(REFEREED RESEARCH)

THE EFFECTS OF WIDTH OF THE FABRIC, FABRIC AND MODEL TYPE ON THE EFFICIENCY OF MARKER PLAN IN TERMS OF APPAREL

ÖRME KONFEKSİYONDA KUMAŞ ENİ İLE KUMAŞ VE MODEL TÜRÜNÜN PASTAL RESMİ VERİMLİLİĞİNE ETKİLERİ

Hilal BİLGİÇ[1], Pınar DURU BAYKAL[2]

[1]*İnönü University, Yakınca Vocational School, Textile Division, Malatya, TURKEY*
[2]*Çukurova University, The Faculty of Engineering and Architecture, Textile Engineering, Adana, TURKEY*

Received: 11.12.2015 Accepted: 31.05.2016

ABSTRACT

The cost of the fabric which is the raw material of apparel constitutes approximately the half of the total product cost. Consequently, it is very important that the fabric be used efficiently. In this study, six different models from upper group garments are chosen. The numbers and shapes of patterns of the models are carefully selected to be different from each other. The marker (cutting) plans of these models are prepared in three different fabric widths and four different fabric types with Gemini Nest Expert Program. Model type, width of the fabric and shrinkage values are selected as independent variables and efficiency of marker plan as dependent variable. The obtained data is analyzed and interpereted.

Keywords: Knitted apparel, fabric width, fabric type, pattern, efficiency, marker (cutting) plan

ÖZET

Konfeksiyonda ürün maliyetinin yaklaşık olarak yarısını hammadde olan kumaş maliyeti oluşturmaktadır. Bu nedenledir ki, kumaşın verimli bir şekilde kullanılması son derece önemlidir. Bu çalışmada örme üst grup giysilerden altı farklı model seçilmiştir. Modellerin kalıp sayılarının ve kalıp şekillerinin farklı olmasına dikkat edilmiştir. Bu modellerin, üç farklı kumaş eninde ve dört farklı kumaş türünde, Gemini Nest Expert programı kullanılarak kesim yerleşim planı (pastal resimleri) hazırlanmıştır. Model türü, kumaş eni ve kumaş çekme değerleri bağımsız değişkenler, pastal resmi verimliliği ise bağımlı değişken olarak seçilmiştir. Elde edilen veriler analiz edilerek, yorumlanmıştır.

Anahtar Kelimeler: Örme konfeksiyon, kumaş eni, kumaş türü, kalıp, verimlilik, kesim yerleşim planı (pastal resmi)

Corresponding Author: Pınar Duru Baykal, pduru@cu.edu.tr

1. INTRODUCTION

The products manufactured in apparel sector are classified as ready-made (underwear, outerwear, upper wear, etc.), home textile (sheets, curtains, upholstery, etc.) and technical textile (sackcloth, canvas, agricultural covering, etc.). Garments made of knitted fabric that provides comfort in movement have gained great importance in the choices of consumers who spend the day in a rush. Knitted fabric used in the manufacturing of underwear, t-shirts, nightgowns and pajamas has been recently used in different types of garments with the effect of exportation of tricot (1).

Fabric is the single largest factor in the cost of a garment, and fabric prices are continuously increasing. All the researches on the costs of the clothing production show that the fabric cost constitutes 50-60% of the clothing cost (2).

Considering that the fabric has a very large amount of the clothing cost, it is understood that the savings obtained from the fabric are very important for the organization. The place of the savings obtained from the fabric is the pattern and marker preparation department in the model section (3).

In the atmosphere of tight price and quality competition which has occurred in recent years, apparel enterprises are obliged to provide the necessary raw material and supplies with appropriate price in the desired time from various sources and carry out the production in extremely limited time by making the best use of available workforce and machines. This means the effective use of production resources. It is clear that economical usage of fabric which composes nearly half of the cost of apparel products provides a very intense resource in terms of lowering the cost of the products. It is known that a significant part of fabric loss is caused during the making of cutting plans. There have been several studies conducted on aiming to decrease fabric expense within this context (4-10).

The aim of this study is to define the parameters that can affect fabric productivity in the preparation of marker plans and to examine the effects of these parameters. Within this scope, model type, fabric type and fabric width are selected as variables that can have an effect on the efficiency of marker plans. Models are chosen to be different from each other in terms of level of difficulty and number of patterns. Selected fabric types are also different in terms of shrinking percentage because fabric type is one of the most important factors that affect the pattern. Fabric width is a substantial criterion affecting the fabric efficiency in marker placements, so marker plans of different widths are prepared.

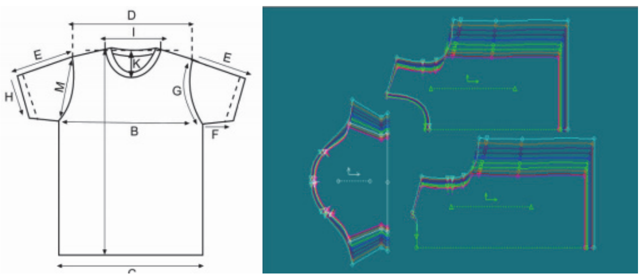
There are studies on marker plan efficiency in the literature, however these studies are not comprehensive enough to analyze the variables chosen in this study in together in different levels. In this study, model type is analyzed in 6 levels, fabric type in 4 levels and fabric width in 3 levels and they are all evaluated together. The outcome of the study is also analyzed statistically and the relationship between marker efficiency and the selected variables are presented.

2. MATERIAL AND METHOD

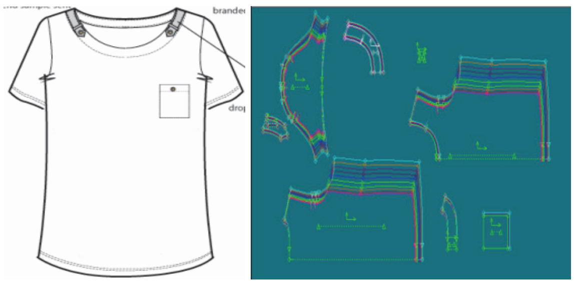
2.1. Material

2.1.1. Models Selected

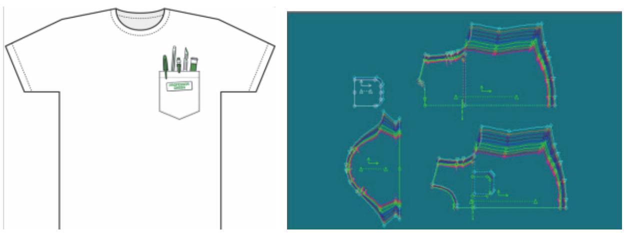
Models are selected different from each other in terms of shapes and numbers of patterns in this study. Figure 1 shows the technical features and patterns of these models. The same assortment plan is used in the preparation of markers of the models in order to determine more reliably the relationship between marker plan efficiencies. The selected assortment plan is composed of different size, medium being more excessive in number. The assortment plan is the most widely used assortment in the enterprise in which the study is conducted.



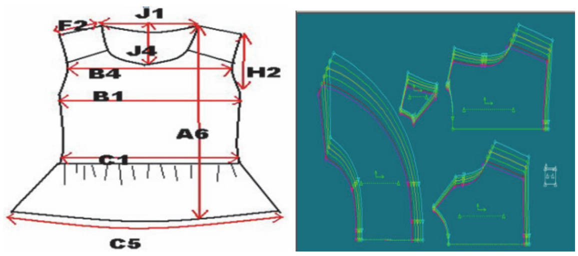
Model A (Short sleeve, crew neck, basic t-shirt)



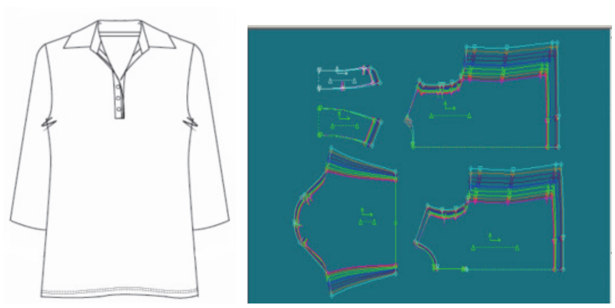
Model D (Short sleeve, crew neck, applique pocket t-shirt with epaulette)



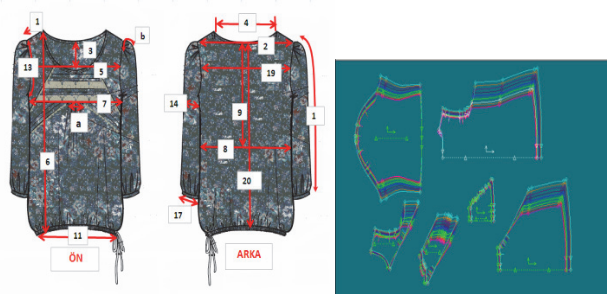
Model B (Short sleeve, crew neck, applique pocket t-shirt)



Model E (Sleeveless, scoop neck, flounced blouse)



Model C (Long sleeve, stand-up collar, basic t-shirt with fly)



Model F (Long sleeve, scoop neck, bounded blouse)

Figure 1. Technical drawings of selected models (11)

2.1.2. Selected Fabrics

100% cotton, 100% viscose and 95% viscose-5% lycra blended knitted fabrics are preferred in this study. They are chosen intentionally with different levels of shrinking value. Most knitted fabrics are prone to shrink in size unless they are exclusively handled (12). While seam allowance is 1 cm in the fabrics that do not shrink in warping direction, the allowance may be assigned as 5 cm in the fabrics that shrink in the warping direction (1).

Dimensional change test is applied to the samples taken from the batches ordered by the enterprise in accordance with DIN 53892 and AATCC 135: Dimensional changes in home laundry. The means of obtained data are calculated and presented in Table 1. The allowable value for every kind (washing, steam, ironed, etc.) of shrinking value generally for apparel enterprises is accepted as 2-3% (13-14).

Table 1. The dimensional change values of knitted fabric types after washing

Fabric material	Knitting	Shrinking value	Evaluation
100%Viscose	Jersey	Width: 1%, Length: 1%	Low
100% Viscose	Interlock	Width: 2%, Length: 3%	Med
95% Viskose-5%Lycra	Jersey	Width: 5%, Length: 5%	High
100% Cotton	Rib	Width: 3%, Length: 5%	Very high

2.1.3. Width of Selected Fabrics

Fabric width is one of the most important parameters that influence marker efficiency. Fabric width is the width of marker plan at the same time. This width needs to be usable. Usable width is the fabric width to be used in the cutting process. Three different fabric widths (145 cm, 165 cm and 170 cm) that are most common in this enterprise are used in this study.

2.2. Method

2.2.1. Pattern Preparation, Grading and Marker Plan Preparation

Gerber-Cad system is used in the preparation and grading process of the patterns for selected models for this study. Preparation process of marker plans is carried out automatically with Gemini Nest Expert program. The patterns should be placed to minimize the loss between the patterns and effective fabric width should be selected in the preparation of marker (cutting placement) plans. The proportion of marker area to the total pattern area is based on during the assessment of efficiency of cutting placement plan.

72 different marker plans are prepared for 3 different fabric widths, 4 different shrinking values and 6 different models in this study. The assortment plan for all marker plans is composed of size 10(1), size 12(1), size 14(3), size 16(4), size 18(3), size 20(2), size 22(1) and size 24(1) that are generally available on the market.

3. RESULTS AND DISCUSSION

3.1. Efficiency Values for Marker Plans of Models

Table 2 shows the efficiency values of 72 different markers. It is observed in the table that the most productive markers are in the width of 170 cm and generally in low and medium shrinking values.

Table 2. Marker Plan Efficiency for The Models

Model	FabricWidth (cm)	FabricShrinking Value	Total PatternNumber in Marker	Total Small PatternNumber in Marker	Marker Efficiency(%)
Model A	145	Low	64	32	80,86
Model A	**165**	**Low**	**64**	**32**	**84,81**
Model A	170	Low	64	32	84,11
Model A	145	Med	64	32	80,10
Model A	165	Med	64	32	84,35
Model A	170	Med	64	32	84,26
Model A	145	High	64	32	79,47
Model A	165	High	64	32	83,16
Model A	170	High	64	32	84,59
Model A	145	Very High	64	32	79,98
Model A	165	Very High	64	32	83,68
Model A	170	Very High	64	32	84,04
Model B	145	Low	80	48	77,78
Model B	165	Low	80	48	80,65
Model B	170	Low	80	48	82,12
Model B	145	Med	80	48	78,15
Model B	165	Med	80	48	81,41
Model B	**170**	**Med**	**80**	**48**	**82,54**
Model B	145	High	80	48	78,02
Model B	165	High	80	48	80,65
Model B	170	High	80	48	81,05
Model B	145	Very High	80	48	77,87
Model B	165	Very High	80	48	81,33
Model B	170	Very High	80	48	82,48

Table 2.

Model	FabricWidth (cm)	FabricShrinking Value	Total PatternNumber in Marker	Total Small PatternNumber in Marker	Marker Efficiency(%)
Model C	145	Low	128	64	84,06
Model C	165	Low	128	64	84,84
Model C	**170**	**Low**	**128**	**64**	**84,86**
Model C	145	Med	128	64	83,28
Model C	165	Med	128	64	83,90
Model C	170	Med	128	64	83,15
Model C	145	High	128	64	82,98
Model C	165	High	128	64	82,94
Model C	170	High	128	64	83,94
Model C	145	Very High	128	64	83,29
Model C	165	Very High	128	64	84,40
Model C	170	Very High	128	64	84,45
Model D	145	Low	176	144	82,44
Model D	165	Low	176	144	85,09
Model D	170	Low	176	144	84,74
Model D	145	Med	176	144	82,71
Model D	165	Med	176	144	85,22
Model D	**170**	**Med**	**176**	**144**	**85,88**
Model D	145	High	176	144	80,63
Model D	165	High	176	144	85,63
Model D	170	High	176	144	85,47
Model D	145	Very High	176	144	82,24
Model D	165	Very High	176	144	85,44
Model D	170	Very High	176	144	85,49
Model E	145	Low	112	32	76,80
Model E	165	Low	112	32	77,38
Model E	170	Low	112	32	77,56
Model E	145	Med	112	32	76,81
Model E	165	Med	112	32	76,81
Model E	**170**	**Med**	**112**	**32**	**78,08**
Model E	145	High	112	32	76,50
Model E	165	High	112	32	77,43
Model E	170	High	112	32	76,87
Model E	145	Very High	112	32	76,85
Model E	165	Very High	112	32	77,26
Model E	170	Very High	112	32	77,12
Model F	145	Low	144	80	82,23
Model F	165	Low	144	80	83,47
Model F	170	Low	144	80	83,47
Model F	145	Med	144	80	82,05
Model F	165	Med	144	80	83,44
Model F	170	Med	144	80	82,81
Model F	145	High	144	80	82,71
Model F	165	High	144	80	83,57
Model F	170	High	144	80	83,29
Model F	145	Very High	144	80	82,81
Model F	165	Very High	144	80	83,36
Model F	**170**	**Very High**	**144**	**80**	**83,65**

The changes in the efficiency of marker plans of the models are shown in the bar graph in terms of fabric width (Figure 2.). According to the chart, it can be seen that the marker plan efficiency is changing in line with model changes and consequent changes in pattern numbers. As one can understand from the chart, Model D which has the most number of small patterns also has the highest efficiency. The reason for this is the small patterns being placed between main patterns in the marker plans to increase efficiency. Model E has the lowest efficiency level because it has a limited number of small patterns and it also has rounded patterns. When the chart is examined in terms of fabric width, it can be seen that the more the fabric width is, the more marker plan efficiency increases for all models.

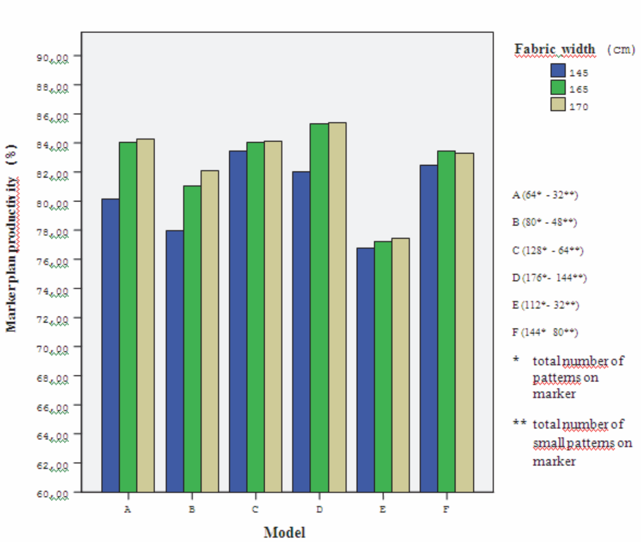


Figure 2. Bar graph for model type-fabric width-marker plan efficiency

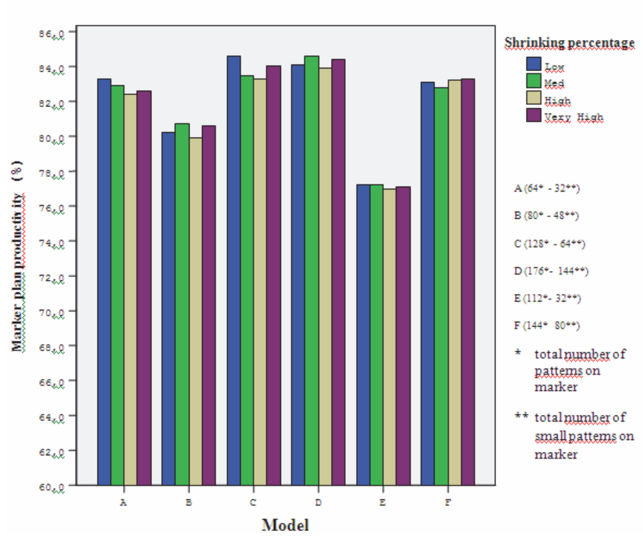


Figure 3. Bar graph for model type-shrinking percentage-marker efficiency

Shrinking values of fabrics are reflected on the model patterns. The patterns are enlarged in accordance with the shrinking value of the fabric. This decreases marker efficiency and fabric waste. Consequently with this fact, shrinking values are considered and analyzed as independent variables. In the graphical evaluations, shrinking values are seen to have a slight influence on marker efficiency (Figure 3.). Marker efficiency for fabrics with low shrinking values is outcome as high.

3.2. Statistical Analysis for Marker Plan Efficiency

Analysis of Variance

Analysis of variance (ANOVA) is used to test the hypothesis on whether the difference between the averages belonging to more than two groups is significant. It is practiced in order to analyze how independent variables chosen in this study react among each other and how these reactions affect the dependent variables, and the results are presented in Table 3. The conformity of the data to normal distribution before the analysis of variance is determined by K-S (normality) test and histograms.

When the effect of variables of fabric width, model type, total pattern number in marker and total small pattern number in marker on marker plan efficiency is examined statistically, it can be said that these variables have a significant effect on marker plan productivity given the significant value in ANOVA table below 0,05. Shrinking value, on the other hand, is seen not to have a significant statistical effect on marker plan efficiency. In other words, marker plan efficiency does not statistically show a significant difference in accordance with shrinking value.

Regression Analysis

The result of the regression analysis for dependent variable of marker plan efficiency shows that independent variables (predictor variables) explain 56,7% of the change in dependent variables (Table 4). The model is statistically significant ($p<0,05$).

Considering the p value of the coefficients in regression equation it can be said that the explanatoriness of the variables of fabric width and model type on marker plan efficiency is statistically significant and the other variables are not.

Table 3. ANOVA Analysis for Marker Efficiency (%)

		Sum of Squares	df	Mean Square	F	Sig.
Fabric Width	Between Groups	77,263	2	38,632	5,420	**,007**
	Within Groups	491,842	69	7,128		
	Total	569,105	71			
Model Type	Between Groups	440,424	5	88,085	45,178	**,000**
	Within Groups	128,682	66	1,950		
	Total	569,105	71			
Shrinking value	Between Groups	2,247	3	,749	,090	**,965**
	Within Groups	566,858	68	8,336		
	Total	569,105	71			
Total Pattern Number in Marker	Between Groups	440,424	5	88,085	45,178	**,000**
	Within Groups	128,682	66	1,950		
	Total	569,105	71			
Total Small Pattern Number in Marker	Between Groups	248,097	4	62,024	12,946	**,000**
	Within Groups	321,008	67	4,791		
	Total	569,105	71			

Table 4. Results of regression analysis of the variables

Regression analysis		Model Type	FabricWidth	Shrinking Value	Total Number of Patterns in Marker	Total Number of Small Patterns in Marker
Marker Plan Efficiency (%)	Coefficients (p-value)	0,002	0,000	0,772	0,158	0,206
	ANOVA (p-value)	**0,000***				
	R²	0,567				
	Adjusted R²	0,535				

Correlation Analysis

The results of correlation analysis of marker plan efficiency and the variables are given in Table 5. There are no linear relationships between model type and marker efficiency (sig>0,05). The situation is the same between shrinking value and marker efficiency (sig>0,05). There is a linear relationship between fabric width and marker efficiency (sig<0,05). Pearson correlation coefficient is 0,367. This shows it is a weak and positive relationship. There is a linear relationship between the total number of patterns in marker and marker efficiency. Pearson correlation coefficient is 0,356. This shows it is a weak and positive relationship. There is a linear relationship between total number of small patterns in marker and marker efficiency. Pearson correlation coefficient is 0,548. This shows it is a positive and medium-level relationship.

4. CONCLUSION

The results obtained in the scope of the study are summarized below;

- Most productive markers are in the largest fabric width (170 cm) and generally in low and medium shrinking values.
- When model changes, the number of patterns of the model is changing and thus marker efficiency is also chaning.
- It is asserted that the variables of fabric width, model type, total number of patterns on marker and total number of small patterns on marker are statistically significant on marker plan efficiency.
- It is seen that the more the fabric width increases, the higher marker plan efficiency is.
- As the shrinking percentage of the model type changes, marker plan efficiency changes accordingly but this change is not considered significant. Shrinking values have a slight influence on marker efficiency. Marker efficiency for fabrics with low shrinking values is outcome as high.
- The result of the regression analysis shows that selected independent variables (model type, fabric width, shrinking value and number of patterns) explain 56,7% of the change in dependent variable of marker plan efficiency.
- The highest efficiency is observed in Model D. It has the highest number of patterns and small patterns on marker plan among others (176-144).
- The highest efficiency in Model D is obtained from the widest fabric width (170 cm).
- Model E yields the lowest efficiency. The reasons for this are patterns not being standard, rounded patterns and small number of small patterns (32).
- Finally; the most important factors affecting marker plan efficiency are marker width, number of small patterns in the model and the pattern part being standard or not.

Table 5. Results of Correlation Analysis of Variables

Correlation Analysis		Model Type	Fabric Width	Shrinking Value	Total Number of Patterns in Marker	Total Number of Small Patterns in Marker
Marker Plan Efficiency (%)	Significance Level sig.(2-tailed)	0,257	**0,002***	0,845	**0,002***	**0,000***
	Correlation Coefficient	-0,135	0,367	-0,024	0,356	0,548
	Relationship	No linear relationship	Positive weak relationship	No linear relationship	Positive weak relationship	Positive medium-level relationship

REFERENCES

1. Kaftan, H., 2007, *"Preparing, Grading and Analysis of Patterns in Women Tricot Outfit Apparel"*, Post Graduate Thesis, Selcuk University, Graduate School of Social Sciences, Department of Education of Clothing Industry and Art of Clothing, Konya, Turkey (In Turkish).
2. Erdoğan, M.Ç., 1999, "Determining of the Ideal Fabric Width of the Internal Market Production Classical Men's Shirt", *Tekstil ve Konfeksiyon*, Number:9(5), pp: 397-402 (In Turkish).

3. Utkun, E., Öndoğan, Z., 2012, “Determination of the Ideal Fabric Width of the Classical Women’s Blouse Models Made From Buldan Cloth”, *Tekstil ve Konfeksiyon*, Number 3, pp: 258-267.

4. Paşayev, N., 2010, “Investigating The Effects of Production Planning on Fabric Costs in Confection Production”, *Tekstil ve Konfeksiyon*, Number 3, pp: 262-270 (In Turkish).

5. Erdoğan, Ç., 1991, “Determination of the Ideal Fabric Width in Work Clothing Manufacture”, *Tekstil ve Konfeksiyon*, Number 6, pp: 593-599.

6. Boz, S., Öndoğan, Z., 2012, “An Investigation on the Cutting Parameters for Various Types of Fabrics”, *Tekstil ve Konfeksiyon*, Number 1, pp: 52-57 (In Turkish).

7. Yılmaz, N., 2007, *“A Research on Cloth Waste and Cost in an Apparel Enterprise”*, Post Graduate Thesis, Istanbul Technical University, Graduate School of Science, Istanbul, Turkey, 205 pages (In Turkish).

8. Göksel, N., Utkun, E., Öndoğan, Z., 2012, Use of Computer Aided Pattern Preparation Method in Clothing Designing, *Tekstil ve Konfeksiyon*, Number 4, pp: 375-382.

9. Öndoğan, Z., 1998, Computer Aided Design, Implementation and Compliance of the Pattern Cutting Plan Preparation System of Apparel Business, *Tekstil ve Konfeksiyon*, Number: 8 (3), pp: 208-213.

10. Bilgiç, H., 2009, *“Optimizing Cutting Placement Plans in Terms of Decreasing Fabric Losses in Trousers Production”,* Post Graduate Thesis, Erciyes University, Graduate School of Science, Kayseri, Turkey, 177 pages (In Turkish).

11. Bilgiç, H., 2015, *“Effects Of Fabric Width And Types And Models Of Fabric On Cutting Placement Plan Efficiency”,* PhD Thesis, Çukurova University, Institute Of Natural And Applied Sciences, Department Of Textile Engineering, Adana, Türkiye (In Turkish).

12. Demirhan, F., Meriç B., 2005, “The Searching of Dimensional Changes on The Knitted Fabrics and Garments after Washing and Drying”, *Pamukkale University Journal of Engineering Sciences,* Vol. 11. Number 3 pp: 381-390 (In Turkish).

13. Duru Baykal, P., 2013, *“Quality Management in Confeciton Enterprises”,* Post Graduate Lecture Notes, Çukurova University, Department of Textile Engineering, Adana, Turkey (In Turkish).

14. Karaman, M, 1994, *“Quality Management and Control Techniques in Clothing Industry”,* Lecture Notes, Marmara University, Faculty of Technical Education, Department of Textile Education, Istanbul, Turkey (In Turkish).