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THEME:

"STUDY METHODS AND TIME LINE SPORTS MEDIAS PRODUCTION COMPANY INC BAYTEX CIA. LTDA FOR IMPROVING PRODUCTIVITY"

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"STUDY METHODS AND TIME LINE SPORTS MEDIAS PRODUCTION COMPANY INC BAYTEX CIA. LTDA FOR IMPROVING PRODUCTIVITY"

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Abstract.

This research was conducted at the production plant of the company "BAYTEX INC. INC. LTDA "which is dedicated to the production of stockings. The study was carried out on the production line of sports socks. The investigation begins with the collection of bibliographic information needed to support the theoretical and scientific tools concerning work study bases. This allowed a clearer view of concepts related to the study of time to thereby be able to run the practical part of the investigation.

Having performed the literature search was undertaken an analysis of the initial situation, I mean, lifting the production process was conducted in order to obtain a clearer picture of the activities performed within the organization approach. A time study performed in different threads to determine which factors can be improved through a proposed working method.

Subsequently, a proposed method to obtain an increase in productivity in the production process of the company arises.

1. Introduction

There are several techniques that are applied within the organization of work which should be applied according to the needs of each organization. These tools are essential because they provide significantly increased level of productivity due to optimum coordination of resources and activities running.

These tools are not currently employed in the research company dedicated to the production of stockings. The application of statistical methods and quantitative models is of paramount importance in the operations of a company. These tools help administrators daily to take swift and successful in production planning and logistics operations decisions.

The company "BAYTEX INC CIA. LTDA. "Is a textile company based in San Antonio de Ibarra, dedicated to the production of stockings and socks high quality to meet customer demand, the organization strives to achieve the highest quality and the best prices in the market. Currently the company has been able to highlight potential problems in the production area, the company does not have a standardization processes, this because in the production line operators perform the current process empirically, which It leads to problems in the order of process flow and generate timeouts that affect the productivity of the organization.

Another evidenced problem was that due to lack of planning methods current job surplus intermediate is generated in the production process to the subsequent process, which triggers in problems such as failure and delays in orders due the bottlenecks generated in the production line of the company.

With the analysis of the current situation in the production process of the company "BAYTEX INC CIA. LTDA. "May be preset design a method to standardize the processes of its production line to improve productivity by designing methods and tools work study.

2. Materials and Methods

Materials

The materials provided support when lifting the information and responsible work measurement analyst they must have are:

- Stopwatch;;
- Board observations (Clipboard);
- Time study forms;

- Similarly it may be useful to use a camera recording.

Methods

- **Inductive-Deductive**

Through this method and prior to observations of the process is a problem, that after an induction process to generate a hypothesis to be validated empirically, conducting research concerning the problems of the organization, for it will make use of the technique of bibliographic research needed to support the theoretical basis.

- **Description**

It allows us to analyze the data collected and thus identify the current situation of the company, allowing determine which variables are related, thus enables us to interpret and relate to the characteristics of the process. Direct observation is used as a technique, which allows us to have a first knowledge of the current reality of the organization.

- **Qualitative and Quantitative**

These methods provide data based on numerical measurement, in addition to statistical analysis, to interpret the results in the research process, in order to establish patterns of behavior and test hypotheses that yield consistent results.

- **Inductive and Predictive**

The inductive method starts from the particular to the general, that is, it involves moving from the results of different observations to the approach of general theories. While the predictive method can predict with any degree of certainty the conduct and behavior of certain variables of the process involved, from knowledge of the preconditions.

- **Analytical**

This method is based on the assumption that all can understand and explain the characteristics of each of its parts and the relations between them, ie, the analytical method allows us to know more detail the object of study, with which you can: explain, make analogies, to better understand their behavior and establish new theories.

2.1 Diagnosis of the current situation of the company "BAYTEX INC. INC. LTDA".

2.1.1 Time Study in the company "BAYTEX INC. INC. LTDA".

Calculation of Number of Observations

Since the purpose of measuring time is to know an exact time will be necessary to make several measurements of time clock each of the elements, in order that between the times taken of the same element can obtain an average time representing that element, thereby compensating for variations that may exist between them. Naturally, the number of times to take each of the elements depends on the accuracy and error with which you want to calculate the representative time.

Among the most commonly used procedures are: Using tables, arithmetic, statistical formulas, among others. The method carried out for the number of observations which I have made is the ABACUS LIFSON.

Abacus Lifson

The Abacus Lifson is a statistical method that allows to know the number of observations needed to be made in the study based on a reading set of observations n = 10, standard deviation is replaced by a B factor, which is calculated by the following formula :

$$B = \frac{S - I}{S + I}$$

Calculation of Factor B

Source: (García R., 2005)

Where:

S = the upper time

I = the lower time

Calculation of Number of Observations

Before using the abacus Lifson proceed to perform n =10 measurements because reading is part of a set of observations.

Calculating observations were made for both processes the production line, I mean, for such processes are part performing the decomposition of tasks into elements then get a reading of 10 measurements, which to obtain an average of the readings we is an average time for each activity.

This procedure was performed for each of the subprocesses of the production line of both processes, such as:

Process 1

- Raw Material Thread
- Thread of Weaving
- With Overlock Sewing Thread
- Thread Sewing with Backhand after Overlock
- Ironing Thread
- Packaging Thread

Process 2

- Raw Material Thread

- Thread of Weaving
- Thread Sewing with-binding
- Thread Sewing with Backhand after-binding
- Ironing Thread
- Packaging Thread

Below is a table as an example of how taking time starting from a fixed reading was made 10 observations.

Table 2.1: Observed Time with Overlock Sewing Thread.

FORMULARIO PARA OBSERVACIONES DE ESTUDIO DE TIEMPOS
"BAYTEX INC. CIA. LTDA"

Proceso: Línea de producción de medias deportivas | Inicia: Coger fajo de medias del cesto | Operario:
Subproceso: Costura con Overlock | Termina: Colocar fajo de medias formadas en cartones | Analista: Javier Novoa
Método: | Actual | X | Propuesto | | Tiempo Total: | 0,55

Tiempo Observado (Ciclos)

Subproceso	Elementos	T (min) 1	T (min) 2	T (min) 3	T (min) 4	T (min) 5	T (min) 6	T (min) 7	T (min) 8	T (min) 9	T (min) 10	Promedio
Costura con Overlock	Coger fajo de medias del cesto	0,01	0,01	0,02	0,01	0,01	0,01	0,01	0,01	0,02	0,01	0,01
	Costura de medias (sin zafar fajo de 2 docenas)	0,50	0,52	0,49	0,51	0,52	0,53	0,55	0,55	0,51	0,55	0,52
	Colocar fajo de medias formadas en cartones	0,01	0,01	0,01	0,02	0,01	0,01	0,01	0,01	0,01	0,01	0,01
											Tiempo Observado del Subproceso	0,55

Source: Enterprise "BAYTEX INC. CIA. LTDA"

Produced by: Javier Novoa

Through the different measurements in each of the activities one Observed Average Total 205.11 Process 1 corresponding to [min] was obtained, obtaining said result of the sum total of the different threads.

$$Observed\ Average\ Total\ Process\ 1 = 205.11\ [min]$$

Through the different measurements in each of the activities one Observed Average Total Process 2 corresponding to 206.13 [min] was obtained, obtaining said result of the sum total of the different threads.

$$Observed\ Average\ Total\ Process\ \ 2 = 206.13\ [min]$$

The measurements obtained allow us to calculate the factor B being indispensable to the calculation time both the upper and the lower time of each item, thereby calculating the factor B corresponding to each element, using the formula:

$$B = \frac{S - I}{S + I}$$

By having the corresponding factors B to each of the activities we proceeded to calculate an average of these factors to thereby obtain a B average 0.15 factor for process 1 and process 2 to 0.12.

With the average factor B we can make use of abacus calculation Lifson to determine the number of observations.

Needless to say, it worked with a risk and corresponding to 0.02 and 4% respectively error.

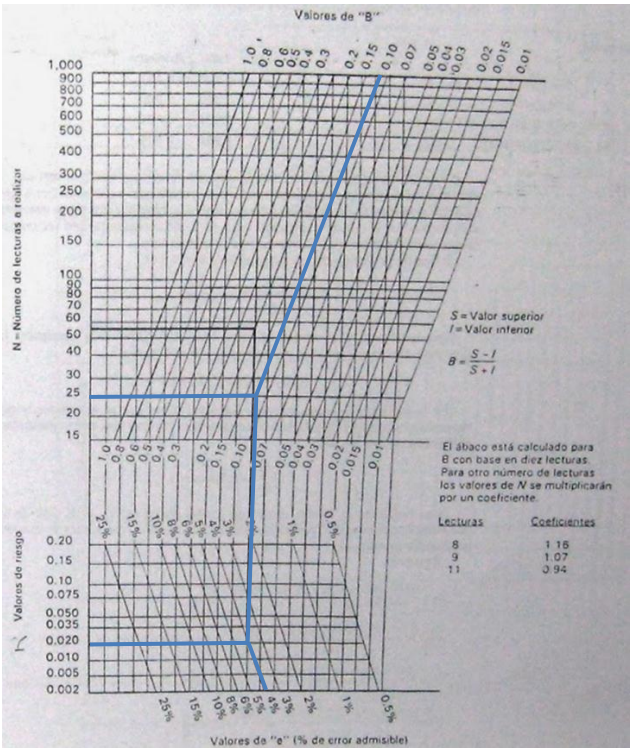

Figure 2.1: Abacus Lifson

The data generated in the study with values of error of 4% and a risk of 0.02 resulted in the graph of abacus Lifson a rallying point which intersects the factor B corresponding to 0.15 thereby obtaining a point follows a horizontal, which states that you must make a total of 30 measurements or observations in each of the activities that the corresponding study is performed to process 1, whereas for process 2 corresponding to 0.12 factor B shows a point follows a horizontal, which states that should make a total of 30 measurements or observations in each of the activities.

By knowing the number of measurements to be performed proceeded to lift the information from the remaining observations for both process 1 to process 2.

Rating Factor

Following the conclusion of the comment period both of process 1 and process 2 is applicable to the calculation of the weighting factor according to the method of Westinghouse considering factors to assess how an operator performs a normal rhythm of work, such are factors to assess the ability, consistency, skill and working conditions.

Westinghouse method allows us to know the normal working time, I mean, the time required by an operator to perform some kind of task. Below is a table of exemplary calculations obtained by this method is shown in the sub feedstock.

Table 2.2: Factor Thread Rating Feedstock

Factor de Valoración Subproceso de Materia Prima					
HABILIDAD			**ESFUERZO**		
A	Habilísimo	+0,15	A	Excesivo	+0,15
B	Excelente	+0,10	B	Excelente	+0,10
C	Bueno	+0,05	C	Bueno	+0,05
D	Medio	0,00	D	Medio	0,00
E	Regular	-0,05	E	Regular	-0,05
F	Malo	-0,010	F	Malo	-0,010
G	Torpe	-0,15	G	Torpe	-0,15
CONDICIONES			**CONSISTENCIA**		
A	Buena	+0,05	A	Buena	+0,05
B	Media	0,00	B	Media	0,00
C	Mala	-0,05	C	Mala	-0,05
TOTAL (S)					0,05
Fv = (1 + S)					**1,05**

Supplements

Supplements will proceed to calculate in order to determine the time allowed the worker in order to compensate for delays, delays and contingent elements that are regular parts of the task. For table supplements the International Labour Organization (OIT) was applied.

Below is a table shown by way of example of the calculations obtained in thread feedstock.

Table 2.3: Sub Supplements Raw Material

Suplementos Subproceso de Materia Prima	
Suplementos Constantes	
Suplementos Constantes	***Hombre (%)***
Necesidades Personales	0,05
Fatiga	0,04
Suplementos Variables	
Suplementos Variables	***Hombre (%)***
Trabajo de pie	0,02
Ligeramente incómodo	0,00
Uso de Energía o Fuerza Muscular Kg	***Hombre (%)***
5 kg	0,01
Condiciones Atmosfericas mili calorías cm2/s	***Hombre (%)***
16	0,00
Iluminación	
Ligeramente por debajo	0,00
Concentración Intensa	
Trabajo de cierta precisión	0,00
Ruidos	
Continuo	0,00
Tensión Mental	
Proceso algo complejo	0,01
Monotonía Mental	
Trabajo algo monótono	0,00
Monotonía Física	
Trabajo algo aburrido	0,00
TOTAL	***0,13***

Standard time (Ts)

The standard time allows us to calculate the time it takes a worker to perform normal activities more employees time to recover from the fatigue caused by work and complementary activities, which are forced to make.

For calculating the standard time we use the average time observed for each of the activities, just as the valuation factor and supplements of the respective activities that have been previously calculated.

Will use the following formula for the calculation of Standard Time (Ts):

$$Ts = To * Fv * (1+S)$$

$Where$:

$Ts = Standar\ time$

$To = Standar\ Observed$

$Fv = Factor\ Rating$

$S = Supplements$

An example of calculating the standard time in the process thread corresponding to the raw material 1 is shown.

Table 2.4: Sub Standard Time Raw Material

SUBPROCESO DE MATERIA PRIMA				
Elementos	***Tiempo Observado (To)***	***Factor de Valoración***	***Suplementos (1 + S)***	***Tiempo Estándar (Ts)***
Seleccionar rollos de hilo de bodega	2,43	1,05	1,13	2,88
Trasladar los rollos al área de Tejeduría	2,11	1,05	1,13	2,50
			Tiempo Estándar Total del Subproceso	***5.39***

For calculating the total standard time we use the standard time of each thread which have been calculated previously, both of process 1 and process 2. The calculation was made of the sum of these threads, such as raw material, weaving, sewing with overlock, reverse after seam overlock, sewing-binding, reverse after seam-binding, ironing and labeling.

The following table shows the total results of process 1 standard time of each thread is.

Table 2.5: Standard Time Process 1

LÍNEA DE PRODUCCIÓN DE MEDIAS DEPORTIVAS PROCESO 1	
SUBPROCESO	***TIEMPO ESTÁNDAR (TS) (min)***
Materia Prima	5,39
Tejeduría	2283,85
Costura con Overlock	47,43
Revés tras Costura con Overlock	82,57
Planchado	387,77
Empaquetado	172,58

$$\boldsymbol{Ts_1 = 2979,59\ min}$$

(Ts_1) It is the standard time of the process 1 which is performed a production of 60 packets corresponding to 1440 medium.

The following table shows the total results of the process 2 of the standard time of each thread is.

Table 2.6: Estándar Time Process 2

LÍNEA DE PRODUCCIÓN DE MEDIAS DEPORTIVAS PROCESO 2	
SUBPROCESO	*TIEMPO ESTÁNDAR (TS) (min)*
Materia Prima	5,37
Tejeduría	2284,35
Costura con Overlock	49,64
Revés tras Costura con Overlock	90,35
Planchado	387,83
Empaquetado	205,37

(Ts_2) Is the standard time of process 2 that is performed a production of 60 packets corresponding to 1440 medium.

After having calculated the Standard process 1 (Ts_1) and Standard Process 2 (Ts_2), has concluded that the process 1 is more convenient because it has a Time standard (Ts) less than the other process, namely:

$$(Ts_1) = 2979{,}59\ min$$

$$(Ts_2) = 3022{,}91\ min$$

Then:

$$(Ts_1) = 2979{,}59\ min < (Ts_2) = 3022{,}91\ min$$

$$(Ts_1) = 49{,}66\ hr < (Ts_2) = 50{,}38\ hr$$

2.1.2 Productivity

Calculation of Productivity Process 1

To calculate productivity the relationship between the units produced and the resources used was made, in this case total time spent. In order to improve productivity it is necessary to optimize the use of resources and maximize results.

$$Initial\ Productivity = \frac{Unit\ produced}{Total\ time}$$

$$Initial\ Productivity = \frac{1440\ socks}{49{,}66\ hours}$$

$$\boldsymbol{Productividad\ Inicial = {}^{28,99\ socks}/_{hours}}$$

Calculation of Productivity Process 2

To calculate productivity the relationship between the units produced and the resources used was made, in this case total time spent. In order to improve productivity it is necessary to optimize the use of resources and maximize results.

$$Productividad\ Inicial = \frac{Unit\ produced}{Total\ time}$$

$$Productividad\ Inicial = \frac{1440\ socks}{50{,}38\ hours}$$

$$\boldsymbol{Productividad\ Inicial = {}^{28,58\ socks}/_{hours}}$$

3. Results

3.1 Analysis and Proposed Design Methods

After having made the diagnosis of the current situation in the production line of sports socks company "BAYTEX INC. INC. LTDA ", and after an analysis of the results generated by the study proposes the following:

In the company "BAYTEX INC.CIA LTDA" the production process running on the sewing thread in two ways:

- with Overlock Sewing Thread (Process 1)
- Sewing Thread with-binding (Process 2)

It is proposed to make a change in the method of work in the sewing area, which is intended to process 1 is deemed as an ideal method, this because the results of the study days held generated better results this process because it has a standard time (Ts) in the standard time lower (Ts) of the process 2.

I mean:

$$(Ts_1) = 2979{,}59\ min$$

$$(Ts_2) = 3022{,}91\ min$$

Then:

$$(Ts_1) = 2979{,}59\ min < (Ts_2) = 3022{,}91\ min$$

$$(Ts_1) = 49{,}66\ hr < (Ts_2) = 50{,}38\ hr$$

3.1.1 New Method Study Times

3.1.1.1 Time Study Method Proposed in Sub Backhand after with Overlock Sewing

New tools transport in the thread setback after sewing Overlock allow time display significantly reduced because the averages would move directly thread backhand to thread ironing, thus avoiding that there is accumulation of stockings, which would be transported by a conveyor belt thereby eliminating the waiting time while the cartons are filled on the thread backhand.

It allows the conveyor belt having a continuous flow process one thread to another, in addition to avoid operator Ironing thread cartons move one place to another.

Standard time (Ts) Thread Backhand

For calculating the standard time we use the observed mean time the new method, just as the valuation factor and supplements that thread.

The calculation of standard time in the thread shown Backhand:

Table 3.1: Sub Standard Time Backhand

SUBPROCESO DE REVÉS				
Elementos	*Tiempo Observado (To)*	*Factor de Valoración*	*Suplementos (1 + S)*	*Tiempo Estándar (Ts)*
Zafar fajo de medias y cortar excedente de hilos	7,20	1,20	1,22	10,54
Virar la media a su derecho (parte frontal)	19,80	1,20	1,22	28,99
Colocar medias en banda transportadora para trasladar a subproceso de planchado (contenedores)	12,00	1,20	1,22	17,57
Tiempo Estándar Total del Subproceso de Revés				*57,10*

3.1.1.2 Proposed Study times Method Ironing Thread

The acquisition of a machine for ironing thread (FULL BOARDING CORTESE MACHINE Mod. 845 M) allow you to have a considerable increase in productivity in the thread mentioned.

Purchase this machine will generate a change in the current method being appropriate to consider the rotation of personnel working on the thread Ironing this because in this thread four operators but the acquisition of the machine CORTESE FULL BOARDING MACHINE Mod work. 845 M requires the implementation of its activities with only 2 operators.

Standard time (Ts) Ironing Thread

For calculating the standard time we use the average time observed the proposed method, just as the valuation factor and supplements that thread.

The calculation of standard time on the thread Ironing shown:

Table 3.2: Thread Standard Time Ironing

SUBPROCESO DE PLANCHADO				
Elementos	*Tiempo Observado (To)*	*Factor de Valoración*	*Suplementos (1 + S)*	*Tiempo Estándar (Ts)*
Programar el panel de control de la máquina CORTESE FULL BOARDING MACHINE Mod. 845 M	1,00	1,20	1,18	1,42
Colocar medias en molde de planchado	66,60	1,20	1,18	94,31
Planchado y extracción de medias en cartones	36,00	1,20	1,18	50,98
Colocar los cartones en el ascensor y transportar al área de empaquetado	0,08	1,20	1,18	0,11
Tiempo Estándar Total del Subproceso de Planchado				*146,82*

3.1.1.3 Calculation Standard Time (Ts) Proposed Method

For this calculation will take into account the standard times of the proposed methods both reverse thread and the thread ironing. Below is a summary table in which you can see the threads with their respective standard times shown.

Table 3.3: Proposed Standard Time Method

LÍNEA DE PRODUCCIÓN DE MEDIAS DEPORTIVAS MÉTODO PROPUESTO	
SUBPROCESO	*TIEMPO ESTÁNDAR (TS) (min)*
Materia Prima	5,39
Tejeduría	2283,85
Costura con Overlock	47,43
Revés tras Costura con Overlock	*57,10*
Planchado	*146,82*
Empaquetado	172,58

For the calculation of Total Standard Time (Ts) of the proposed method included the new times, then:

$$\boldsymbol{Ts_{(Propuesto)} = 2713,17\ min}$$

3.1.2 Productivity

3.1.2.1 Calculation Method Proposed Productivity

The calculation of productivity is obtained from the relationship between the units produced and the resources used, in this case the units produced are 1440/2 (60 packs) and staff resources total time spent, ie Standard Time (Ts) the proposed method. The calculation of the productivity gained by changing the working method is shown.

$$Productivity_{(proposed\ method)} = \frac{Unit\ produced}{Total\ Time}$$

$$Productivity_{(proposed\ method)} = \frac{1440\ socks}{45{,}22\ hours}$$

$$\boldsymbol{Productivity_{(proposed\ method)} = 31,84\ socks/hours}$$

3.1.2.2 Productivity Variation Method Proposed vs Current Method

For calculating the variation in productivity should be considered the initial productivity of the present process which corresponds to half 28,99 sock/ hour on the final productivity corresponding to the proposed method that has been previously calculated and corresponds to 31.84 socks /hour.

$$\Delta Pr = \left(\frac{\Delta Pr.Final}{\Delta Pr.Initial} - 1\right) * 100$$

$$\Delta Pr = \left(\frac{31{,}84\ {}^{socks}/_{hour}}{28{,}99\ {}^{socks}/_{hour}} - 1\right) * 100$$

$$\Delta Pr = (1{,}0983 - 1) * 100$$

$$\Delta Pr = (0{,}0983) * 100$$

$$\boldsymbol{\Delta Pr = 9{,}83\ \%}$$

This calculation allowed us to observe that the proposed new method allows an increase in productivity of 9.83% in the production line of sports socks.

3.2 Comparative Analysis

A Below is a summary table where you can see the data from both the current method and the proposed method, which is presented below:

Table 3.4: Obtained Results Summary Table Current and Proposed Method Method

EMPRESA "BAYTEX INC. CIA. LTDA"			
Método Actual		**Método Propuesto**	
Tiempo Estándar Subproceso de Revés (Ts)	82,57 min	Tiempo Estándar Subproceso de Revés (Ts)	57,10 min
Tiempo Estándar Subproceso de Planchado (Ts)	387,77 min	Tiempo Estándar Subproceso de Planchado (Ts)	146,82 min
Tiempo Estándar Total (Ts) – Línea de Producción de Medias Deportivas	2979,59 min	Tiempo Estándar Total (Ts) – Línea de Producción de Medias Deportivas	2713,17 min
Capacidad Diseñada paquetes/semana	72,6 paquetes/semana	Capacidad Diseñada paquetes/semana	79,80 paquetes/semana
Capacidad Diseñada paquetes/mes	290,40 paquetes/semana	Capacidad Diseñada paquetes/mes	319,20 paquetes/semana
Productividad Subproceso de Revés	17,44 medias/min	Productividad Subproceso de Revés	25,22 medias/min
Productividad Subproceso de Planchado	3,71 medias/min	Productividad Subproceso de Planchado	9,81 medias/min

4. Conclusions

The theoretical and scientific foundations on which this research was based was the study methodology times, which allowed across different types of tools work study analyzing the production process in order to obtain an analysis of the current situation in the that the company "is BAYTEX INC. INC. LTDA ".

In order to meet the production process analysis of the current situation we were conducted, using tools such as analytical flow chart through which could detail the sequence of activities relevant to the different threads, also this tool allowed to appreciate the distance and the time of the activities carried out by operators.

Similarly, the time study was performed on the production line of sports socks company "BAYTEX INC. INC. LTDA ", which is divided into two processes, this because the sewing thread runs in two different ways, the first one is done with Overlock machine, while the second runs with the connecting machine. Thus time study was conducted in both processes to determine the Standard Time each process, for it was considered the observed time, the valuation factor and supplements.

Result is obtained as the Standard process 1 is $(Ts_1) = 2979{,}59\ min$, and the standard processing time 2 is $(Ts_2) = 3022{,}91\ min$. Having calculated the Standard of the respective processes, it was concluded that the process 1 is the ideal working method because it has a lower than Standard Standard Time Process 2.

Regarding the study of methods, it was raised as a proposal for improvement new working methods, new tools such as transportation sewing thread, ie a conveyor belt; and in turn the acquisition of an ironing machine (FULL BOARDING CORTESE MACHINE Mod. 845 M) would obtain an increase in productivity globally in the company corresponding to 9.83%.

Gratefulness

I thank the Technical University of the North and the Faculty of Engineering in Applied for allowing me to train as a professional in their classrooms Sciences. I thank the teachers who with their effort and dedication were able to instill their knowledge.

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About the Author

Francisco Javier NOVOA VARGAS, was born in the province of Pichincha.

Formal Instruction

Primary studies were conducted at the "President Velasco Ibarra Model" School of the city of Ibarra; high school in the College "Teodoro Gómez de la Torre"; later he entered the Technical University North to Industrial Engineering.

Specialization Courses

OPERATIONS AND PROCESSES FOR STANDARD ISO 9001-2008, with a duration of 40 hours.

INNOVATION, MANAGEMENT AND CONSERVATION - SOURCES FOR DEVELOPMENT, with a duration of 26 hours.

NEW CHALLENGES AND INNOVATIONS OF THE CENTURY, lasting 32 hours