Influencing fabric shrinkage and different size ratios on marker making efficiency and fabric consumption rate for men's shirt.

Hazem A. Yassin
Industrial Education Department, Faculty of Education, Helwan University, Cairo, Egypt
Alsiad Ahmed Almetwally
Spinning & Weaving Engineering Dept., Textile Research Centre, Dokki, Cairo, Egypt

Abstract:
As the fabric cost forms more than 65% of the total garment cost, thus saving fabric in clothing factory especially in cutting section plays a vital role in this industry. This paper aimed at investigating the influence of fabric shrinkage in lengthwise and widthwise and the different size ratios on marker making efficiency and fabric consumption rate. It was found that fabric shrinkage has a significant influence on maker efficiency and fabric consumption rate. As the fabric shrinkage increases the marker making efficiency increases. Also fabric consumption rate was associated with 2% shrinkage in both direction of the fabric while shrinkage of 3% leads to lower the fabric consumption rate.

Keywords:
Fabric Shrinkage
Cloth Size
Pattern Planning
Pattern Grading
Marker Efficiency
Fabric Consumption Rate
Fabric Wastage.

Paper received 11th February 2018, Accepted 23th March 2018, Published 1st of April 2018

1. Introduction
Apparel industry is one of the largest, oldest and the most popular industry in the world. It is an initiator and typical industry for countries that intend to integrate in export-oriented industrialization; also it is a labor-intensive. The basic aim of the apparel making industry is to transform a 2D dimensional fabric to 3D apparel. In order to achieve this final objective, the two dimensional fabric passes through different interrelated, consistent and controlled steps such as fabric spreading, marking making, cutting, sewing, finishing and packing process [1].

Marker making is one of the most important processes in garment industry with respect to determining the highest usage and lowest wastage of the fabrics. A marker can be defined as a plot of an accurate arrangement of pattern pieces for a particular style and sizes that will be cut from a single spread. It can also be defined as a thin paper, known as marker paper, that includes all pattern pieces for all sizes of a specific style of garment [2]. Marker making can be judged by its efficiency. The higher marker efficiency refers to lower fabric waste. Also the more efficient marker is considered a helpful tool for any factory to diminish the fabric consumption and increasing its profits [3].

In apparel industry, marker making is performed using two distinct methods, namely manual and computerized methods. Nowadays, CAD systems are widely used in marker making all over the world. But rarely and in some special cases in which complicated patterns of fabrics are used, manual marker planning becomes more preferable [4]. The advantages of using CAD systems as a marker making tool are high accuracy, increasing control over variables and lower time required for marking process [5]. On the other hand, manual method for marker making has lower efficiency, high time consumption and requires skilled, efficient and expertise operators. Finally, in the case of CAD systems, marker making efficiency and fabric consumption rate will be displayed on the computer screen while in the manual method it is impossible [6].

Numerous research works have been conducted to examine the influence of marker making efficiency on fabric consumption and the factors affecting this efficiency. In his study to investigate the influence of different sorts of marker efficiency on fabric consumption, M S Haque [7] found that fabric design, repeat size and shade variation significantly affect marker making efficiency and the amount of fabric consumption. It was also found a negative relationship between marker efficiency and the amount of fabric consumption. In clothig industry, marker palning is conducted using two fundamental systems, namely manual and Computer Aided Design (CAD). Ziynet O. and Cetin E. [8] compared between the two systems for pattern making, grading and marker making processes. They concluded that CAD system is advantageous in the steps prior to marker making procedure such

as grading patterns, checking graded patterns, making arrangement. There were no significance difference between the two systems during marker making preparation, checking, correcting and plotting procedures. Finally it was also found that the total times for all procedures and steps were significantly lowered using CAD system.

The effect of fabric parameters on their physical properties, especially fabric shrinkage, was studied extensively in the research works [9-12]. However, the impact of pattern planning, material types and sizes ratios were studied in limited number of researches. The main objective of this study focuses mainly on the influence of fabric shrinkage, and different sizes of men's shirt model on the marker making efficiency and fabric consumption rate.

2. Experimental work

2-1: Selected model and fabrics

In this study, a long sleeve men's shirt was chosen as a model to be investigated. This model type was selected because of it's heavily demand in the Egyptian market throughout the year; also it can be produced in all apparel companies. This model is generally composed of 13 pieces.

There are two main different woven fabrics were used to design and implement this model, namely 100% cotton fabric and cotton: polyester blended fabrics. These fabric types were intentionally selected from a garment factory. Also, these fabric types under study have different shrinkage values in the width and length directions. The shrinkage values in lengthwise and widthwise will be taken into consideration during pattern planning, grading and marker making. The width of all fabric samples were kept constant at 144 cm. Technical drawing of the selected model was shown in figure 1. The specifications of selected woven fabrics with different shrinkage values in width and length directions were listed at table 1. The shrinkage of fabrics used to design this model can be calculated as follows:

$$Shrinkage,\% = \frac{L_0 - L_w}{L_0} \times 100$$

Where, L_0 = length or width of fabric sample before washing , L_w = length or width of fabric sample after washing

Table 1: Specifications of the woven fabrics with different shrinkage ratios used in this study.

Sample No.	Shrinkage value, %		Woven fabrics specifications				Fiber content
	Lengthwise	Widthwise	Warp yarn count(Ne)	Weft yarn count (Ne)	Warp density (ends/cm)	Weft density (picks/cm)	
1	2	1	30	30	30	28	Cotton:polyester 65%:35%
2	1	1	60/2	60/2	44	33	100% cotton
3	2	2	16	16	22	20	100% cotton
4	3	5	30/2	30/1	23	24	Cotton:polyester 65%:35%
5	1	2	50	30	48	29	100% cotton
6	2	1	30	30	30	28	Cotton:polyester 65%:35%

Figure 1: Technical drawing of the selected model (men's long sleeve shirt)

In order to making pattern for the selected model, four different sizes were selected ,

namely, S, M, L and XL respectively; where S is the smallest size and XL is the largest one. The designed measurements are essentially for pattern making of the different sizes. It is worthy noted that the different sizes were used with different ratios. Table 2 represents the different measurements in each size. The markers designed in this study with different sizes and associated ratios were depicted in figure 2.

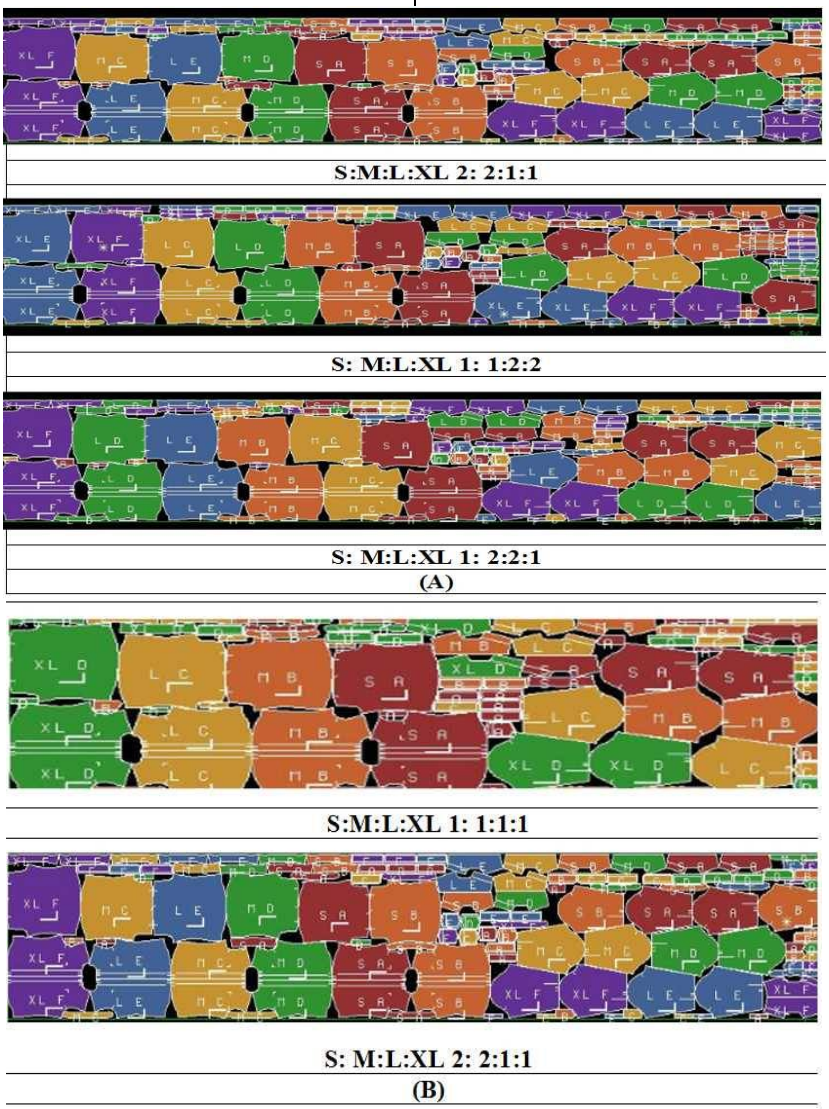

Figure 2- A and B: Some of the used markers with different sizes and ratios

Table 2: Key measurements of each size of garment for men's shirt model

Key measurements in centimeters	Different sizes				
	XS	S	M	L	XL
Back length from center back	73	74.5	76	77	78.5
1/2 Chest	49.5	51.5	53.5	55.5	58.5
1/2 Waist	45.5	47.5	59.5	51.5	54.5
1/2 Hem width	49.5	51.5	53.5	55.5	58.5
1/2 Armhole	21	22	23	24	25
Sleeve Length from Shoulder	64	65	66	67	67.5
Collar length	38	38	40	42	44
Chest Pocket Length	12.5	13	13	13	13.5
Chest Pocket Width	10.5	11	11	11	11.5

2-2: Pattern preparation, grading and marker making

With the aid of measurements represented in table 1, a pattern for M size was made. In order to convert pattern for the rest of garment sizes from XS to XL, pattern grading has been done. From lowest to largest sizes, pattern grading is a helpful tool to make different sizes of pattern for different sizes of garment for XS, S, M, L and XL sizes respectively.

CAD system using Gerber Software was used in preparing and grading of patterns for the selected model under study. In general, marker efficiency can be defines as the ratio of the area of marker used in the garment to the total are of the marker. It can also defined as the ratio of the fabric weight consumed by pattern pieces in the marker to the overall weight of the fabric under marker area. Thus marker efficiency can be calculated by the following formula:

Marker efficiency, % = **Error!** ×100

Results and discussion

Fabric shrinkage whether in lengthwise or widthwise represents an undesirable factor and a vital problem that should be given a full attention by the cutting room management. During marker drawing, fabric spreading and cutting, fabric shrinkage should be taken into consideration. In this part of study, the effects of fabric shrinkage and different sizes ratios on marker making efficiency and fabric consumption rate of men's shirt will be discussed in more details.

Effects on marker making efficiency

The skill and success of marker planner is judged by the efficiency of marker plan. Generally, the higher is the marker efficiency, the lower is the fabric wastage and vice versa. The values of marker making efficiency at different size ratios and fabric shrinkage in lengthwise and widthwise were tabulate in table 3.

Table 3: Marker making efficiency for one shirt for different sizes and their ratios at different fabric shrinkages

Fabric shrinkage, %		Used Sizes	Sizes ratios	Marker efficiency, %
Lengthwise	Widthwise			
3	5	S:M:L:XL	2:2:2:1	89
1	2	S:M:L:XL	1:1:1:1	88.7
2	2	S:M:L:XL	1:1:1:1	88.7
2	2	S:M:L:XL	1:2:1:1	88.8
2	2	S:M:L:XL	2:1:1:1	88.4
1	1	S:M:L:XL	1:1:1:	89
1	1	S:M:L:XL	2:1:1:1	88.7
2	1	S:M:L:XL	1:1:1:1	88
2	1	S:M:L:XL	1:1:1:1	88
2	1	S:M:L:XL	1:1:1:2	89.3
2	1	S:M:L:XL	1:2:1:1	87.2
1	2	S:M:L:XL	1:1:1:1	89.2
1	2	S:M:L:XL	1:1:1:1	88.7
3	0	S:M:L:XL	1:1:1:2	88.5
3	0	S:M:L:XL	1:2:1:1	88.5
3	0	S:M:L:XL	1:1:1:1	89.1
3	0	S:M:L:XL	1:1:1:1	88.8
6	1	S:M:L:XL	1:1:2:1	88.4

From this table it can be see that there is a difference between marker making efficiency values at different size ratios and fabric shrinkage. Regardless the size ratios, fabric shrinkage has a

significant effect on the marker making efficiency. As the fabric shrinkage increases the marker making efficiency increases. High marker efficiency (89%) was exhibited at 3% and 5% lengthwise and widthwise shrinkage of fabric respectively; whereas the low maker efficiency (87%) was shown at 2% and 1% shrinkage in warp and weft directions respectively. It was also found that the sizes ratio influences the marker making efficiency slightly. The size ratios of 1:1:1:2 for S:L:M: XL gave the high efficiency of marker making (89.3%) while the size of grade 1:1:2:1 has the low marker efficiency (87.2%).

Effects on fabric consumption rate ,

Fabric consumption rate is an alternative to judge the marker planner's skill and his success. As the fabric consumption rate reduced, the planner is considered well trained and skilled. Fabric consumption rate in square meter at different size ratios and fabric shrinkage values were listed in table 41.

Table 4: Fabric area utilization for one shirt for different sizes and their ratios at different fabric shrinkages

Fabric shrinkage, %		Used Sizes	Sizes ratios	Fabric area utilization for one shirt Lengthwise(m) × widthwise(m)	Fabric area utilization for one shirt (m^2)
Lengthwise	Widthwise				
3	5	S:M:L:XL	2:2:2:1	1.25×1.44	1.8
1	2	S:M:L:XL	1:1:1:1	1.3×1.44	1.872
2	2	S:M:L:XL	1:1:1:1	1.3×1.44	1.872
2	2	S:M:L:XL	1:2:1:1	1.5×1.44	2.16
2	2	S:M:L:XL	2:1:1:1	1.4×1.44	2.016
1	1	S:M:L:XL	1:1:1:	1.3×1.44	1.872
1	1	S:M:L:XL	2:1:1:1	1.24×1.44	1.7856
2	1	S:M:L:XL	1:1:1:1	1.36×1.44	1.9584
2	1	S:M:L:XL	1:1:1:1	1.43×1.44	1.9152
2	1	S:M:L:XL	1:1:1:2	1.36×1.44	1.9584
2	1	S:M:L:XL	1:2:1:1	1.47×1.44	2.1168
1	2	S:M:L:XL	1:1:1:1	1.45×1.44	2.088
1	2	S:M:L:XL	1:1:1:1	1.3×1.44	1.872
3	0	S:M:L:XL	1:1:1:2	1.25×1.44	1.8
3	0	S:M:L:XL	1:2:1:1	1.18×1.44	1.6992
3	0	S:M:L:XL	1:1:1:1	1.17×1.44	1.6848
3	0	S:M:L:XL	1:1:1:1	1.3×1.44	1.872
6	1	S:M:L:XL	1:1:2:1	1.25×1.44	1.8

As shown from this table values of fabric consumption rate differ significantly at shrinkage values and different size ratios. Regardless the size ratios the higher fabric consumption (2.16 m^2 rate) for one men's shirt was associated with 2% shrinkage in lengthwise and widthwise of fabrics followed by 2.11 m^2 for 2% and 1% shrinkage in the above direction. While the lower consumption rate of woven fabric were 1.68m^2 for one shirt in the case of 3% shrinkage in lengthwise of the fabric. Also it can be concluded that the low fabric consumption was accompanied by the size ratio 1:1:1:1 for S:M:L:XL sizes; while high consumption rate was obtained by the size ratio 1:2:1:1.

Conclusion

As the fabric cost forms more than 65% of the total garment cost; thus saving fabric in clothing factory especially in cutting section plays a vital role in this industry. Marker making plan is one of

the main procedures on which saving of fabric rely on. Throughout this study, the influence of fabric shrinkage in both directions and size ratios and their effects on fabric consumption rate and marker making efficiency were examined. It was found that both independent variables have a significant effect on marker making efficiency and fabric consumption rate. High marker making efficiency is accompanied by 3% fabric shrinkage in warp direction and 5% in weft direction. While high consumption rate of fabrics was found at 2% shrinkage of fabric samples. The low consumption rate was also associated with size of ratio 1:1:1:1.

References

1- Gereffi, G. (2002) Outsourcing and Changing Patterns of International Competition in the Apparel Commodity Chain, Paper presented at the conference on *Responding to Globalization: Societies, Groups, and Individuals*, Hotel Boulderado, Boulder, Colorado, April 4-7, 2002..http://www.colorado.edu/IBS/PEC/gadconf/papers/gereffi.pdf

2- Dumishllari, E. & Guxho, G. (2015). Impact of Marker on Cut Plan in Garment. International Journal of Innovative Research in Science, 7377-7381

3- Ahmad, S., Khalil, A.A.B & Rashed, C.A.A (2012). Impact of efficiency in apparel supply chain Asian Journal of Natural Applied Sciences, 1(4), 36-45.

4- IParthraj Puranik and Saloni Jain. Garment marker planning – A review. International Journal of Advanced Research in Education & Technology (IJARET), Vol. 4, Issue 2, (April-June, 2017).

5- IParthraj Puranik, and Saloni Jain. Garment Marker Planning – A Review. International Journal of Advanced Research in Education & Technology. 4(2), 2017.

6- Spahiu, T., Shehi, E & Piperi, E. (2014). Advanced CAD/CAM systems for garment design and simulation. Advanced CAD/CAM systems for garment design and simulation (pp. pp. 1-6). Tirana, ALBANIA: 6th INTERNATIONAL CONFERENCE OF TEXTILE

7- Md Nazmul Haque. Impact of different sorts of marker efficiency in fabric consumption. International Journal of Textile Science 2016, 5(5): 96-109 . DOI: 10.5923/j.textile.20160505.02

8- Ziynet O. and Cetin E. The Comparison of the manual and CAD systems for pattern making, grading and marker making processes. FIBRES & TEXTILES in Eastern Europe January / March 2006, Vol. 14, No. 1 (55).

9- Alsaid Ahmed Almetwally, M M Mourad. Effects of spandex drawing ratio and weave structure on the physical properties of cotton/spandex woven fabrics. The Journal of the Textile Institute, 105(3), 235-245, 2014.

10- Y M E Hassan, A El-Salmawy and Alsaid Ahmed Almetwally. Performance of woven fabrics containing spandex. Indian Textile Journal, 120, 22-27, 2010.

11- Alsaid A Almetwally and Mona M Salem. Comparison between mechanical properties of fabrics woven from compact and ring spun yarns. Autex Research Journal, 10(1), 35-40, 2010.

12- Alsaid Ahmed Almetwally, Hatim MF Idrees and Ali Ali Hebeish. Predicting the tensile properties of cotton/spandex core-spun yarns using artificial neural network and linear regression models. The Journal of the Textile Institute, 105(11), 1221-1229, 2014.