International Journal of Engineering Inventions
e-ISSN: 2278-7461, p-ISSN: 2319-6491
Volume 13, Issue 4 [April. 2024] PP: 114-119

Determine fabric consumption of products for garment production and business

Pham Thi Huyen, Nguyen Thi Mai Hoa
Faculty of Garment technology and Fashion design, Hanoi University of Industry, Ha Noi, Vietnam

ABSTRACT: *When ordering fabric to produce and business garment orders, merchandisers often send fabric specifications and quantities to the supplier. The amount of fabric that needs to be purchased is directly related to the quantity of garments that need to be produced. Therefore, fabric consumption must be calculated accurately. This study proposes a method to determine fabric consumption for men's shirts. Marker Making V6R2 software is used for designing, grading, and making markers for 5 sizes of men's shirts on 5 different width types of fabric. From there, determine the length and performance of the marker and calculate fabric consumption for a garment. Use R software to determine the relationship between the parameters of the marker to fabric consumption. As a result, a multivariate linear regression model was determined between fabric consumption (Cons) with fabric width (Width), shirt sizes (Size), and performance of marker (Eff). This model allows calculating the fabric consumption of a garment for the buying or allocation of fabric when knowing the fabric width, and size and choosing flexible marker performance to help garment enterprises achieve higher performance in the production and business of garments.*

Keywords: *Fabric consumption, fabric width, garment production, garment business*

Date of Submission: 02-04-2024 Date of acceptance: 12-04-2024

I. INTRODUCTION

In merchandising, accurately determining the fabric consumption for a garment will help the merchandiser purchase the correct and enough fabric needed for garment production and business. The merchandiser usually sends the fabric specifications and fabric quantity to the supplier. The amount of fabric needed to buy is calculated based on the fabric consumption for a garment and the number of garments that need to be produced. Quick and accurate calculation of fabric consumption is one of the important factors that helps merchandisers do business on time with the right amount of garments according to the natural season and have garments available when needed; Doing business in the right quantity ensures the set profit; Doing business at the right price to ensure necessary profits, compete with other competitors and respond customer expectations [1].

Fabric consumption can be determined in different ways. Much research on calculating fabric consumption has been carried out to increase fabric usage performance. Md Nazmul Haque has shown a linear relationship between marker performance and fabric consumption performance [2]. Choosing the patterns of a garment that are suitable for the fabric width also increases the performance of fabric use [3]. Fabric consumption depends on garment shape, structure, number of garments on the marker, fabric width, elimination wastage method for fabric cutting table ... [4].

In Vietnam, there has been research to increase the performance of fabric use. A researcher named Nguyen Thi Le showed that the number of garments on the marker, the length of the marker, and the width of the marker have a linear relationship with T-shirt fabric consumption. Fabric consumption increases as the number of garments decreases on the marker [5]. Author Nguyen Thi Sinh has proposed a method to calculate material consumption and set up calculation software for FOB orders [6].

The above research was all conducted with methods to determine the amount of fabric consumption but still not yet help fabric purchasing be fast, accurate, and convenient. Therefore, this study proposes a method to determine fabric consumption for men's shirts. This is an important factor that helps garment enterprises achieve greater performance in producing and business garments.

II. METHODS

2.1. Object and scope of the research

Fabric: The fabric used for this study is a type of fabric commonly used to make men's shirts with 5 different widths used for marker making, including 1m, 1.2m, 1.4m, 1.5m, and 1.6m.

Size of shirt: The size of the shirt used for this study includes 5 sizes named S, M, L, XL, and XXL. This is a men's shirt with a slim fit, long sleeves with cuffs, a stand collar, tail hem, round bottom chest pocket, and detached shoulder. These shirts are traditional products of many garment businesses.

2.2. Marker making and calculating fabric consumption

Parameters of the marker include marker length, marker performance (Eff), and marker width (Width). Use MakerMaking V6R2 software to create markers.

Choosing arranging patterns of shirts on the marker that are suitable with the pattern of the fabric.

Arrange 3 patterns of shirts with the same size on a marker. The fabric consumption (Cons) of a shirt for each marker is determined by formula (1).

Cons = Length of marker/ number of shirts on marker (meter per shirt) (1)

2.3. Determine the relationship between fabric consumption and fabric width and marker performance

To determine the relationship between fabric consumption (Cons) and the parameters of the marker including fabric width (Width) and marker performance (Eff), use a multivariate linear regression model in the form of a matrix as follows:

$$\text{Cons} = X\beta + \varepsilon \quad (2)$$

In which, Cons is a vector of fabric consumption for a shirt. X is the matrix of values of fabric width and marker performance, β is the vector of regression coefficients, and ε is the vector of residual values [7].

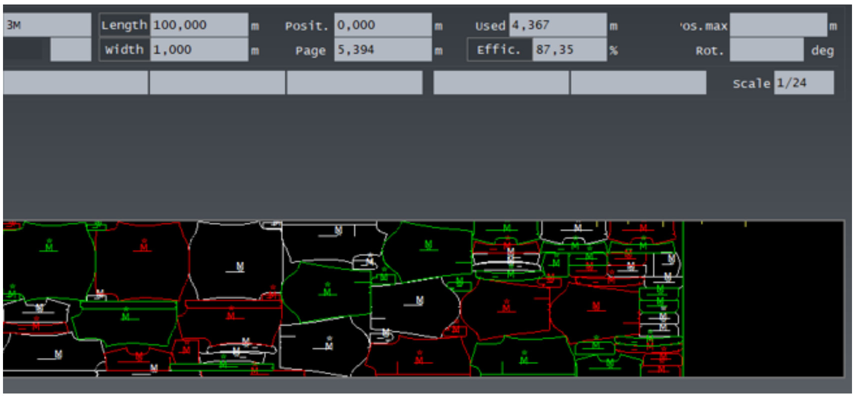
R software is used to determine the relationship between fabric consumption (Cons) and the parameters of the marker, fabric width (Width), and marker performance (Eff); Use the cbind function to consider the correlation of pairs of input variables; Use the summary command to view results ensuring high reliability and accuracy.

To consider the impact of each input variable on the variation of fabric consumption (Cons), use the LMG method to divide the model's coefficient of determination R^2 for each input variable. LMG is the abbreviation of the three statisticians who came up with this index Lindermann, Merenda, and Gold. This is a new and good measure used by many statisticians. Use the calc.relimp function and the boot.relimp function in R to divide the coefficient of determination R^2 of the model for each input variable [7]

III. RESULTS AND DISCUSSION

3.1. Marker results and marker performance

Using 25 markers, each marker has 3 set patterns of shirts with the same size, each marker is on different fabric widths of 1m, 1.2m, 1.4m, 1.5m, and 1.6m. The result of the size M marker is as shown. The marker results for other sizes are as shown in Table 1.



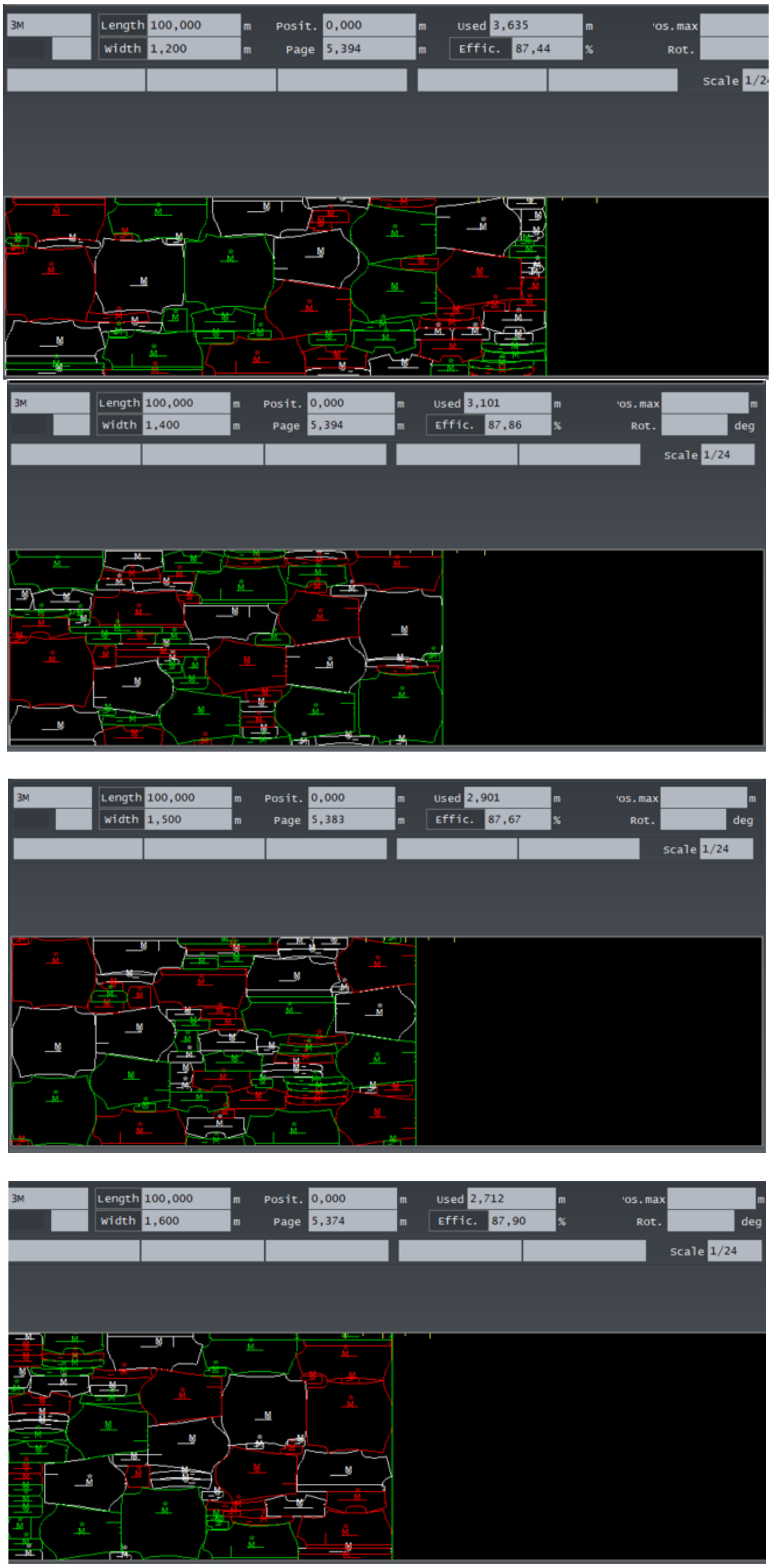


Figure 1. Size M shirt marker with different fabric widths

Table 1. Marker making results

No	Size	Width (m)	Cons (m)	Eff (%)	No	Size	Width (m)	Cons (m)	Eff (%)
1	S	1	1.434	85.5	16	XL	1	1.583	87.84
2	S	1.2	1.168	87.43	17	XL	1.2	1.326	87.36
3	S	1.4	0.999	87.68	18	XL	1.4	1.139	87.21
4	S	1.5	0.931	87.72	19	XL	1.5	1.060	87.45
5	S	1.6	0.878	87.26	20	XL	1.6	0.997	87.16
6	M	1	1.456	87.35	21	XXL	1	1.668	87.14
7	M	1.2	1.212	87.44	22	XXL	1.2	1.382	87.62
8	M	1.4	1.034	87.86	23	XXL	1.4	1.182	87.84
9	M	1.5	0.967	87.67	24	XXL	1.5	1.101	87.97
10	M	1.6	0.904	87.9	25	XXL	1.6	1.038	87.53
11	L	1	1.525	87.13					
12	L	1.2	1.260	87.88					
13	L	1.4	1.087	87.3					
14	L	1.5	1.012	87.55					
15	L	1.6	0.947	87.66					

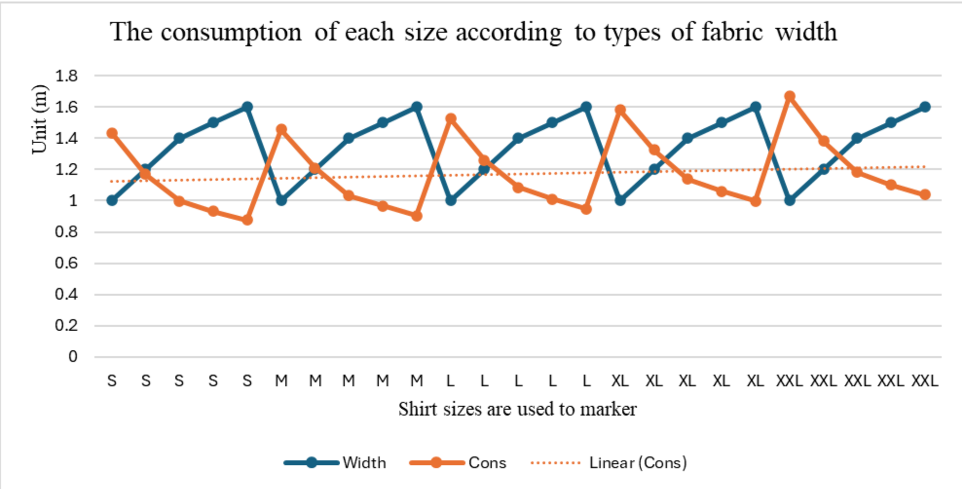


Figure 2. Representation of fabric consumption for a shirt of each shirt size when changing fabric width

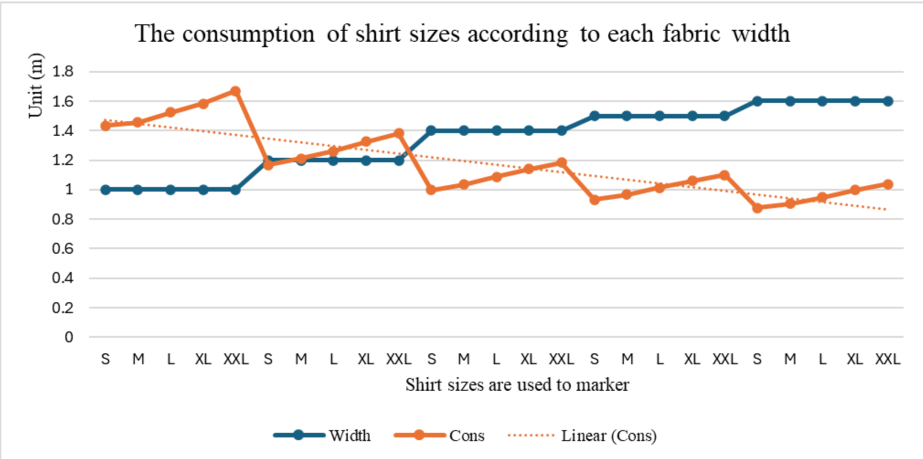


Figure 3. Representation of fabric consumption for a shirt of shirt sizes on each fabric width

Table 1 and Figure 2 show that with the same fabric width, fabric consumption for a shirt gradually increases as the size of the shirt increases. With a fabric width of 1m, when the shirt size increases from size S to XXL, the fabric consumption for a shirt increases by 16.3%. With fabric widths of 1.2m, 1.4m, 1.5m, and

1.6m, when the shirt size increases from size S to XXL, the fabric consumption for a shirt increases by about 18.3%.

Table 1 and Figure 3 show that fabric consumption for a shirt tends to decrease as the width of the fabric increases. When the width of the fabric increases combined with the size of the shirt decreasing, the fabric consumption for a shirt tends to decrease significantly. Within the scope of this study, the lowest fabric consumption for a shirt is size S with 0.88m when arranging patterns on a fabric width of 1.6m.

When the width of the fabric decreases and the size of the shirt increases, the fabric consumption for a shirt tends to increase significantly. Within the scope of this study, the fabric consumption for an XXL size shirt is 1.67m when arranging patterns on a 1m fabric width.

3.2. The results determine the fabric consumption for a shirt

3.2.1. Correlation between pairs of input data

The input data are fabric width (Width), shirt size (Size), and marker performance (Eff). These variables are correlated as follows:

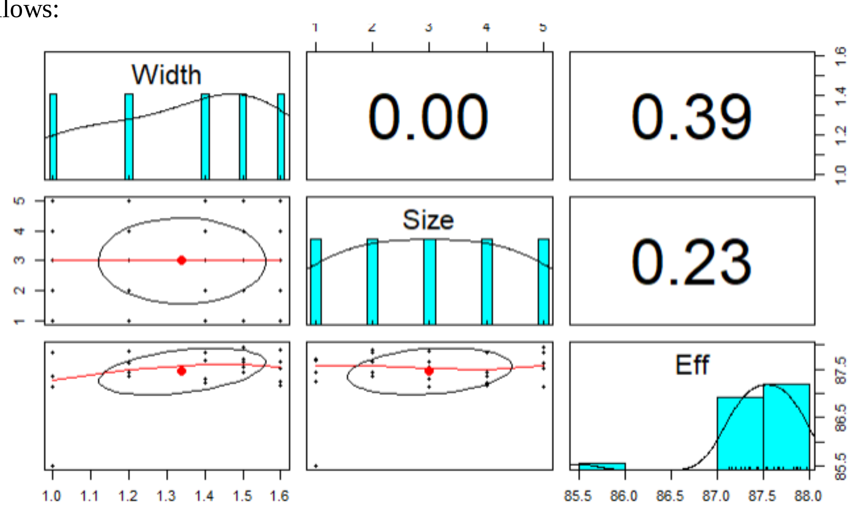


Figure 4. Correlation chart between pairs of input data

When considering the correlation between pairs of input data with the participation of all 3 variables, the results on the correlation chart show that there is no value of the correlation coefficient r greater than or equal to 0.95 means are input variables that are independent of each other. Therefore, it is possible to consider and search for separate relationships between output variables and input variables.

3.2.2. Relationship between input data and the output value of fabric consumption

The data is processed using R software to consider the linear relationship between the input variables fabric width (Width), shirt size (Size), and marker performance (Eff) with the value of the consumption output fabric (Cons). The results show that there exists a multivariate relationship between Cons and input variables as follows:

$$\mathbf{Cons = 4.65 - 0.94*Width + 0.05*Size - 0.03*Eff} \quad \textbf{(3)}$$

The model has a coefficient of determination $R^2 = 0.9824$; p-value: $< 2.2e-16 < 0.05$ has statistical significance. Thus, the variation of the input values Width, Size, and Eff explains 98.24% of the variation in fabric consumption (Cons) for a shirt within the research scope. This model allows estimating fabric consumption for a shirt when knowing the width of the fabric and shirt size.

Model (3) is a model that shows the correlation between the input variables fabric width (Width), shirt size (Size), and marker performance (Eff) with the value of the output of fabric consumption (Cons). The regression coefficients in the model show that the fabric consumption (Cons) for a shirt will decrease when increasing the width of the fabric (Width) and keeping the shirt size (Size) and the marker performance (Eff) constant. When the value of the input variable fabric width (Width) increases by 1 unit and the shirt size (Size) and the mapping performance (Eff) do not change, the fabric consumption (Cons) for a shirt will decrease by 0.94 units within the study range.

The model for calculating fabric consumption (Cons) depends on three input variables including fabric width (Width), shirt size (Size), and marker performance (Eff). The model shows the impact of all three variables on the variation of fabric consumption through the determination coefficient R^2. Use the calc.relimp function and the boot.relimp function in R to determine the model's coefficient of determination R^2 for each input variable. The following results:

The coefficient for determining R^2 of fabric width (Width) is 0.8032.

The coefficient for determining R^2 of shirt size is 0.1095.

The coefficient of determination R^2 of marker performance (Eff) is 0.0696

Thus, the variation of the input values Width explains 80.32%, that of Size explains 10.95%, and Eff explains 6.96% of the variation in fabric consumption (Cons) for a shirt within the scope of the study. This result shows that fabric width changes have the most influence on the change in fabric consumption.

IV. CONCLUSION

The parameters of the marker are fabric width (Width), shirt size (Size), and marker performance (Eff) which have a linear relationship with fabric consumption (Cons). The fabric consumption (Cons) for a shirt will decrease when increasing the width of the fabric (Width) and keeping the shirt size (Size) and the marker performance (Eff) the same.

The multivariable linear regression model between the Cons and basic parameters of the marker has been determined:

Cons = 4.65 - 0.94*Width + 0.05*Size - 0.03*Eff

$R^2 = 0.9824$; p-value: < 2.2e-16

This model allows estimating fabric consumption for a shirt when knowing the width of the fabric and shirt size. It is necessary to consider and choose the appropriate fabric width to reduce fabric consumption, thereby determining more accurately fabric consumption when purchasing and distributing fabric for production. Specifically, to calculate the general consumption for the entire order by choosing a representative size, choosing the width of the fabric, determining the low marker performance Eff, then use model (3) to calculate the fabric consumption when buying fabric from a supplier. When it is necessary to allocate fabric for production, use the higher marker performance Eff.

When fabric width changes, it will have the most impact on the change in fabric consumption. The variation of the input values of fabric width explains 80.32% of shirt size explains 10.95%, and marker performance explains 6.96% of the variation in fabric consumption for a shirt within the scope of research.

The results of this study are the basis to help garment enterprises achieve greater efficiency in producing and business garments.

REFERENCES

[1]. R.Rathinamoorthy, R.Surjit, 2018, APPAREL MERCHANDISING, Woodhead Publishing India Pvt. Ltd, 303, Vardaan House, 7/28, Ansari Road, Daryaganj, New Delhi - 110002, India.

[2]. Md Nazmul Haque, 2016, Impact of different sorts of marker performance in fabric consumption. International Journal of Textile Science, 5(5): 96-109

[3]. Hazem Yassin & AlSaid Al Metwally, 2018, Influencing fabric shrinkage and different size ratios on marker-making performance and fabric 58 consumption rate for men's shirts. International Design Journal, Volume 8, Issue 2

[4]. Parthraj Puranik, Saloni Jain, 2017, Garment Marker Planning - A Review. International Journal of Advanced Research in Education & Technology, Vol. 4, Issue 2, 30-33.

[5]. Nguyễn Thị Lệ, 2017, Ảnh hưởng của thông số sơ đồ giác tới định mức vải áo T- shirt trong may công nghiệp. Tạp chí Khoa học và công nghệ (số 50 – 2019)

[6]. Nguyễn Thị Sinh, 2014, Nghiên cứu đề xuất phương án tính định mức tiêu hao nguyên liệu và xây dựng phần mềm tính toán phù hợp với đơn hàng FOB ngành công nghiệp may. Đề tài cấp Bộ Công Thương

[7]. Dalgaard, 2004, Introductory statistics with R. Springer.