NORTH TECHNICAL UNIVERSITY

FACULTY OF ENGINEERING IN APPLIED SCIENCE

CAREER OF INDUSTRIAL ENGINEERING

SCIENTIFIC ARTICLE PRIOR TO THE OBTAINMENT OF INDUSTRIAL ENGINEER MAJOR

THEME:

"ORGANIZATION OF WORK THROUGH METHODS OF TIMES AND MOVEMENTS IN THE NANTU TAMIA TEXTILE WORKSHOP DRESSING AREA TO INCREASE PRODUCTION"

AUTHOR: Edwin Rolando Jimbo Santellán

DIRECTOR: Ing. Carlos Alberto Machado Orges

Ibarra – Ecuador

2017

"ORGANIZATION OF WORK THROUGH METHODS OF TIMES AND MOVEMENTS IN THE NANTU TAMIA TEXTILE WORKSHOP DRESSING AREA TO INCREASE PRODUCTION"

Author- Edwin Rolando JIMBO SANTELLÁN

Technical University of North, Av. July 17, 5-21 and General Jose Maria Cordova, (593 6) 2997800 ext. 7070

Ibarra, Imbabura

Faculty of Engineering in Applied Sciences - Industrial Engineering

erjimbos@utn.edu.ec

Summary

The present investigation was carried out in the production area of the NANTU TAMIA microenterprise, this microenterprise is dedicated to the preparation of dresses and blouses. In the aforementioned research, greater emphasis was placed on the search for strategies to increase production. To do this, it begins with the compilation of pertinent and necessary information related to work study, which allows to generate solid guidelines for the practical elaboration of the research.

Once the bibliographic research is concluded, it is of vital importance to make a diagnosis that allows to determine the initial situation of the microenterprise, for that reason begins the diagnosis helped by flow diagrams processes, method and time studies, together with the balance of the Valuable information for subsequent analysis.

After performing the data analysis the results obtained showed the current production, the activities performed by the operators with their respective standard time and the costs involved in the production of dresses. Finally the idea of a technological innovation is proposed, which implies a change of the work method, distribution of activities and as a final result to increase production.

Keywords

Study of methods and times, Standard time, Productivity, line balance.

1. Introduction

The micro-enterprise "Nantu Tamia" is dedicated to the preparation of dresses and blouses in cotton cloth, has a trajectory of more than 7 years, time in which it has realized its activities of handmade way. The significant drawback is that it does not have standardized processes. The processes and activities by the staff are done in a traditional way, as it is the way the workshop has worked the last 7 years responding to the demand of the national and international market.

In the absence of a standardized process, it can not give a precise response to the time it will take to finalize the order of its clients. Therefore, the workshop uses the expertise on the part of the owner, based on previously completed orders, which sometimes it works, while at other times additional time is required to fulfill outstanding orders, causing discomfort and dissatisfaction to customers.

In addition, it has been observed that since there are no defined activities at each job, the staff loses time in preparing material, in correcting sewing errors, and as, the following sub process depends

on the previous unproductive times are notorious in the dressmaking process .

The experience of the staff working in the workshop dates from about 5 to 7 years where the training has been sporadic and do not fit in the activities that each worker performs in certain sub processes that mark the difference of quality against the competition, The embroidery appliques are only made by one person, this generates a bottleneck, inventories in process increase drastically, and the time of delivery of the order to the client is prolonged.

2. Materials and Methods

2.1 Procedure for the study of methods and times.

Lifting Processes

Flow diagrams were used to describe the production process.

Breakdown of Tasks in Operations

The breakdown of the productive process helps determine the tasks, activities and operations with their respective initial and final milestones.

Making times

All operations were timed giving a standard time of 19.35 minutes, time necessary for the making of a girl dress size 8.

Problem Determination

To determine the root cause of the problems facing the production process, the 5 Why? Technique is used to find possible solutions.

Calculation of productivity

The calculation of the monofactorial and multifactorial productivity is carried out in order to determine the initial situation.

Improvement proposal

After analyzing the problems and their possible solutions, we opt for technological innovation, since it is the option that best results to the microenterprise.

3. Diagnosis

The diagnosis begins with the division of the productive process into activities and these in turn in operations, identified the initial and final milestones of each operation, proceed to perform the calculation of observations necessary to perform the time study. The activities are listed below:

- Bass Cutting
- Body cut
- Edge stitching
- Bottom seam
- Body sewing
- End stitching
- Encarrujado
- Shoulder seam
- Assembly of parts
- Review of dresses

Calculation of observations

Make 10 preliminary observations and with the help of the MUNDEL table the necessary observations are calculated with the following equation:
(A-B) / (A + B)
A being the upper value and B the lower value and the factor obtained indicates the number of total observations that will be timed. In the fabric lay operation A = 12 and B = 9 then the factor obtained is (12-9) / (12 + 9) = 0.14.

Table 1 Number of observations to be made with the Table of Mundel

TABLA DE MUNDEL					
	Serie inicial de			Serie inicial de	
(A-B)/(A+B)	5 mediciones	10 mediciones	(A-B)/(A+B)	5 mediciones	10 mediciones
0,05	3	1	0,28	93	53
0,06	4	2	0,29	100	57
0,07	6	3	0,30	107	61
0,08	8	4	0,31	114	65
0,09	10	5	0,32	121	69
0,10	12	7	0,33	129	74
0,11	14	8	0,34	137	78
0,12	17	10	0,35	145	83
0,13	20	11	0,36	154	88
0,14	23	13	0,37	162	93
0,15	27	15	0,38	171	98
0,16	30	17	0,39	180	103
0,17	34	20	0,40	190	108
0,18	38	22	0,41	200	114
0,19	43	24	0,42	210	120
0,20	47	27	0,43	220	126
0,21	52	30	0,44	230	132
0,22	57	33	0,45	240	138
0,23	63	36	0,46	250	144
0,24	68	39	0,47	262	150
0,25	74	42	0,48	273	156
0,26	80	46	0,49	285	163
0,27	86	49	0,50	296	170

Source: *(José Agustín Cruelles, 2013, pág. 537)*

The result shows that we need to perform 10 cycles of 13 measurements. This is done at each operation of the cutback activity.

Table 2 Calculation of the number of observations

CÁLCULO DE OBSERVACIONES																
	ESTUDIO N°	MÉTODO		ACTUAL							OPERACIÓN: CONFECCIÓN DE VESTIDOS					
	OBSERVACIONES PRELIMINARES	SECCIÓN:		ÁREA DE PRODUCCIÓN							HOJA	1		(A-B)/(A+B)		
		ELABORADO POR:		ROLANDO JIMBO S.							FECHA:	LUNES 02 DE MAYO 2016				
ELEMENTOS		OBSERVACIONES (segundos)										VALOR INFERIOR (B)	VALOR SUPERIOR (A)	TOTAL	Total obs.	
		1	2	3	4	5	6	7	8	9	10					
1	Corte de Bajera	Tender tela en la mesa	9	10	11	10	12	11	9	12	10	11	9	12	0,14	130
		Medir tela para bajera	16	17	20	16	17	21	18	19	17	18	16	21	0,14	130
		Corte de tela	19	20	21	19	21	20	19	21	20	21	19	21	0,06	20
		Doblado de tela para bajera	20	18	16	16	18	18	16	16	20	18	16	20	0,12	100

The result shows that for operation 1, 2, 3 and 4 130,130, 20 and 100 observations should be performed respectively.

NORMAL TIME

The normal time is the time necessary for the execution of an operation working in normal activity. (Cruelles, 2013)

$$Tn = \frac{Observed\ time\ x\ \ Observed\ activity}{Normal\ activity}$$

Equation 2: Normal time (Cruelles, 2013)

The weighting of the observed activity is performed before starting the timing giving a weighting of 60 to 100, the observed time is the recording of the time of an operation, and normal activity occurs under normal working conditions.

SCRUTINY

It is a set of mathematical operations that results in modal time and observed activity and is performed at each of the operations. It starts with normalizing the data, for this we apply the following:

$$Tn = \frac{Observed\ time\ x\ \ Observed\ activity}{Normal\ activity}$$

$$Tn = \frac{11\ x\ 75}{100} = 8{,}25\ seg$$

In the tender fabric operation we have 8.25 seconds

The next step is to eliminate all times that have a deviation greater than and less than 33% with respect to the average of the normalized times.

Table 3 Upper and lower deviation from the mean

Data regarding the average	
Upper Deviation u	(+33%)
mean	X
Lower Deviation l	(-33%)

Source: *(Cruelles, 2013)*

$$u = 7{,}85 * (1{,}33) = 10{,}443$$

$$mean = \frac{1020{,}75}{(26*5)} = 7{,}85$$

$$l = 7{,}85 * (1 - 0{,}33) = 5{,}2595$$

All standard times that are outside the upper limits 10.43 and lower 5.25 must be eliminated.
The new list of standard times is then divided into intervals using the following equation:

$$Namber\ of\ intervals = sample\ size$$

$$N°\ de\ intervalos = \sqrt{130} = 11{,}402$$

Equation 3: Number of intervals (Cruelles, 2013)

The interval increment is then calculated with the following equation:

$$Increment = \frac{Longer\ Time - Minor\ time}{Intervals}$$

$$Increment = \frac{9\ - 6{,}75}{11} = 0{,}2045$$

Equation 4: Increment (Cruelles, 2013)

The next step is to carry out the scrutiny or count of the normalized times and identify the average of the data that will be our new observed time

Tabla 4 Frequency to put cloth on the table times

OPERACIÓN		ACTIVIDAD								
Tiempo	Actividad N° de repeticiones	60	65	70	75	80	85	90	95	100
6,75										
6,95					38					
6,95										
7,16										
7,16										
7,36										
7,36										
7,57					32					
7,57										
7,77										
7,77										
7,98										
7,98										
8,18										
8,18										
8,39					21					
8,39										
8,59										
8,59										
8,80										
8,80					39					
9,00										

The average value is:

$$\bar{x} = \frac{8{,}80 + 9}{2} = 8{,}9$$

To find the normal time of operation and for this the following formula is used:

$$Tn = \frac{Observed\ time\ x\ \ Observed\ activity}{Normal\ activity}$$

$$Tn = \frac{8{,}9\ \ x\ \ 75}{100} = 6{,}6733\ (seg)$$

Equation 5: Normal time (Cruelles, 2013)

It is concluded that the normal time for fabric fabrication is 6.67 seconds.

SUPPLEMENTS

The worker can not be at all times operating in person due to his or her human condition, it is necessary that he take some breaks that allow him to recover from the fatigue produced by the tasks he performs, as well as to fulfill his personal needs.

$$(1 + s) = Supplement$$

Equation 6: Supplements (Garcia Criollo)

Cruelles proposes three supplements assignable to a study of times and these are:

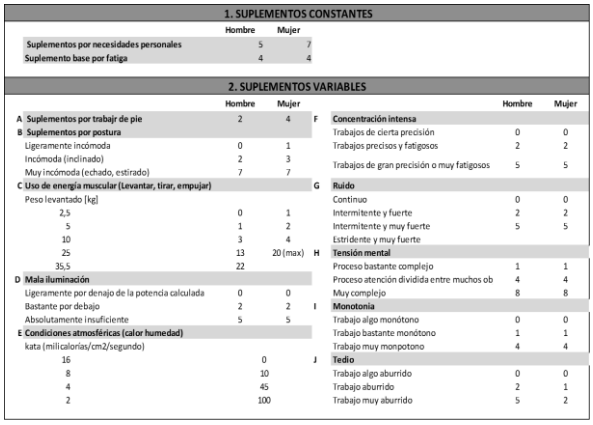
a) Supplements for personal delays
b) Supplements for delays due to fatigue (rest)
c) Supplements for special delays, including:
   - Delays due to unusual contingent items
   - Delays in worker activity caused by supervision
   - Delays caused by unavoidable foreign elements, concession that can be temporary or definitive.

The figures for one or the other supplement vary according to the working conditions and the sex of the operator. For this we use the figure 1 of supplements proposed by the ILO. (García Criollo, 2005, page 224)

Fv = Valuation factor
(1 + S) = Supplements

We perform the same calculation for all operations.

Table 5 Standard time of activity 1



1. SUPLEMENTOS CONSTANTES

	Hombre	Mujer
Suplementos por necesidades personales	5	7
Suplemento base por fatiga	4	4

2. SUPLEMENTOS VARIABLES

	Hombre	Mujer
A Suplementos por trabajr de pie	2	4
B Suplementos por postura		
Ligeramente incómoda	0	1
Incómoda (inclinado)	2	3
Muy incómoda (echado, estirado)	7	7
C Uso de energía muscular (Levantar, tirar, empujar)		
Peso levantado [kg]		
2,5	0	1
5	1	2
10	3	4
25	13	20 (max)
35,5	22	
D Mala iluminación		
Ligeramente por denajo de la potencia calculada	0	0
Bastante por debajo	2	2
Absolutamente insuficiente	5	5
E Condiciones atmosféricas (calor humedad)		
kata (milicalorías/cm2/segundo)		
16	0	
8	10	
4	45	
2	100	

	Hombre	Mujer
F Concentración intensa		
Trabajos de cierta precisión	0	0
Trabajos precisos y fatigosos	2	2
Trabajos de gran precisión o muy fatigosos	5	5
G Ruido		
Continuo	0	0
Intermitente y fuerte	2	2
Intermitente y muy fuerte	5	5
Estridente y muy fuerte		
H Tensión mental		
Proceso bastante complejo	1	1
Proceso atención dividida entre muchos ob	4	4
Muy complejo	8	8
I Monotonia		
Trabajo algo monótono	0	0
Trabajo bastante monótono	1	1
Trabajo muy monpotono	4	4
J Tedio		
Trabajo algo aburrido	0	0
Trabajo aburrido	2	1
Trabajo muy aburrido	5	2

FIGURE 1: Rest Supplement System
Source: (García Criollo, 2005, page 228)

The supplements for our case study are the following values.

1. SUPLEMENTOS CONSTANTES	Hombre	Mujer
Suplementos por necesidades personales	5	7
Suplemento base por fatiga	4	4
B Suplementos por postura		
Ligeramente incómoda	0	1
C Uso de energía muscular (Levantar, tirar, empujar)		
Peso levantado [kg]		
5	1	2
D Mala iluminación		
Bastante por debajo	2	2
F Concentración intensa		
Trabajos precisos y fatigosos	2	2
H Tensión mental		
Proceso bastante complejo	1	1
Total suplementos		19
suplemento= (1+suplemento)		1,19

FIGURE 2: Resting supplements in the fabric operation

STANDARD TIME

The standard time is the measurement of the time required to finish a unit of work, it helps to establish precise standards; In addition, to indicate what can occur in a normal day of work, helps to improve the quality standards. (García Criollo)

$$T_s = T_o * F_v * (1 + s)$$

Equation 7: Standard Time (Garcia Criollo)

Where:
Ts = Standard Time
To = Observed Time

The standard time for fabric fabrication operation is:

$T_s = 8{,}9 * 75 * 1{,}19 = 7{,}9$ Seconds

TIEMPO ESTANDAR						
	ESTUDIO N°		MÉTODO		ACTUAL	PROPUESTO
	TIEMPO ESTANDAR		SECCIÓN:		ÁREA DE PRODUCCIÓ	
			ELABORADO POR:		ROLANDO JIMBO S.	
ELEMENTOS			Tiempo estandar (segundos)				
			Intervalo modal (seg)	Factor de valoración	Tiempo normal(seg)	Suplementos	Tiempo estandar (seg)
1	Corte de Bajera	Tender tela en la mesa	8,9	75	6,68	1,19	7,9
		Medir tela para bajera	17,1	85	14,52	1,19	17,3
		Corte de tela para bajera	17,2	85	14,59	1,19	17,4
		Doblado de tela para bajera	17,3	90	15,59	1,19	18,6

4. Results obtained

After analyzing the problems and possible solutions for the microenterprise, it is determined that the most appropriate option is technological innovation since productivity increases by 24%.

Table 6 Summary table of the improvement proposal.

Cuadro de resumen de la tarea				
Descripción	**Actual**	**Propuesta**	**Mejora**	**%**
Tiempo estandar (min/unid)	19,35	17,8	2	8%
Total horas trabajadas (día)	24,1	22,24	1,9	8%
Unidades /hora	6,84	8,99	2,2	31%
Unidades /Turno	54,7	71,9	17,2	31%
Unidades /mes	1094,4	1438,4	344,0	31%
Total desplazamientos (m)	13	13	0,0	0%
Descripción	**Actual**	**Propuesta**	**Mejora**	**%**
Precio de venta unitario ($/unid)	$ 8,79		$ -	0%
Coste de hora ($/hora)	$ 2,925	$ 2,925	$ -	0%
Coste por unidad ($/unid)	$ 3,89	$ 2,96	$ 0,93	24%
Cantidad x Precio de venta unitario ($/mes)	$ 9.619,78	$ 12.643,54	$ 3.023,76	31%
costo por unidad($/mes)	$ 5.595,38	$ 4.257,66	$ 1.337,71	24%
Ahorro	$ 5.595,38	$ 4.257,66	$ 1.337,71	24%

In short, the cycle time decreases from 19.35 to 17.8 minutes, units per shift increase from 54 to 71 units achieving an increase in production from 1094 to 1438 units per month, and finally reduces the cost per unit from $ 3.89 to $ 2.96, which means a monthly savings of $ 1337.71.

5. Conclusions

To know the real scenario of the production process, the diagnosis was made in the production area and the results show that the standard time for the making of a dress is 19.35 minutes, making 54.7 units per shift, and 1094.4 Monthly units, cost per unit is $ 3.89, line balance percentage is 76%, and productivity is 6.84 units per hour of work.

The proposal for the organization of the work allows to increase the production in the productive process since the standard time for the preparation of clothes decreases to 17.8 minutes, making 71.9 units per shift, giving a total of 1438.4 monthly units, The cost per unit reduced to $ 2.96, the line balance percentage increased to 92%, productivity increased to 8.99 units per hour of work, achieving a saving of $ 1337.71 per month and $ 16052, 54 per year.

Referencias bibliográficas

Cruelles, J. A. (2013). Mejora de Métodos y Tiempos de Fabricación. En J. A. Cruelles, *Mejora de Métodos y Tiempos de Fabricación* (pág. 343). México: Alfaomega.

José Agustín Cruelles. (2013). *Ingeniería Industrial, Métodos de trabajo, tiempos y su aplicación a la planificación y mejora continua.* México D.F: Alfaomega Grupo edito, S.A.

Kanawaly George. (2005). Introducción al estudio de trabajo. En G. Kanawaly, *George Kanawaly* (pág. 77). Ginebra: Organización Internacional del Trabajo.

Meyers, F. E. (2000). *Estudio de tiempos y movimientos. Para la manufactura ágil.* México: Person Educación.

Niebel, A. F. (2014). Ingeniería Industrial de Niebel Métodos, estandares y diseño del trabajo . En A. F. Niebel, *Ingeniería Industrial de Niebel Métodos, estandares y diseño del trabajo* (pág. 548). México D.F: McGrawHill.

García Criollo, R. (2005). *Estudio del trabajo.* Monterrey: McGRawHill.