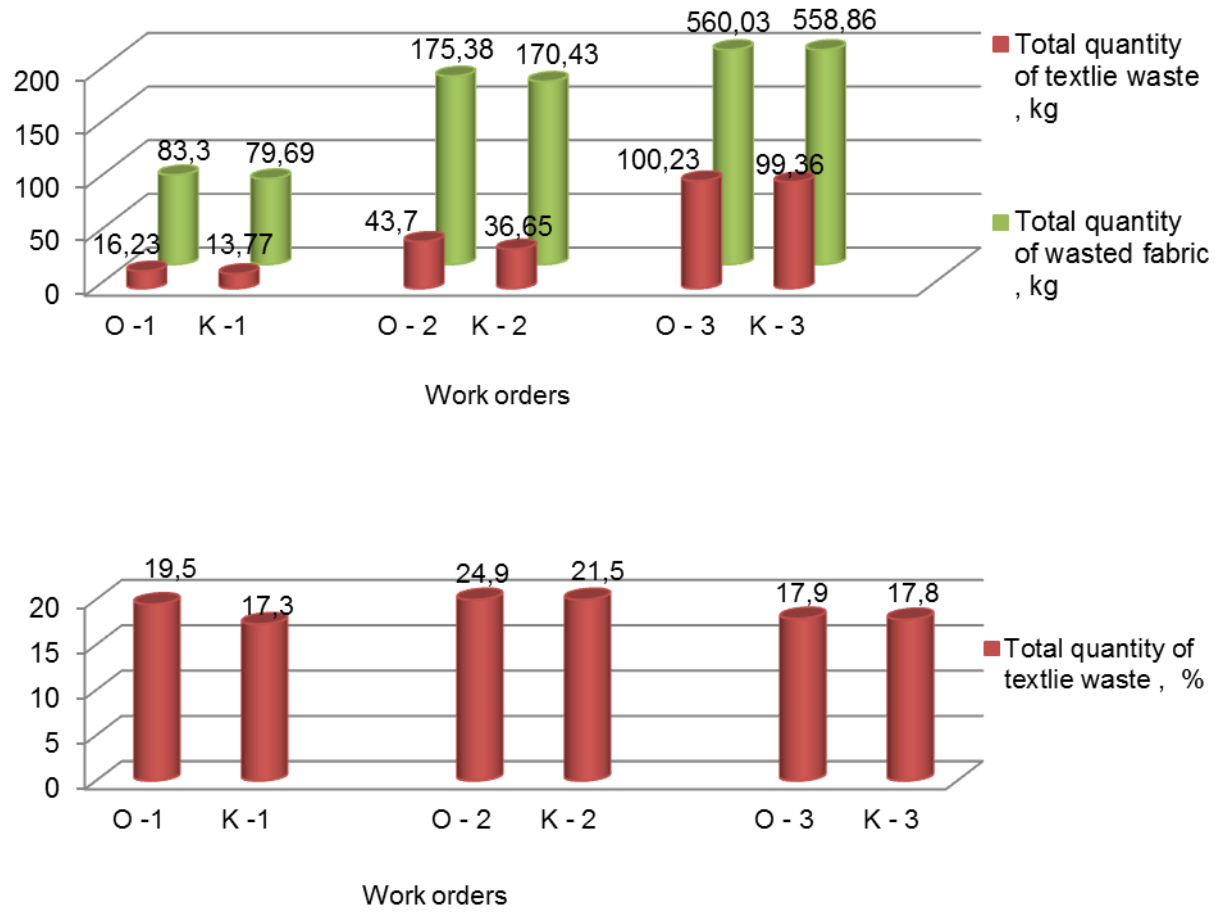
In order to be able to assess the effects of automatic optimization of cut order plan with Cut Plan software and application of Gerber AccuNest of work orders 1, 2 and 3, comparison was made with manual made optimization (Table 2). Table 2 presents the summary of obtained results from a research conducted in clothing manufacturing company A.

Table 2. Comparing the results from manual and automatic optimization of cut order plans for work orders 1, 2 and 3

Work order		Number of cutting clothing pieces	Total amount of consumed fabric		Material costs, €	Average consumption of fabric for clothing unit, m	Total quantity of textlie waste		Total quantity of textlie waste	
			m	kg			kg	%	Cut layers, %	Remnants, %
1	O*	236	206,3	83,30	928,350	0,89	16,23	19,5	18,0	1,5
	K*	232	197,35	79,69	888,075	0,85	13,77	17,3	16,0	1,3
	Difference	4	8,95	3,61	40,275	0,04	2,46	2,2	2,0	0,2
2	O	276	337,23	175,38	1686,150	1,22	43,70	24,9	23,3	1,6
	K	274	327,71	170,43	1638,550	1,20	36,65	21,5	21,0	0,5
	Difference	2	9,52	4,95	47,600	0,02	7,05	3,4	2,3	1,1
3	O	960	1222,99	560,03	6726,450	1,27	100,24	17, 9	17,0	0,9
	K	960	1220,44	558,86	6712,450	1,27	99,36	17,8	16,9	0,9
	Difference	/	2,55	1,17	14,025	/	0,88	0,1	0,1	/

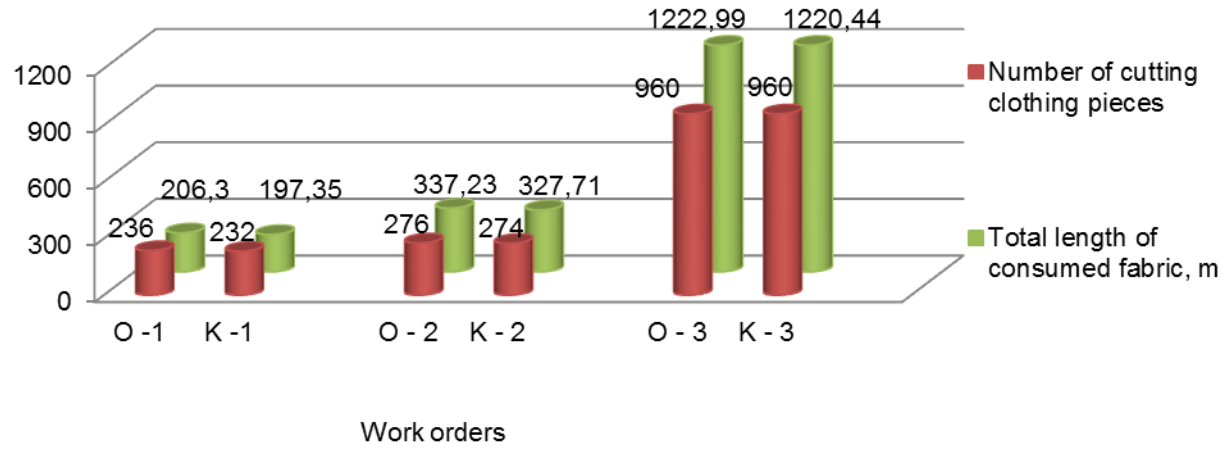
* (O - manually performed optimization of cut order plan K - automatically performed optimization of cut order plan)

The obtained values for the total amount of wasted fabric and generated textile waste, depending on the applied cut plan of the work orders 1, 2 and 3 are given in the diagram (Fig. 1). In order to estimate the realized material savings, the total number of cut clothing pieces and the total length of consumed fabric in different ways of processing work orders in the manufacturing company A is graphically presented (Fig. 2).



O - Manually performed optimization of cut order plan
K - Automatically performed optimization of cut order plan

Figure 1. Total quantity of wasted fabric and generated textile waste in different ways of processing work orders 1, 2 and 3



O - Manually performed optimization of cut order plan
K - Automatically performed optimization of cut order plan

Figure 2. Total number of cut clothing pieces and the total length of consumed fabric in different ways of processing work orders

CONCLUSION

Based on the analysis conducted in the representative company A (Figure 1 and 2), it can be concluded that in all three cases there are realized material savings, and there is reducing of the quantity of generated textile waste, compared to manually performed optimization of cut order plan. Compared to the corresponding total quantities of generated textile waste (19,5, 24,9 and 17,9)%, with manual optimization of cut order plan (Table 1), in all three cases with automatic optimization we reduced textile waste 2,2, 3,4 and 0,1%.

For the analyzed work order 1 corresponding savings of textile fabric are 8,95 m, and the average consumption of fabric for clothing unit is reduced by 4,5%, compared to the manually optimized order plan. For work order 2 with automatic optimization of cut order plans, there are realized savings of 9,52 m fabric, or the average consumption of fabric is reduced by 1,6%, while for the work order 3, the realized savings are negligible (2,55 m), compared to the manually optimized order plan.

The results confirm that in all three cases, despite the realized material savings with automatic optimization of cut order plans, labor costs are significantly reduced because it takes only 1-2 minutes to make the cut order plans with Cut Plan software, while each marker with Gerber AccuNest is made for 2 minutes. The subjective nature of manual optimization wouldn't guarantee the optimal planning and scheduling of the process. By applying advanced information technology we can achieve better results in terms of reducing the overall production costs.

In the analyzed company, material costs dominate over labor costs, which clearly indicate that when planning cut orders the priority should be given to the material costs. An efficient utilization of textile materials by use of software applications for cut order plan and automatically generated production markers will help to reduce the production costs and quantities of generated textile waste.

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