

SCIENTIFIC ARTICLE

"APPLICATION OF TOOLS OF PLANNING AND CONTROL OF THE PRODUCTION IN BRASIERES's LINE COMFORT OF THE COMPANY ANY PRINTEX FOR THE IMPROVEMENT OF THE PRODUCTIVITY."

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Abstract.

The purpose of applying tools of planning and control of production in the company of clothing Any Printex is to improve the productivity of the production line of bras and to better meet the requirements of customers.

The study and research starting with the situational analysis of the company, was defined the production line that will carry out the study, using diagram cause and effect Ishikawa was identified the problems that presents the process and was selected the main problem, described the necessary scientific theoretical necessary, subsequently rose necessary information of the current situation by direct observation Finally applied the tools of planning and control of production in order to consolidate and appreciate the results that the study.

KEYWORDS

Planning, control, production, efficiency, effectiveness, productivity, capacity, forecasts, distribution and processes.

1. Introduction

The application of tools of planning and control of the production, it will allow to the company to improve the satisfaction of the clients what will generate the opening to new markets allowing to overcome his expectations of growth in the productive, economic, social and cultural area, the permanency of his workers in his working places and that generate new squares(seats) of employment. In addition, to improve his productivity to optimize his resources and for ende the attention to the client, and hereby will continue enjoying himself of the loyalty and acceptance of the products, which causes that the company has the capacity of competitiveness with the textile companies of the sector and is positioned more on the local and national market of confections.

2. Context.

2.1 Tools of planning and control of the production.

Forecasts Predictions. It is the art and the science of predicting the future events by means of the use of historical information and his projection towards the future. The goal of any system of forecasts predictions is to provide these forecasts predictions with the necessary accuracy, in time and to a reasonable cost. (Sipper, 1998 , pág. 102).

The added planeación. It is a process by means of which a company determines the ideal levels of capacity, production, subcontracting, inventory, lacking and enclosedly prices, during a horizon of specific time. The object of the added planeación is to satisfy the demand lawsuit and at the same time to maximize the usefulness. (Chopra & Meindl, 2013 , págs. 211,212).

Planeación and utilization of the capacity. The capacity is the “ volume of production “ (throughput) or number of units that it can lodge, receive, store or produce an installation in a specific period of time. (Render & Heizer, 2009 , pág. 288).
Control of production. The control of activities of production (CAP) concerns, when it is necessary, the programming detailed to the control of the individual works in the centers of work in the floor of the plant, as well as the programming supplier. (Vollman, 2005 , pág. 392).

2.2 Application of tools of planning and control of the production.

For the application of the tools of planning and control of the production use of the following formulae.

<table>
<thead>
<tr>
<th>FORMULA</th>
<th>ECUACIÓN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variación de la productividad</strong></td>
<td>(\Delta P_m = \left(\frac{Pmf}{Pm0} - 1\right) \times 100%)</td>
</tr>
<tr>
<td><strong>Productividad monofactorial</strong></td>
<td>Productividad = (\frac{\text{Número de unidades producidas}}{\text{Insumo empleado}})</td>
</tr>
<tr>
<td><strong>Productividad multifactorial</strong></td>
<td>Productividad = (\frac{\text{Salida}}{\text{MU + MF + Energía + Capital + Otros}})</td>
</tr>
<tr>
<td><strong>Error de pronóstico</strong></td>
<td>Error de pronóstico (et) = Dt – Ft</td>
</tr>
<tr>
<td><strong>Desviación media absoluta</strong></td>
<td>(\text{MAD}_1 = \alpha(</td>
</tr>
<tr>
<td><strong>Señal de rastreo</strong></td>
<td>(\text{Señal de rastreo} = T = \frac{\text{Suma acumulada de la desviación del pronóstico}}{\text{MAD}})</td>
</tr>
<tr>
<td><strong>Promedio móvil</strong></td>
<td>Promedio móvil = (\frac{\text{Promedio movil}}{\Sigma \text{Demanda en los n periodos previos}})</td>
</tr>
<tr>
<td><strong>Promedio móvil ponderado</strong></td>
<td>(\text{PMP} = \frac{\Sigma (\text{Ponderación para el periodo } n)(\text{Demanda en el periodo } n)}{\Sigma \text{Ponderaciones}})</td>
</tr>
<tr>
<td><strong>Suavizamiento o exponencial</strong></td>
<td>Ft = Ft – 1 + (\alpha(At – 1 – Ft – 1))</td>
</tr>
<tr>
<td><strong>Colchón de capacidad</strong></td>
<td>(\text{Golchón de capacidad} = 100% - % \text{ de Utilización})</td>
</tr>
<tr>
<td><strong>Capacidad diseñada</strong></td>
<td>(\text{Capacidad diseñada} = \text{(Días/Semana} \times \text{Turnos} \times \text{Horas trabajadas}) \times \text{(Producción por hora)})</td>
</tr>
<tr>
<td><strong>Capacidad efectiva</strong></td>
<td>(\text{Capacidad efectiva} = \frac{\text{(Disponibilidad neta)} \times \text{(Carga consolidada)}}{\text{Carga utilizada}})</td>
</tr>
<tr>
<td><strong>Utilización</strong></td>
<td>Utilización = Producción real/Capacidad de diseño</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Eficacia</th>
<th>Eficacia = Producción real/Capacidad efectiva</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eficacia</td>
<td>Porcentaje de eficacia = (\frac{\text{Producción real}}{\text{Producción programada}}) \times 100</td>
</tr>
<tr>
<td>Tasa de utilización</td>
<td>Tasa de utilización = (\frac{\text{Salida real}}{\text{Capacidad proyectada}}) \times 100</td>
</tr>
<tr>
<td>Tiempo observado</td>
<td>(To (1 + s) = \frac{T_s}{F_v})</td>
</tr>
<tr>
<td>Tiempo estándar</td>
<td>(T_s = FV \times To \times (1 + s))</td>
</tr>
<tr>
<td>Suplementos</td>
<td>((1+s))</td>
</tr>
<tr>
<td>Abaco de lífson</td>
<td>(B = S - I)</td>
</tr>
<tr>
<td>Grado de ocupación de máquinas</td>
<td>Grado de Ocupación = (\frac{\text{Minutos necesarios por operación}}{\text{Tiempo neto de trabajo}}) \times 100</td>
</tr>
<tr>
<td>Índice de producción</td>
<td>(\text{IP} = \frac{\text{Unidades a fabricar}}{\text{Tiempo disponible de un operador}})</td>
</tr>
<tr>
<td>Número de operadores</td>
<td>(\text{NO} = \frac{\text{TE} \times \text{IP}}{E})</td>
</tr>
<tr>
<td>Número de máquinas</td>
<td>Número de máquinas requeridas = (\frac{Dp}{N[1 - (C/100)]})</td>
</tr>
<tr>
<td>Punto de equilibrio en unidades</td>
<td>(\text{PEu} = \frac{\text{Costos fijos totales}}{\text{Precio de venta por unidad} - \text{Costo variable por unidad}})</td>
</tr>
<tr>
<td>Punto de equilibrio dólares</td>
<td>Punto de equilibrio $$ = \frac{\text{Costos fijos totales}}{1 - \text{Costos variables}})</td>
</tr>
<tr>
<td>Valor actual neto</td>
<td>(\text{VAN} = \sum_{t=1}^{n} \frac{\text{FE}_t}{(1 + k)^t} - \text{FE}_0)</td>
</tr>
<tr>
<td>Tasa interna de retorno</td>
<td>(\text{TIIR} = \sum_{t=1}^{n} \frac{\text{FE}_t}{(1 + \text{TIIR})^t} - \text{FE}_0)</td>
</tr>
<tr>
<td>Relación costo beneficio</td>
<td>(\frac{\text{Relación costo beneficio}}{(C/B)})</td>
</tr>
<tr>
<td>Mínimos cuadrados</td>
<td>(\hat{y} = a + bx)</td>
</tr>
<tr>
<td>Valor b de los mínimos cuadrados</td>
<td>(b = \frac{\Sigma xy - \Sigma x \Sigma y}{\Sigma x^2 - (\Sigma x)^2})</td>
</tr>
<tr>
<td>Valor a de los mínimos cuadrados</td>
<td>(a = \frac{\Sigma y - b \Sigma x}{N})</td>
</tr>
</tbody>
</table>
Crecimiento de ventas  \[ c = \frac{b \ (n)}{\Sigma y} \]

ROI  \[ ROI = \frac{(\text{Ingresos} – \text{Inversión})}{\text{Inversión}} \times 100 \]

Periodo de repago  \[ PR = \frac{\text{Inversión inicial}}{\text{Entrada efectivo}} \]

Mínimo teórico  \[ \text{Mínimo Teórico} = TM = \frac{\Sigma t}{c} \]

Tiempo de ciclo  \[ c = \frac{1}{r} \]

Table 1. Formulea used in the project.


Forecasts Predictions of demand.

Suavizamiento exponential.

Period N° 2
\[ Ft = Ft - 1 + \alpha (At - 1 - Ft - 1) \]
\[ Ft = 690 + .10(650 - 690) \]
\[ Ft = 686 \]

Error of forecast \((et) = Dt - Ft\)

Error of forecast \((et) = 700 - 686\)

Error of forecast \((et) = 14\)

\[ \text{MAD}_t = \alpha |D_t - F_t| + (1 - \alpha) \text{MAD}_{t-1} \]
\[ \text{MAD}_t = .114|1| + .9 (9) \]
\[ \text{MAD}_t = 9,5 \]

Tracking signal \(T = \frac{\text{Sum accumulated of the diversion of the forecast prediction}}{\text{MAD}}\)

Tracking signal \(T = 14 \\div 9,5 = 1,47\)

One presents the calculations for a period the final result appears in the following table.

<table>
<thead>
<tr>
<th>Royal demand</th>
<th>Forecast α .10</th>
<th>Forecast α .15</th>
<th>Forecast α .30</th>
</tr>
</thead>
<tbody>
<tr>
<td>8080</td>
<td>8124</td>
<td>8088</td>
<td>8028</td>
</tr>
</tbody>
</table>

Table 2. Results of the model of forecast prediction.

Regresión lineal

<table>
<thead>
<tr>
<th>YEARS (x)</th>
<th>SALES (y)</th>
<th>x²</th>
<th>y²</th>
<th>(x) (y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8080</td>
<td>1</td>
<td>65286400</td>
<td>8080</td>
</tr>
<tr>
<td>2</td>
<td>8484</td>
<td>4</td>
<td>71978256</td>
<td>16968</td>
</tr>
<tr>
<td>3</td>
<td>16564</td>
<td>5</td>
<td>137264656</td>
<td>25048</td>
</tr>
</tbody>
</table>

Table 3. Components to apply the formula of square minimums.

Growth of the sales

<table>
<thead>
<tr>
<th>PROJECTION OF SALES IN UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
</tr>
<tr>
<td>8080</td>
</tr>
</tbody>
</table>

Table 4 Projection of sales to 5 years.

Illustración 1. Method of the square minimums equation of the straight line.

Illustración 2. Life cycle of the product.

Times of current production.

Total time = (13,5 min /u)

Time of cycle = \( c = \frac{1}{40} \times 60 = 1,5 \text{ min /u} \)
Standard time for unit = \( \frac{1.5 \text{ min}}{1 \text{ prenda}} = 1.5 \text{ min/ u} \)

Production \( = \frac{60 \text{ min}}{1.5 \text{ min/ clothing}} = 40 \text{ clothing/ hour} \)

Production \( = \frac{1 \text{ clothing} \times 480 \text{ min}}{1.33 \text{ min/ u}} = 360 \text{ clothing/ day} \)

Times of production improved.

Total time = (10.8 \text{ min/ u})

Time of cycle = \( c = \frac{1}{45} \times 60 = 1.33 \text{ min/ u} \)

Standard time for unit = \( \frac{1.33 \text{ min}}{1 \text{ prenda}} = 1.33 \text{ min/ u} \)

Production \( = \frac{60 \text{ min}}{1.33 \text{ min/ clothing}} = 45 \text{ clothing/ hour} \)

Production \( = \frac{1 \text{ clothing} \times 480 \text{ min}}{1.33 \text{ min/ u}} = 360 \text{ clothing/ day} \)

### Production brasieres comfort.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Production/ Hour (units)</th>
<th>Time in minutes</th>
<th>Percentage (%)</th>
<th>Work in hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tejido</td>
<td>14</td>
<td>20,71</td>
<td>46%</td>
<td>0.33</td>
</tr>
<tr>
<td>Triangulado</td>
<td>87</td>
<td>5,99</td>
<td>75%</td>
<td>0.15</td>
</tr>
<tr>
<td>Presecado</td>
<td>712</td>
<td>0,91</td>
<td>19%</td>
<td>0.09</td>
</tr>
<tr>
<td>Sellado</td>
<td>285</td>
<td>1,26</td>
<td>32%</td>
<td>0.10</td>
</tr>
<tr>
<td>Pagado de etiqueta</td>
<td>279</td>
<td>1,29</td>
<td>32%</td>
<td>0.10</td>
</tr>
<tr>
<td>Revisado</td>
<td>127</td>
<td>2,65</td>
<td>58%</td>
<td>0.05</td>
</tr>
<tr>
<td>Enfunado</td>
<td>112</td>
<td>0,69</td>
<td>25%</td>
<td>0.03</td>
</tr>
<tr>
<td>Abiertos de hombros</td>
<td>147</td>
<td>0,81</td>
<td>18%</td>
<td>0.02</td>
</tr>
<tr>
<td>Refilado</td>
<td>66</td>
<td>1,06</td>
<td>25%</td>
<td>0.02</td>
</tr>
<tr>
<td>Tinturado</td>
<td>313</td>
<td>1,15</td>
<td>38%</td>
<td>0.04</td>
</tr>
<tr>
<td>Revisado</td>
<td>108</td>
<td>1,30</td>
<td>26%</td>
<td>0.02</td>
</tr>
<tr>
<td>Sellado</td>
<td>257</td>
<td>1,23</td>
<td>51%</td>
<td>0.05</td>
</tr>
<tr>
<td>Empacado</td>
<td>765</td>
<td>0,07</td>
<td>15%</td>
<td>0.01</td>
</tr>
<tr>
<td>TOTAL</td>
<td>52,60</td>
<td>3,035,800</td>
<td>100%</td>
<td>6,57</td>
</tr>
</tbody>
</table>

### Table 5. Summary of production

Degree of occupation = \( \frac{\text{Necessary minutes for operation}}{\text{Clear time of work}} \times 100 \)

### Table 6. Summary of occupation you machinate

Men’s assignment and you machinate.

Calculation of the number of operators.

\[
\text{IP} = \frac{\text{Units to making}}{\text{Available time of an operator}}
\]

\[
\text{IP} = \frac{360}{(B(60))} = 0.75
\]

Number of operators tinturado = \( \frac{0.63 \times 0.75}{0.90} = 0.53 \)

### Table 7. Assignment of operatives workforce

Calculation of the number of machines.

Number of needed asked machines = \( \frac{\text{Dp}}{N \left[ 1 - \left( \frac{C}{100} \right) \right]} \)

\( D = \) Forecast of the number of units per year
\( P = \) Time of standard processing
N= Total number of Hours per year  
C= Mattress of capacity wished  

\[
\text{Needed machines} = \frac{8124 \times 1.35}{[(240 \text{ dias año}) \times (1 \text{ turno/día}) \times (8 \text{ horas/turno})] \times (1 - \frac{12}{100})}
\]

\[
= 10967.4 \approx 7
\]

**Redaquisition of times**

<table>
<thead>
<tr>
<th>Operation</th>
<th>STANDARD UNITARY TIME (Ts)</th>
<th>OPERATIVE TIME</th>
<th>STANDARD ASSIGNED TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.22</td>
<td>3.52</td>
<td>1.2</td>
</tr>
<tr>
<td>2</td>
<td>0.63</td>
<td>0.51</td>
<td>1.2</td>
</tr>
<tr>
<td>3</td>
<td>0.08</td>
<td>0.07</td>
<td>1.2</td>
</tr>
<tr>
<td>4</td>
<td>0.21</td>
<td>0.18</td>
<td>1.2</td>
</tr>
<tr>
<td>5</td>
<td>0.21</td>
<td>0.18</td>
<td>1.2</td>
</tr>
<tr>
<td>6</td>
<td>0.47</td>
<td>0.39</td>
<td>1.2</td>
</tr>
<tr>
<td>7</td>
<td>0.15</td>
<td>0.12</td>
<td>1.2</td>
</tr>
<tr>
<td>8</td>
<td>0.04</td>
<td>0.03</td>
<td>1.33</td>
</tr>
<tr>
<td>9</td>
<td>1.3</td>
<td>1.08</td>
<td>1.33</td>
</tr>
<tr>
<td>10</td>
<td>0.15</td>
<td>0.12</td>
<td>1.2</td>
</tr>
<tr>
<td>11</td>
<td>0.18</td>
<td>0.16</td>
<td>1.33</td>
</tr>
<tr>
<td>12</td>
<td>0.58</td>
<td>0.47</td>
<td>1.2</td>
</tr>
<tr>
<td>13</td>
<td>0.39</td>
<td>0.36</td>
<td>1.2</td>
</tr>
<tr>
<td>14</td>
<td>0.2</td>
<td>0.17</td>
<td>1.2</td>
</tr>
<tr>
<td>15</td>
<td>0.08</td>
<td>0.07</td>
<td>1.2</td>
</tr>
</tbody>
</table>

**Table 8. Assignment of standard time.**

Production take per day by means of the assignment of standard time.

The activity N° 8 is the one that was determining the production of the line, the activity of the operative with the time more shortly in this case the process of opened of shoulders.

Clothing per day 0.03 operator x 480 min = 360 clothing  
0.04 Standard time

**Point of balance (P.E)**

Point of balance \( u = \frac{\text{Fixed total costs}}{\text{Price of sale for unit} - \text{Variable cost for unit}} \)

Point of balance \( u = \frac{1750.17}{3.95} = 443 \text{ unit} \)

Point of balance \( s = \frac{\text{Fixed total costs}}{1 - \frac{\text{Variable total costs}}{\text{Total volume of sales}}} \)

\[
\text{Point of balance} = \frac{1750.17}{1 - \frac{1157.65}{2907.82}} = 2907.87 \text{ $}
\]

**P.E by means of Excel.**

**Illustration 3. Point of balance in sales**

**Balance sheet of the line of production**

Current efficiency

\[
E = \frac{\text{Minutes standard for operation}}{\text{Minutes standard assigned} \times \text{Number of operatives}} = \frac{10.8}{(1.33) \times (9)} = 90.22 \%
\]

Efficiency = \( \frac{\sum t}{n \times c} \)

\( \sum t = \text{Total time needed for assembles of a unit.} \)

\( n = \text{Number of working stations.} \)

\( c = \text{Time of cycle}. \)

Efficiency = \( \frac{10.8}{9 \times 1.33} = 90.22 \%
\]

**Improved efficiency**

Theoretical minimum = \( T_M = \frac{\sum t}{c} \)

\( \sum t = \text{Total time needed for assembles of a unit.} \)
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C = Time of cycle.

Theoretical minimum \( \frac{10,8}{1,33} \) = 8 Operatives.

\[ E = \frac{10,8}{(1,33) \times 8} \times 100 = 100 \% \]

Efficiency \( \frac{10,8}{8 \times 1,33} = 100 \% \)

Projected production.

Plaster of elastic tape with 2 operatives

Standard production \( \frac{N^* \times \text{Operatives} \times \text{Clear time}}{Ts} \)

Standard production plaster of elastic tape \( \frac{2 \times 480}{1,3} = 738 \text{ clothing} \)

59,04 $ costs

Fabric of the article to double shift

Capacity = Shifts \times \text{Prendas/hour} \times \text{hours/Shift}

Capacity = 2 \times 14 \times 8 = 224 clothing

47,94 $ costs

Planning of the production

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>PERSON IN CHARGE</th>
<th>MACHINE MATERIAL</th>
<th>TIME (seg)</th>
<th>CODIFICATION</th>
<th>UTILIZATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tejido</td>
<td>José Vinasse</td>
<td>Circular spin for fabric microfiber in &quot;Z&quot; and in &quot;S&quot;</td>
<td>253,2</td>
<td>TE 2</td>
<td>1</td>
</tr>
<tr>
<td>Tejido</td>
<td>Ramírez</td>
<td>Circular spin for fabric microfiber in &quot;Z&quot; and in &quot;S&quot;</td>
<td>253,2</td>
<td>TE 2</td>
<td>1</td>
</tr>
<tr>
<td>Tinturado</td>
<td>Tinturadora</td>
<td>Chemists</td>
<td>63</td>
<td>TI 1</td>
<td>1</td>
</tr>
<tr>
<td>Presecado</td>
<td>Secadora</td>
<td>Secadora</td>
<td>8</td>
<td>SE 1</td>
<td>1</td>
</tr>
<tr>
<td>Calado</td>
<td>Recubridora</td>
<td>Recubridora</td>
<td>47</td>
<td>RE 1</td>
<td>1</td>
</tr>
<tr>
<td>Defile</td>
<td>Recubridora</td>
<td>Recubridora</td>
<td>47</td>
<td>RE 1</td>
<td>1</td>
</tr>
<tr>
<td>Pegado de algodón</td>
<td>Artesadora</td>
<td>Artesadora</td>
<td>78</td>
<td>AR 2</td>
<td>1</td>
</tr>
<tr>
<td>Escotado</td>
<td>Orador</td>
<td>Orador</td>
<td>19</td>
<td>OR 2</td>
<td>1</td>
</tr>
<tr>
<td>Pegado de algodón</td>
<td>Artesadora</td>
<td>Artesadora</td>
<td>78</td>
<td>AR 2</td>
<td>1</td>
</tr>
<tr>
<td>Pegado de algodón</td>
<td>Artesadora</td>
<td>Artesadora</td>
<td>78</td>
<td>AR 2</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 10. Planning of the production

Planeacion and utilization of the capacity.

Capacity of design = \( \frac{\text{Total of working hours a year}}{\text{Average of working hours for unit}} \)

Project capacity = 1800 units / Weeks

Utilization

\[ \% \text{Utilization} = \frac{0,88 \times 100}{1371} = 88 \% \]

Efficiency

\[ \text{Efficiency} = \frac{1200}{1371} = 88 \% \]

Comparative analysis

Table 11. Planning of the capacity

Graph causes effect.

Illustration 4: Graph Causes effect Ishikawa

Description of the improvements

BEFORE

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>MATERIAL</th>
<th>TIME (seg)</th>
<th>CODIFICATION</th>
<th>UTILIZATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tejido</td>
<td>Circular spin for fabric microfiber in &quot;Z&quot; and in &quot;S&quot;</td>
<td>253,2</td>
<td>TE 2</td>
<td>1</td>
</tr>
<tr>
<td>Tinturado</td>
<td>Chemists</td>
<td>63</td>
<td>TI 1</td>
<td>1</td>
</tr>
<tr>
<td>Presecado</td>
<td>Secadora</td>
<td>8</td>
<td>SE 1</td>
<td>1</td>
</tr>
<tr>
<td>Calado</td>
<td>Recubridora</td>
<td>47</td>
<td>RE 1</td>
<td>1</td>
</tr>
<tr>
<td>Defile</td>
<td>Artesadora</td>
<td>78</td>
<td>AR 2</td>
<td>1</td>
</tr>
<tr>
<td>Escotado</td>
<td>Orador</td>
<td>19</td>
<td>OR 2</td>
<td>1</td>
</tr>
<tr>
<td>Pegado de algodón</td>
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<td>78</td>
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AFTER

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<th>TIME (seg)</th>
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<th>UTILIZATION</th>
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<td>TE 2</td>
<td>1</td>
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<td>Chemists</td>
<td>63</td>
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<td>1</td>
</tr>
<tr>
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<td>Secadora</td>
<td>8</td>
<td>SE 1</td>
<td>1</td>
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<tr>
<td>Calado</td>
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<td>1</td>
</tr>
<tr>
<td>Pegado de algodón</td>
<td>Artesadora</td>
<td>78</td>
<td>AR 2</td>
<td>1</td>
</tr>
</tbody>
</table>

BEFORE

AFTER

Photographs. 2. Area of tinturado

BEFORE

AFTER

Photographs. 3. Area of confection.

Control of production.

Process flow chart

Table 12. Card of process production

<table>
<thead>
<tr>
<th>Activity</th>
<th>Distance (m)</th>
<th>FV (1 + s)</th>
<th>To(min)</th>
<th>Ts min/seg</th>
<th>Ts seg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tejido 2</td>
<td>1,19</td>
<td>0,13</td>
<td>3,14</td>
<td>4,22</td>
<td>253,2</td>
</tr>
<tr>
<td>Tinturado 12</td>
<td>1,19</td>
<td>0,18</td>
<td>0,75</td>
<td>1,05</td>
<td>63</td>
</tr>
<tr>
<td>Pre secado 1</td>
<td>1,19</td>
<td>0,18</td>
<td>0,06</td>
<td>0,08</td>
<td>8</td>
</tr>
<tr>
<td>Secado 1</td>
<td>1,19</td>
<td>0,18</td>
<td>0,15</td>
<td>0,21</td>
<td>21</td>
</tr>
<tr>
<td>Pasar filo</td>
<td>1,19</td>
<td>0,13</td>
<td>0,16</td>
<td>0,22</td>
<td>22</td>
</tr>
<tr>
<td>Refilado 45</td>
<td>1,19</td>
<td>0,13</td>
<td>0,35</td>
<td>0,47</td>
<td>47</td>
</tr>
<tr>
<td>Unión de hombros</td>
<td>1,19</td>
<td>0,13</td>
<td>0,11</td>
<td>0,15</td>
<td>15</td>
</tr>
<tr>
<td>Abierto de hombros</td>
<td>1,19</td>
<td>0,13</td>
<td>0,03</td>
<td>0,04</td>
<td>4</td>
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<tr>
<td>Pegado de elástico</td>
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<td>0,58</td>
<td>0,78</td>
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<tr>
<td>Tracado 2</td>
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<td>0,13</td>
<td>0,11</td>
<td>0,15</td>
<td>15</td>
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<tr>
<td>Pegado de etiqueta</td>
<td>1,19</td>
<td>0,13</td>
<td>0,14</td>
<td>0,19</td>
<td>19</td>
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<tr>
<td>Revisado</td>
<td>1,19</td>
<td>0,13</td>
<td>0,42</td>
<td>0,56</td>
<td>56</td>
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<td>Enfundado</td>
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<td>0,13</td>
<td>0,14</td>
<td>0,19</td>
<td>19</td>
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<tr>
<td>Sellado 1</td>
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<td>0,11</td>
<td>0,15</td>
<td>0,20</td>
<td>20</td>
</tr>
<tr>
<td>Empacado 1</td>
<td>1,19</td>
<td>0,13</td>
<td>0,7</td>
<td>0,08</td>
<td>8</td>
</tr>
</tbody>
</table>

Total 6,55

Table 13. Rule of priority of production FCFS

<table>
<thead>
<tr>
<th>TRABAJO EN ORDEN</th>
<th>TIEMPO</th>
<th>PLAZO EN DÍAS</th>
<th>TIEMPO TRASITO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tejedura</td>
<td>3,21</td>
<td>6,55</td>
<td>3,21</td>
</tr>
<tr>
<td>Tintura</td>
<td>0,69</td>
<td>6,55</td>
<td>3,90</td>
</tr>
<tr>
<td>Corte</td>
<td>0,51</td>
<td>6,55</td>
<td>4,41</td>
</tr>
<tr>
<td>Preparación</td>
<td>0,14</td>
<td>6,55</td>
<td>4,55</td>
</tr>
<tr>
<td>Armado</td>
<td>1,65</td>
<td>6,55</td>
<td>6,20</td>
</tr>
<tr>
<td>Enganche</td>
<td>0,35</td>
<td>6,55</td>
<td>6,55</td>
</tr>
<tr>
<td>TOTAL</td>
<td>6,55</td>
<td>6,55</td>
<td>28,82</td>
</tr>
</tbody>
</table>

Figure 1. General graph of processes
Diego TIXILIMA, Ramiro SARAGURO, "Application of tools of planning and control of the production in brasieres's line comfort of the company Any Printex for the improvement of the productivity"

### Rule of sequence SOT

<table>
<thead>
<tr>
<th>TRABAJO EN ORDEN</th>
<th>TIEMPO PROCESAMIENTO DIAS</th>
<th>PLAZO EN DIAS</th>
<th>TIEMPO TRANSITO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparacion</td>
<td>0.14</td>
<td>6.55</td>
<td>0.14</td>
</tr>
<tr>
<td>Ensayo</td>
<td>0.35</td>
<td>6.55</td>
<td>0.49</td>
</tr>
<tr>
<td>Corte</td>
<td>0.51</td>
<td>6.55</td>
<td>1.00</td>
</tr>
<tr>
<td>Tintura</td>
<td>0.69</td>
<td>6.55</td>
<td>1.69</td>
</tr>
<tr>
<td>Armado</td>
<td>1.65</td>
<td>6.55</td>
<td>3.34</td>
</tr>
<tr>
<td>Tejeduria</td>
<td>3.21</td>
<td>6.55</td>
<td>6.55</td>
</tr>
<tr>
<td>TOTAL</td>
<td>6.55</td>
<td></td>
<td>13.21</td>
</tr>
</tbody>
</table>

Table 14. Rule of priority of production SOT

**Implements for the improvements in the production**

**Lay out area of confection**

**Strategies of marketing**

**Administration of the strategy of marketing**

**Lay out area of fabric and tinturado**

**Illustration 5. Lay out ground plant**

**Figure 2. Strategy of marketing orientated to the product**

**The 4 p of the mixture of the marketing**

**Figure 3. Mixture of marketing of the product**
3. Results.

<table>
<thead>
<tr>
<th>INDICATORS</th>
<th>INITIAL ANALYSIS</th>
<th>FINAL ANALYSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>Value</td>
<td>General</td>
</tr>
<tr>
<td>Productivity mono factorial (workforce)</td>
<td>7,91 u$/Pvu</td>
<td>Productivity mono factorial (workforce)</td>
</tr>
<tr>
<td>Productivity multifactorial (workforce)(manpower) + raw material(commodity) + CIF)</td>
<td>2,83 u$/Pvu</td>
<td>Productivity multifactorial (workforce)(manpower) + raw material(commodity) + CIF)</td>
</tr>
<tr>
<td>Productivity of the workforce(manpower) for worn out hour</td>
<td>4,44 u</td>
<td>Productivity of the workforce(manpower) for worn out hour</td>
</tr>
<tr>
<td>Productive deficit in units on the basis of the Point of balance</td>
<td>123 u</td>
<td>Productive deficit in units on the basis of the Point of balance</td>
</tr>
<tr>
<td>Efficiency of the line</td>
<td>90,22%</td>
<td>Efficiency of the line</td>
</tr>
</tbody>
</table>

ECONOMIC LOSSES

<table>
<thead>
<tr>
<th>INITIAL ANALYSIS</th>
<th>FINAL ANALYSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pvu</td>
<td>4.59 $</td>
</tr>
<tr>
<td>Daily loss.</td>
<td>564.57 $</td>
</tr>
<tr>
<td>Weekly loss.</td>
<td>2022,85 $</td>
</tr>
<tr>
<td>Pvu</td>
<td>6.57 $</td>
</tr>
<tr>
<td>Daily loss.</td>
<td>545,31 $</td>
</tr>
<tr>
<td>Weekly loss.</td>
<td>2726,55</td>
</tr>
</tbody>
</table>

INCREASE OF PRODUCTIVITY AND PERCENTAGE OF DECREASE OF LOSSES.

| Decrease of losses (%) | -96% |
| Increase of the productivity units (%) | 12,50% |
| Increase of productivity mono factorial (%) | 43,24% |
| Increase of productivity multifactorial (%) | 29% |

Table 15. Analysis of indicators after the study of investigation(research)

<table>
<thead>
<tr>
<th>BEFORE</th>
<th>AFTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOT PLC 77836</td>
<td>LOT PLC 1008633</td>
</tr>
<tr>
<td>Brasier Black Comfort</td>
<td>Brasier Black Comfort</td>
</tr>
<tr>
<td>Produced units.</td>
<td>320</td>
</tr>
<tr>
<td>Number of operatives.</td>
<td>9</td>
</tr>
<tr>
<td>Number of machines.</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 16. Production before and after the improvements

Recovery of the investment

Table 17. Technical study of the Project

Table 18. Financial study of the project

Table 19. Recovery of the investment


It was fulfilled by the raising of the theoretical scientific documented information of the company by means of technologies of direct observation and investigation(research), to obtain primary information, of the process in study and bibliographical reference of the topic as secondary information.

The suitable application of the tools of planning and control of the production in the company of confections Any Printex allowed to increase the quantity of units made from 320 articles to 360 articles finished during a labor day.

The control and short-term planning provide relevant information of the need of resources that has the company, and facilitate the coordination of activities and details of the manufacture. By means of the balance sheet of line the number of operatives diminished from 9 to 8
persons and of the machinery from 9 to 7 machines for the whole process of confection.

The means necessary for the confection of the brasers comfort as, operatives, machineries, time of production, spaces in the plant were organized in an efficient way, which allowed to reduce the time of cycle from 1,5 minutes to 1,35 minutes for every unit produced in the line and the productivity was improved in 43,24 %.

The inadequate distribution of plant was concerning notably the performances of the processes of production, with what with a suitable distribution of the lay Out one managed to improve the flow of materials and the distances crossed by the operatives the tour diminished from 164 to 73 meters what does that the line of production is more productive.

5. Thanks.

God and the Holiest Virgin of the Quinche, for being the light that they illuminate and guide my way, and me strength(fortress) and benedictions have given to me. Thank specifically the lady Bolaños Jaramillo Ana Bertha and to his distinguished family for having collaborated in the development of this project of investigation research of thesis, for opening me the doors of your prestigious company and for the unconditional and constant help that they have offered to me.

To the Ing. Ramiro Saraguro, for sharing his knowledge and being the director of the present work.

6. References.


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MARITAL STATUS: Single

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Curso sobre el Fortalecimiento de Capacidades Productivas y Asociativas de la E.P.S en la zona 1- Superintendencia de Economía Popular y solidaria (BPM’s) - Duración 360 horas.

Curso Formulación, Evaluación y Análisis Financiero de Proyectos - Universidad Técnica del Norte - Duración 40 horas.


WORKSHOPS AND COURSES OF SPECIALIZATION

Asistente al IX congreso ecuatoriano de estudiantes de Ingeniería Industrial, con la temática: “Innovación, Gestión y Conservación - Fuentes para el Desarrollo Sostenible” - Universidad Técnica del Norte - Duración 26 horas.

Pasante en la Empresa Pública de Servicios Municipales de Antonio Ante SERMAA- EP. En el área de Seguridad Industrial y productividad – Duración 300 horas.

Coauthor- Ramiro SARAGURO

Experience

Jefe de BPM’s
Pinturas Cóndor – 1990/1994

Jefe de planta

Jefe de compras
Expocolor – 2000/2004

Jefe de logística
Pinturas Cóndor – 2004/2008

Jefe de planificación
Pinturas Cóndor – 2008/2013

Docente UTN - Actual