Calculation method for the determination of the unit costs of fabrics woven in semi-automatic looms in small-sized enterprises

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REZUMAT – ABSTRACT

Metodă de calcul pentru determinarea costurilor unitare ale țesăturilor produse în întreprinderile mici-mijlocii cu războaie de țesut semi-automate

Modul elementar de maximizare a profitului în țesătoriile de mici dimensiuni, care îți desfășoară activitatea într-un mediu extrem de competitiv din industria textilă, este de a reduce costurile, cu condiția menținerii stabile a calității producției. Cu toate acestea, asemenea majorității întreprinderilor de mici dimensiuni din industrie, care au o structură de producție de tip atelier pe bază de comandă, procesele de calculație a costurilor sunt în mod curent efectuate pe baza experiențelor profesionale, fără o metodă specifică. Aceasta complică controlul costurilor și maximizarea profitului în țesătoriile de mici dimensiuni.

În cadrul acestui studiu, obiectivul a fost de acela de a conștientiza referitor la semnificația calculării corespunzătoare a costurilor în țesătoriile de mici dimensiuni și de a propune o metodă de calcul de bază pentru calcularea costurilor unitare. În plus, metoda de calcul a costurilor, care a fost elaborată având în vedere cerințele întreprinderilor din regiune, a fost aplicată în calcularea costurilor unitare pentru articolele "fular" și "eșarfă", acestea fiind cele mai frecvente produse țesute în intreprinderile de mici dimensiuni din regiune.

Cuvinte-cheie: țesere, războaie de țesut semi-automate, calcularea costurilor unitare, metodă de calculare a costurilor, întreprinderi mici

Calculation method for the determination of the unit costs of fabrics woven in semi-automatic looms in small-sized enterprises

The most basic way of maximizing the profit in small-sized weaving enterprises, which manufacture in a highly competitive environment in textile industry, is to reduce the costs provided that the product manufacturing quality is kept stable. However, as most of the small-sized enterprises in the industry have a workshop-type manufacturing structure on a per order basis, the cost calculation processes are usually conducted based on professional experiences without a specific method. This complicates the cost control and profit maximization in small-sized weaving enterprises.

Within this study, the objective was to raise awareness on the significance of proper cost calculation in small-sized weaving enterprises and to propose a basic calculation method for the calculation of unit costs. In addition, the cost calculation method, which was developed considering the requirements of the enterprises within the region, was applied in calculation of the unit costs of "peshtemal" and "scarf" items, which are the most popular woven products in the small-sized weaving enterprises in the region.

Keywords: weaving, semi-automatic looms, unit cost calculation, cost calculation method, small-sized enterprises

INTRODUCTION

The enterprises that manufacture goods and services, which the society needs, by combining various production factors are the building blocks of national economies. The said enterprises' being able to make a profit and so to contribute to the economy is made possible by manufacturing products in required quantities with minimum cost. In the industries where free competition is dominant, although the selling prices of manufactured goods are determined by the enterprises, they arise at the point where supply and demand cross under the market conditions. Therefore, the most important activity that needs to be performed so that enterprises can make profit in a preferred rate is to calculate the costs in the most correct way and to build an efficient cost control system. Thus, it will be possible to have minimum manufacturing costs by continuously checking them [1].

Weaving industry, which is one of the most important sub-branches of textile industry, is a manufacturing industry where there is a high level of competition in the world market today. The fact that the unit prices of fabrics, which are especially woven in the countries such as China, India and Brazil where the labor and energy costs are relatively low, are low and that the output is high complicates the competitiveness of other countries in this industry.

Enterprises need methods for an efficient calculation of their manufacturing costs and for a consistent cost control in order that they can compete and can be permanent in weaving industry [2, 3]. Medium-sized and big enterprises in the industry usually have the cost calculation programs and the trained personnel to use the methods for efficiently calculating the manufacturing costs within their existing organizational structures.

However, as most of the small-sized enterprises in the industry have a workshop-type manufacturing structure on a per order basis, the cost calculation processes are usually conducted based on professional experiences without a specific method. The possibility of making a mistake is quite high in cost calculations which are conducted without any specific method. In this industry where there is a high level of competition, such cost calculation mistakes may cause small-sized enterprises to encounter financial difficulties in a short time.

Various studies related to the subject are summarized as follows.

Rendall et al. (1999) conducted a survey study in order to research the cost management in textile companies and evaluated the results. The results proved that companies usually used traditional cost management systems and could not benefit from the advantages of modern cost management systems. However, apart from this, it was suggested that companies endeavored to improve themselves with practical experiences [4].

In their study, Koç and Kaplan (2006) made a theoretical approach in order to determine the cost of the yarns which are manufactured with specific properties in yarn enterprises. Following this, they made a cost calculation for 30/1 combed cotton weaving yarn by using the equations obtained from this theoretical approach, and compared the obtained values under the light of literature [1].

In another study, Kaplan and Koç (2006) defined equations for the calculation of the cost of a typical woven fabric and conducted an application study in a weaving enterprise. They made a cost calculation for a woven fabric with specific properties and the data obtained from the calculation were compared to the data obtained from the literature. At the end of the study, it was stated that the suggested equations were usable in the cost calculation of a woven fabric [5].

Ünal and Koç (2010) studied the manufacturing parameters, performance specifications and cost analysis of woven towel fabrics. Moreover, they endeavored to develop a software program which would optimize the costs of towel fabrics and to optimize the cost elements so as to minimize the unit cost [6].

In their study, Koç and Çinçik (2010) examined the energy types and amount used during the manufacturing of woven fabrics. As an application study, they also analyzed the energy consumption in a weaving enterprise. They aimed to develop a theoretical model in order to determine the energy consumption in the enterprise [7].

In their study, Değirmenci and Çelik (2013) elaborated the factors which affect the unit cost in a knitting enterprise and developed a software which calculates the unit cost of double-knit fabrics. At the end of the study, they compared the theoretical calculations and the results obtained from the software, and it was observed that the results obtained from the software were successful. By means of the software, the cost calculations in enterprises will be able to reach a definite speed and it will help make efficient decisions in especially manufactural problems [8].

The objective of this study is to raise awareness on the significance of proper cost calculation in workshop-type small-sized weaving enterprises that manufacture on a per order basis and to propose a basic calculation method for the calculation of unit costs. In the application study, the unit costs of "Peshtemal" and "Scarf" products, which were the most popular woven products in the small-sized textile enterprises in Buldan, were determined based on the calculation method.

The calculation method was specifically prepared for small-sized weaving enterprises; there is not any specific study for this purpose in literature.

EXPERIMENTAL PART

Denizli and its surroundings are one of the centers where weaving is the permanent source of income in Anatolia. It is known that city of Buldan is one of the headquarters of weaving in Denizli [9]. Most of the products manufactured in the city today are manufactured in workshop-type small-sized enterprises and semi-automatic weaving looms. According to an inventory research conducted by Ertuğrul and Utkun in 2009, it was confirmed that there were 127 units of semi-automatic weaving looms in the city [10]. The capital structure and output of the small-sized weaving enterprises in the region are not in the level to compete with big weaving enterprises. Therefore, enterprises endeavor to survive within the industry with high costs and low profit margin. Such enterprises need to utilize a calculation method with which they can calculate their unit costs in the most correct way and to have a consistent cost control in order that they can exist in the market for a long term.

Materials

In the application study, the unit costs of "Peshtemal" and "Scarf" products, which were the most popular woven products in the semi-automatic weaving looms in small-sized enterprises operating in Buldan, were determined based on the calculation method. In the study, the data obtained from the Limited Buldan Weavers' Association No: 1 was used. Limited Buldan Weavers' Association, which was founded in 1937 with 195 numbers of shareholders, works to improve weaving in the city. It was the first association in Turkish Republic in weaving area. It also reflects the characteristics of the products in the region.

The images of the products are displayed in figures 1 and 2. The technical details of the products are presented in table 1.

Method

In the study, a calculation method was proposed to use in the calculation of unit costs in workshop-type small-sized weaving enterprises that usually manufacture on a per order basis.

Table 1

TECHNICAL DATA OF PRODUCTS		
	1st product Peshtemal	**2nd product Scarf**
Weaving Preparation (Hour)		
a) Warp **(T_W)**	4	6
b) Drawing in **(T_D)**	2	6
c) Combing **(T_C)**	2	3
d) Knotting **(T_K)**	0	0
Weaving Preparation Labor Hourly Rate ($)		
a) Warp **(C_{WL})**	50	75
b) Drawing in **(C_{DL})**	75	100
c) Combing **(C_{CL})**	45	50
d) Knotting **(C_{KL})**	0	0
Technical data of fabrics		
Fabric width (cm)	90	60
Fabric length **(L_{UF})** (m)	1,80	1,80
Weft density in 1 cm **(D_{Wt})**	22	22
Comb width **(W_C)** (cm)	95	62
Weft yarn count **(W_C)**	300 denier = 30 Nm	300 denier = 30 Nm
Wastage Rate of Yarn **(R_{WY})** (%)	7	7
Production quantity **(Q_P)** (Piece)	1000	1000
Type of weft yarn	100% Insect Silk	100% Floss Silk
Type of warp yarn	100% Cotton	100% Floss Silk
Yarn Price – Insect Silk (300 denier) **(P_Y)** ($/Kg)	150	
Yarn Price – Cotton (Nm 40/2) **(P_Y)** ($/Kg)	7,20	
Yarn Price – Floss Silk (300 denier) **(P_Y)** ($/Kg)		19
Warp Length **(L_{UW})** (m)	1,80	1,80
Number of Teeth on the Comb in One cm **(TN_C)**	7	7
Number of Thread in One Teeth in Hem **(Th_{NH})**	4	4
Warp Width of Fabric Hem **(WW_{FH})** (cm)	2	2
Number of Thread in One Teeth in Floor **(Th_{NF})**	2	2
Warp Width of Fabric Floor **(WW_{FF})** (cm)	88	58
Warp yarn count **(CT_{WY})**	Nm 40/2	300 denier = 30 Nm
Shrinkage Amount of Product in Warp Direction **(SA_W)** (%)	0	0
Machine Speed **(S_M)** (turnover/minute)	115	115
Production Efficiency **(E_{MP})** (%)	80	80
Normal Monthly Working Minutes of a Worker **(T_{WM})**	10800	
Monthly Labor Cost of One Worker **(C_{ML})** ($)	600	
Monthly Energy Cost of One Machine**(C_{ME})** ($)	150	
Unit Cost of Semi-Automatic Loom **(C_{UL})** ($)	15000	
Economic Life of Machine **(EL_M)** (year)	10	
Other Costs Rate **(R_{OC})** (%)	10	10
Wastage Rate of Product **(R_{WP})** (%)	2	2
The right and left edges of both products are 1 cm.		
Both products were manufactured in plain weave and their surfaces are smooth.		
After the weaving process was completed, the fabrics were kept in 50ºC water for 90 minutes without adding any substance; following this, they were left to dry.		
The products can optionally have a tassel in their warp length. If a tassel is not requested, these tassels must be tied by knotting as the last process.		

Fig. 1. Peshtemal sample

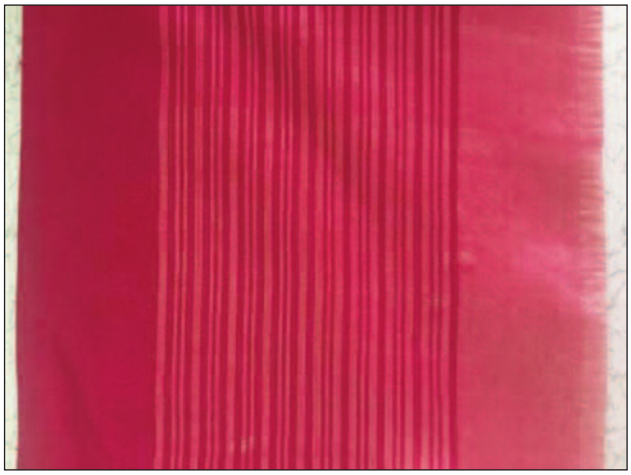

Fig. 2. Scarf sample

When proposing a calculation method to use in the calculation of unit costs in weaving enterprises, the cost items such as yarn cost (weft + warp + wastage + shrinkage amounts), labor cost, energy cost, amortization cost, incalculable small costs and wastage rate of product were considered.

Calculation of the unit cost of woven fabrics

The cost calculation system developed in the study was designed in accordance with the conditions of plain weave system. The most important reason to prefer this method is that it is the most common weaving method in the small-sized enterprises operating in Buldan and its surroundings. This situation constitutes a constraint of the study. In addition, the basic abbreviations, which are used in the cost calculation method developed in the study, and their explanations are given as follows.

C	= Cost	**R**	= Rate
CT	= Count	**S**	= Speed
D	= Density	**SA**	= Shrinkage Amount
E	= Expenses	**T**	= Time
EF	= Efficiency	**ThN**	= Number of Thread
EL	= Economic Life	**TN**	= Number of Teeth
L	= Length	**W**	= Width
P	= Price	**WL**	= Warp Length
Q	= Quantity	**WW**	= Warp Width

In weaving enterprises, as in the other enterprises, first of all, the expenses occurring during the manufacturing process of the product must be determined in order to determine the unit costs. As it is seen in equation (1), first of all, Raw Material Cost (C_{RM}) and General Production Expenses (E_{GP}) are divided into Production Quantity (Q_P) in calculation of Total Unit Cost (C_{TU}) of the fabrics woven in semi-automatic looms in small-sized enterprises. Other Costs Rate (R_{OC}) in a definite rate and Wastage Rate of Product (R_{WP}), which may vary from product to product, are added to the unit cost and C_{TU} figure is obtained.

The most important problem in the calculation of unit costs in small-sized weaving enterprises is that the required cost calculation data cannot be obtained in detail. Therefore, at the end of the one-on-one meetings with the industry representatives, it was confirmed that other costs rate as 10% must be added to the total unit cost. Other costs rate include "Incalculable Micro Costs", "Indirect Labor Costs", "Invisible Costs", "Unexpected Costs" and "Possible Calculation Deficits-Errors".

$$C_{TU}(\$) = \left[\left(\frac{C_{RM}(\$) + E_{GP}(\$)}{Q_P\ (\text{Piece})}\right) \times 1, R_{OC}\right] \times 1, R_{WP} \quad (1)$$

where:

C_{TU}	= Total Unit Cost
C_{RM}	= Raw Material Cost
E_{GP}	= General Production Expenses
Q_P	= Production Quantity
R_{OC}	= Other Costs Rate
R_{WP}	= Wastage Rate of Product

Calculation of Raw Material Cost

Raw material cost is generally the cost of the main elements that constitute a product. Considering the woven fabric, the raw material is taken as yarn [8]. As it is seen in equation (2), the order-based raw material cost (C_{RM}) in woven fabrics was determined by adding up Weaving Preparation Cost (C_{WP}) and Yarn Cost (C_Y).

$$C_{RM}(\$) = C_{WP} + C_Y \quad (2)$$

where:

C_{RM}	= Raw Material Cost
C_{WP}	= Weaving Preparation Cost
C_Y	= Yarn Cost

a) Weaving Preparation Cost

Weaving preparation process consists of four main titles as "Warp preparation", "Drawing-in", "Combing" and "Knotting".

The purpose of warp preparation is to allow the warp to feed to the loom in a layer consisting of parallel

yarns in equal tension and to maintain this position during the weaving process [11].

The other preparation process right after the warp is prepared is to draw in the warp by framing it in an appropriate level and then to comb it properly [11].

If a new weaving process with a different weaving knit will start on the loom, drawing-in and combing processes are performed; however, if the same product will continue to be woven, only the knotting process is performed.

As it is seen in equation (3), order-based Weaving Preparation Cost (C_{WP}) is calculated by adding up Warp Cost (C_W), Drawing-in Cost (C_D), Combing Cost (C_C) and Knotting Cost (C_K). All of these costs are determined by multiplying the time to be spent for the process with the labor cost.

$$C_{WP}(\$) = C_W + C_D + C_C + C_K \quad (3)$$

where:

C_{WP} = Weaving Preparation Cost
C_W = Warp Cost
C_D = Drawing in Cost
C_C = Combing Cost
C_K = Knotting Cost

$$C_{WP}(\$) = \left[(T_W \times C_{WL}) + (T_D \times C_{DL}) + (T_C \times C_{CL}) + (T_K \times C_{KL})\right] \quad (4)$$

where:

C_{WP} = Weaving Preparation Cost
T_W (Hour) = Warp Time
C_{WL} ($/Hour) = Warp Labor Cost
T_D (Hour) = Drawing in Time
C_{DL} ($/Hour) = Drawing in Labor Cost
T_C (Hour) = Combing Time
C_{CL} ($/Hour) = Combing Labor Cost
T_K (Hour) = Knotting Time
C_{KL} ($/Hour) = Knotting Labor Cost

b) Yarn Cost

The most important cost item in weaving process is Yarn Cost (C_Y). As it is seen in equation (4), order-based C_Y is determined by adding up Weft Yarn Cost (C_{WP}) and Warp Yarn Cost (C_{WY}).

$$C_Y(\$) = C_{WtY} + C_{WY} \quad (5)$$

where:

C_Y = Yarn Cost
C_{WtY} = Weft Yarn Cost
C_{WY} = Warp Yarn Cost

As it is seen in equation (5), first of all, the weft yarn quantity to be used for the ordered product is specified as kg. in calculation of Weft Yarn Cost (C_{WtY}). The total weft yarn cost as per order is calculated by multiplying the specified quantity with the yarn price [12].

$$C_{WtY} = \left[\left(\frac{L_{UF} \times D_{Wt} \times W_C}{CT_{WtY}} \times 1, R_{WY}\right) \times Q_P\right] \times \frac{P_Y}{1000} \quad (6)$$

where:

C_{WtY} ($) = Weft Yarn Cost
L_{UF} (m) = Unit Fabric Length
D_{Wt} (in 1 cm) = Weft Density
W_C (cm) = Comb Width
CT_{WtY} (Nm) = Weft Yarn Count
R_{WY} = Wastage Rate of Yarn
Q_P (Piece) = Production Quantity
P_Y ($/Kg) = Yarn Price

As it is seen in equation (6), first of all, the warp yarn quantity to be used for the ordered product is specified as kg. in calculation of Warp Yarn Cost (C_{WY}). The total warp yarn cost as per order is calculated by multiplying the specified quantity with the yarn price [12].

$$C_{WY} = \left[\left(\frac{L_{UW} \times (TN_C \times Th_{NH} \times WW_{FH} + TN_C \times Th_{NF} \times WW_{FF})}{CT_{WY} \times (1 - SA_W)} \times 1, R_{WY}\right) \times Q_P\right] \times \frac{P_Y}{1000} \quad (7)$$

where:

C_{WY} ($) = Warp Yarn Cost
L_{UW} (m) = Unit Warp Length
TN_C (in 1 cm) = Number of Teeth on the Comb in One cm
Th_{NH} (in one teeth) = Number of Thread in One Teeth in Hem
WW_{FH} (cm) = Warp Width of Fabric Hem
Th_{NF} (in one teeth) = Number of Thread in One Teeth in Floor
WW_{FF} (cm) = Warp Width of Fabric Floor
CT_{WY} (Nm) = Warp Yarn Count
SA_W (%) = Shrinkage Amount of Product in Warp Direction
R_{WY} = Wastage Rate of Yarn
Q_P (Piece) = Production Quantity
P_Y ($/Kg) = Yarn Price

Calculation of General Production Expenses

As it is seen in equation (7), General Production Expenses (E_{GP}) in the small-sized weaving enterprises running on a per order basis are determined by adding up the calculated Labor Cost (C_L), Energy Cost (C_E) and Amortization Cost (C_A).

$$E_{GP}(\$) = C_L + C_E + C_A \quad (8)$$

where:

E_{GP} = General Production Expenses
C_L = Labor Cost
C_E = Energy (Electricity) Cost
C_A = Amortization Cost

a) Labor Cost:

In the formula to be used in calculation of the labor cost in small-sized weaving enterprises, first of all, the monthly working hours required for the related order are calculated, and then, the obtained result is multiplied with the monthly labor cost of one worker. In calculation of the labor cost, the social security deductions of the employer must be added to the cost in addition to the gross pay. As there is a workshop-type manufacturing in small-sized weaving enterprises, the calculated labor cost is "Direct Labor Cost". As "Indirect Labor Cost" was very low and incalculable in the total labor cost, it was not included in the calculation. The impact of the indirect labor cost on the manufacturing cost is included in "Other Costs".

As it is seen in equation (8), first of all, the time to be spent for manufacturing the ordered product is specified in minutes in calculation of the labor cost. The coefficient, which is determined by dividing the specified figure into 10.800 minutes that is the normal monthly working hours of a worker, is multiplied with Monthly Labor Cost of One Worker (C_{ML}), so the total Labor Cost (C_L) as per order is calculated.

$$C_L = \frac{\left(\frac{L_{UF} \times D_{Wt}}{S_M \times E_{MP}}\right) \times Q_P}{T_{WM}^*} \times C_{ML} \qquad (9)$$

where:

C_L ($) = Labor Cost

L_{UF} (cm) = Unit Fabric Length

D_{Wt} (in 1 cm) = Weft Density

S_M (Turnover/Minute) = Machine Speed

E_{MP} = Production Efficiency

Q_P (Piece) = Production Quantity

T_{WM} (Minute/Month) = Normal Monthly Working Minutes of a Worker

C_{ML} ($) = Monthly Labor Cost of One Worker

- **Normal Monthly Working Hours:**

As per the agreement no: 47 acknowledged by International Labor Organization (ILO) in 1935, the normal weekly working hours of workers were determined as 40 hours. Each country throughout the world may apply different normal weekly working hours. As the application study was conducted in Turkey, the normal weekly working hours were defined as 45 hours in the local labor act. Based on that, the normal monthly working hours of a worker were calculated in minutes as follows (This situation constitutes a constraint of the study, and this section must be revised based on the normal weekly working hours in the countries where the cost calculation method is used):

Normal Monthly Working Hours of a Worker (WH_N)**:** 4 Weeks × 45 Hours = 180 Hours × × 60 Minutes = **10.800 Minutes/Month**

b) Energy Cost

In the formula to be used in calculation of the energy cost in small-sized weaving enterprises, first of all, the monthly working hours required for the related order are calculated and then, the obtained result is multiplied with the monthly average energy cost of one machine. As the proportion of the energy cost to the total cost is very low in the manufacturing in semi-automatic looms, the monthly energy cost of the looms was not calculated in detail in the study and an average cost figure was taken into consideration. This situation constitutes another constraint of the study.

As it is seen in equation (9), first of all, the time to be spent for manufacturing the ordered product is specified in minutes in calculation of the energy cost. The coefficient, which is determined by dividing the specified figure into 10.800 minutes that is the normal monthly working hours of a worker, is multiplied with Monthly Energy Cost of One Machine (C_{MF}), so the total Energy Cost (C_F) as per order is calculated.

$$C_E = \frac{\left(\frac{L_{UF} \times D_{Wt}}{S_M \times E_{MP}}\right) \times Q_P}{T_{WM}^*} \times C_{ME} \qquad (10)$$

where:

C_E ($) = Energy Cost

L_{UF} (cm) = Unit Fabric Length

D_{Wt} (in 1 cm) = Weft Density

S_M (Turnover/Minute) = Machine Speed

E_{MP} = Production Efficiency

Q_P (Piece) = Production Quantity

T_{WM} (Minute/Month) = Normal Monthly Working Minutes of a Worker

C_{ME} ($) = Monthly Energy Cost of One Machine

c) Amortization Cost

Amortization means the depreciation of the fixed assets in enterprises. Enterprises use the tangible assets, which they purchase to utilize, for more than one year under normal conditions. The average life cycle of tangible assets is called as economic life. Therefore, the amortization costs of tangible assets must be added to the production costs based on their economic life and considering their manufacturing time. The most important tangible asset which is subject to amortization in small-sized weaving enterprises is the loom.

In the formula to be used in calculation of the amortization cost in small-sized enterprises, first of all, the monthly working hours required for the related order are calculated and then, the obtained result is multiplied with the monthly amortization cost of one semi-automatic weaving loom. The monthly amortization cost of a weaving loom is calculated by dividing the

Table 2

SAMPLE PESHTEMAL ORDER – UNIT COST CALCULATION TABLE			
	Weaving Preparation		$C_{WP}(\$) = [(4\,(\text{Hour}) \times 50\,(\$/\text{Hour})) + (2\,(\text{Hour}) \times 75\,(\$/\text{Hour})) + (2\,(\text{Hour}) \times 45\,(\$/\text{Hour})) + (0\,(\text{Hour}) \times 0\,(\$/\text{Hour}))] = \mathbf{440,00}$
	Yarn Cost	Weft Yarn Cost	$C_{WtY}(\$) = \left[\left(\frac{1.80\,(\text{m}) \times 22\,(\text{in 1 cm}) \times 95\,(\text{cm})}{30\,(\text{Nm})} \times 1.07\right) \times 1000\,(\text{Piece})\right] \times \left(\frac{150\,(\$/\text{Kg})}{1000}\right) = \mathbf{20.126,70}$
		Warp Yarn Cost	$C_{WY}(\$) = \left[\left(\frac{1.80\,(\text{m}) \times (7\,(\text{in 1 cm}) \times 4\,(\text{in one teeth}) \times 2\,(\text{cm}) + 7\,(\text{in 1 cm}) \times 2\,(\text{in one teeth}) \times 88\,(\text{cm}))}{20(\text{Nm}) \times (1-0)} \times 1.07\right) \times 1000\,(\text{Piece})\right] \times \left(\frac{7.20\,(\$/\text{Kg})}{1000}\right) = \mathbf{893,05}$
RAW MATERIAL COST			$C_{RM}(\$) = 440,00 + (20.126,70 + 893,05) = \mathbf{21.459,75}$
	Labor Cost		$C_L(\$) = \left[\frac{\left(\frac{180(\text{cm}) \times 22\,(\text{in 1 cm})}{115\,(\text{Turnover/Minute}) \times 0.80}\right) \times 1000\,(\text{Piece})}{10.800(\text{Minute/Month})*}\right] \times 600\,(\$) = \mathbf{2.391,30}$
	Energy Cost		$C_E(\$) = \left[\frac{\left(\frac{180(\text{cm}) \times 22\,(\text{in 1 cm})}{115\,(\text{Turnover/Minute}) \times 0.80}\right) \times 1000\,(\text{Piece})}{10.800(\text{Minute/Month})*}\right] \times 150\,(\$) = \mathbf{597,83}$
	Amortization Cost		$C_L(\$) = \left[\frac{\left(\frac{180(\text{cm}) \times 22\,(\text{in 1 cm})}{115\,(\text{Turnover/Minute}) \times 0.80}\right) \times 1000\,(\text{Piece})}{10.800(\text{Minute/Month})*}\right] \times \left[\frac{\left(\frac{15.000\,(\$)}{10\,(\text{Year})}\right)}{12}\right] = \mathbf{498,19}$
GENERAL PRODUCTION EXPENSES			$E_{GP}(\$) = 2.391,30 + 597,83 + 498,19 = \mathbf{3.487,32}$
TOTAL UNIT COST			$C_{TU}(\$) = \left[\left(\frac{21.459,75\,(\$) + 3.487,32\,(\$)}{1000\,(\text{Piece})}\right) \times 1,10\right] \times 1,02 = \mathbf{\$27,99/pcs}$

Table 3

SAMPLE PESHTEMAL ORDER – UNIT COST CALCULATION TABLE			
	Weaving Preparation		$C_{WP}(\$) = [(6\,(\text{Hour}) \times 75\,(\$/\text{Hour})) + (6\,(\text{Hour}) \times 100\,(\$/\text{Hour})) + (3\,(\text{Hour}) \times 50\,(\$/\text{Hour})) + (0\,(\text{Hour}) \times 0\,(\$/\text{Hour}))] = \mathbf{1.200,00}$
	Yarn Cost	Weft Yarn Cost	$C_{WtY}(\$) = \left[\left(\frac{1.80\,(\text{m}) \times 22\,(\text{in 1 cm}) \times 62\,(\text{cm})}{30\,(\text{Nm})} \times 1.07\right) \times 1000\,(\text{Piece})\right] \times \left(\frac{19\,(\$/\text{Kg})}{1000}\right) = \mathbf{1.663,67}$
		Warp Yarn Cost	$C_{WY}(\$) = \left[\left(\frac{1.80\,(\text{m}) \times (7\,(\text{in 1 cm}) \times 4\,(\text{in one teeth}) \times 2\,(\text{cm}) + 7\,(\text{in 1 cm}) \times 2\,(\text{in one teeth}) \times 58\,(\text{cm}))}{30(\text{Nm}) \times (1-0)} \times 1.07\right) \times 1000\,(\text{Piece})\right] \times \left(\frac{19\,(\$/\text{Kg})}{1000}\right) = \mathbf{1.058,79}$
RAW MATERIAL COST			$C_{RM}(\$) = 1.200,00 + (1.663,67 + 1.058,79) = \mathbf{3.922,46}$
	Labor Cost		$C_L(\$) = \left[\frac{\left(\frac{180(\text{cm}) \times 22\,(\text{in 1 cm})}{115\,(\text{Turnover/Minute}) \times 0.80}\right) \times 1000\,(\text{Piece})}{10.800(\text{Minute/Month})*}\right] \times 600\,(\$) = \mathbf{2.391,30}$
	Energy Cost		$C_E(\$) = \left[\frac{\left(\frac{180(\text{cm}) \times 22\,(\text{in 1 cm})}{115\,(\text{Turnover/Minute}) \times 0.80}\right) \times 1000\,(\text{Piece})}{10.800(\text{Minute/Month})*}\right] \times 150\,(\$) = \mathbf{597,83}$
	Amortization Cost		$C_L(\$) = \left[\frac{\left(\frac{180(\text{cm}) \times 22\,(\text{in 1 cm})}{115\,(\text{Turnover/Minute}) \times 0.80}\right) \times 1000\,(\text{Piece})}{10.800(\text{Minute/Month})*}\right] \times \left[\frac{\left(\frac{15.000\,(\$)}{10\,(\text{Year})}\right)}{12}\right] = \mathbf{498,19}$
GENERAL PRODUCTION EXPENSES			$E_{GP}(\$) = 2.391,30 + 597,83 + 498,19 = \mathbf{3.487,32}$
TOTAL UNIT COST			$C_{TU}(\$) = \left[\left(\frac{3.922,46\,(\$) + 3.487,32\,(\$)}{1000\,(\text{Piece})}\right) \times 1,10\right] \times 1,02 = \mathbf{\$8,33/pcs}$

unit cost of the loom into the economic life of the machine and then dividing the obtained figure into 12. As it is seen in equation (10), first of all, the time to be spent for manufacturing the ordered product is specified in minutes in calculation of the amortization cost. The coefficient, which is determined by dividing the specified figure into 10.800 minutes that is the normal monthly working hours of a worker, is multiplied with monthly amortization cost of one machine which is calculated via another equation, so the total Amortization Cost (C_A) as per order is calculated.

$$C_A = \frac{\left(\frac{L_{UF} \times D_{Wt}}{S_M \times E_{MP}}\right) \times Q_P}{T_{WM}^*} \times \frac{\frac{C_{UL}}{EL_M}}{12} \qquad (11)$$

where:

C_A ($) = Amortization Cost

L_{UF} (cm) = Unit Fabric Length

D_{Wt} (in 1 cm) = Weft Density

S_M (Turnover/Minute) = Machine Speed

E_{MP} = Production Efficiency

Q_P (Piece) = Production Quantity

T_{WM} (Minute/Month) = Normal Monthly Working Minutes of a Worker

C_{UL} ($) = Unit Cost of Semi-Automatic Loom

EL_M (Year) = Economic Life of Machine

RESULTS AND DISCUSSION

In accordance with the data obtained from the Limited Buldan Weavers' Association No: 1 by using the unit cost calculation method developed for small-sized weaving enterprises, the unit cost calculation of the sample peshtemal is given in table 2 and the unit cost calculation of the sample scarf is given in table 3.

In table 2, the unit cost of the sample peshtemal, the weft of which was made of silkworm yarn and the warp of which was made of cotton yarn, was calculated as $27.99/pcs based on the calculation method.

In table 3, the unit cost of the sample scarf, the weft and warp of which were made of floss silk yarn, was calculated as $8.33/pcs based on the calculation method.

CONCLUSION

There are two basic methods to maximize the profit in manufacturing enterprises. The first one is to increase the selling prices, and the second one is to reduce the costs. Considering that there is a highly competitive environment for the enterprises manufacturing in textile industry and that the selling prices are formed under the market conditions, it does not seem much possible to maximize the profit by raising the selling prices. It is possible to maximize the profit only through the remaining second method, which is to reduce the costs. The main condition for the enterprises to reduce their costs provided that they keep the production quality stable is to have a proper cost calculation method that provides correct results. In most of the big textile enterprises, the costs can be efficiently calculated via computer programs and other calculation methods. But as most of the small-sized enterprises in the industry have a workshop-type manufacturing structure on a per order basis, the cost calculation processes are usually conducted based on professional experiences without a specific method. This complicates the cost control and profit maximization in small-sized weaving enterprises.

The majority of weaving manufacturing is carried out in workshop-type small-sized enterprises and semi-automatic weaving looms in Buldan, which is one of the most important manufacturing centers of textile industry in Turkey and throughout the world from past to present.

Within this study, the objective was to raise awareness on the significance of proper cost calculation in workshop-type small-sized weaving enterprises that manufacture on a per order basis and to propose a basic calculation method for the calculation of unit costs.

The cost calculation method, which was developed considering the requirements of the enterprises in the region, was applied in calculation of the unit costs of peshtemal and scarf which were the most popular woven products in the small-sized weaving enterprises in the city of Buldan.

This cost calculation method could apply for various woven products. Following this study, it is planned to develop a computer program that will calculate the unit costs of the products manufactured in small-sized weaving enterprises.

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