

## SCIENTIFIC ARTICLE

### *IMPROVEMENT OF THE ORGANIZATION OF THE WORK FOR THE IMPROVEMENT OF PRODUCTIVITY IN THE PRODUCTION LINE FOR MANUFACTURE OF GARMENTS FOR GIRL IN THE COMPANY "XIOMAC FASHION AND STYLE"*

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#### **Abstract**

*Company XIOMAC Fashion and Style lacking knowledge about the control and management of the processes for the production of their products, is set to make the improvement of the Organization of the work for the improvement of the productivity of the production line for child who is the product star of the company.*

*Carry out the implementation of techniques for the study of the use of working time and the study of times to achieve the improvement of the Organization of work, is of great importance to make them in any company where production processes that are not controlled in general is there.*

*During the development of the procedure for the Organization of work in the company XIOMAC, is the uprising of general information of the company, making macro-process and meso-process diagrams to identify the scope of these within the company.*

*Then is the micro-process of the elaboration of the clothes for girl to make analysis of this production process time; where is that operating time by units, calculated on the basis of the data of the previous year's production is too high, causing delays in production and delivery of orders, hours the subcontract of staff and extras.*

*Applying the combination of the technique of instant observations during the daily workday and the study of times to establish a standard time is of utmost importance, as it allows to identify the productive and unproductive, times which will help to efficiently schedule production time by distributing and using the resources that are effectively. Thus obtaining higher performance, the proper use of personnel involved and the equipment used.*

*After the study, analyse the results and define the way will make the monitoring of processes and how they are going to take production controls. Proposes to modify the tab of production which takes place the control of use of raw materials and implement the unit daily times of production control and batch tab. The development has been applied the knowledge acquired within the career during my training.*

#### **KEY WORDS**

*Method of instant observations (MOI)*

*Effective working hours (JLE)*

*Process*

*Operating time*

*Standard time*

*Performance standard (Nr)*

*Productivity.*

## 1. Introduction

The problems that arise in the area of manufacturing in producing garments that are made in XIOMAC Fashion & Style is mainly caused by the lack of organizational technical knowledge of senior management who are responsible for managing the company.

Not having studies measuring productivity in the company, as a result of ignorance and lack of resource management techniques in the organization of work has led to quality work is not performed

Factors such as lack of standards times and yields, lack of design work organization, production control and misallocation of physical space among others, have caused the company does not comply with the delivery of orders on time as well as wasted time, unnecessary work, poor utilization of the working day, and breaches of the operators.

A sequel to this, often management has been forced to subcontract personnel outside the company (maquiladora) or to work overtime (evenings) in order to meet production contracts that the company has with its customers.

A consequence of the above, the company has seen the need for a technical study to identify and propose actions to eradicate the underlying causes of these deficiencies.

## 2. Procedure for the measurement of the work in the company XIOMAC Fashion & Style



Figure 1: PROCEDURE FOR THE MEASUREMENT OF WORK IN COMPANIES

Source: (Nieves Julbe, 2008)

Below are the formulas used in the application of the procedure for the measurement of work on enterprises.

Table 1: FORMULAE USED IN THE PROJECT

FÓRMULAS	
<b>PRODUCTIVIDAD</b>	
Productivity with A Factor	$P = \frac{\text{Unidades producidas}}{\text{Horas empleadas}}$
<b>MÉTODO DE LAS OBSERVACIONES INSTANTÁNEAS (MOI)</b>	
Total number of observations (MOI)	$P + Q = N$
Number of initial tours	$N_{Ri} = \frac{100}{K}$
Number of observations necessary	$Nd = 1600 * \frac{1-p}{p}$
Percentage of utilization of the day	$p_{aj} = \frac{P_{aj}}{N_{aj}}$
Control limits	$\bar{\sigma} = \sqrt{\frac{p_{aj}(1-p_{aj})}{N_{aj}}}$
Final precision control chart	$sf = \sqrt{\frac{\sigma^2(1-p_{aj})}{N_{aj} * p_{aj}}}$
Conversion observations in minutes	$T(t) = \frac{N(t)}{N_{aj}} * JLE$
Effective workday	$JLE = JL - TDNP - TINE O$ $JL - TDNP$
Use of the workday	$AJL = \frac{TV + TDNP}{JL} * 100$ $AJL = p_{aj} * 100$
<b>STANDARD TIME</b>	
<b>TECHNICAL TIMING VALUATION FACTOR RATING AND SUPPLEMENTS</b>	
Average time per item	$Te = \frac{\sum Xi}{n}$
basic elemental time	$Tn = Te(F.V. en \%)$
normal or granted time element	$Tt = Tn(1 + Sup.)$
Standard time	$TE = Tt(F.V.) * (1 + Sup)$
<b>TÉCNICA DEL CRONOMETRAJE ESTADÍSTICO</b>	
Number of observations	$Nd = 169 * \frac{R^2}{\bar{X}^2}$
Standard Time	$Nt = \frac{To}{U} (1 + \frac{\sum TC}{JL - \sum TC}) (\frac{\sum TV}{TO})$
Performance standard	$Nr = \frac{JL}{Nt}$
Time Operating Unit	$TO_{operadora} = \frac{JL}{Nr}$

Source: (Gutierrez Pulido & De Vara Salazar, Control quality and six sigma statistics, 2009), (Marsan, 1987), (Creole Garcia, 2005).

**2.1. PHASE I: PREPARATION**

**2.1.1. STEP 1: INVOLVEMENT OF ALL LEVELS**

Held a meeting with management and operators to publicize the important themes of work to be applied to improve productivity.

**2.1.2. STEP 2: SELECTION AND PREPARATION OF THE TASK FORCE**

The team is made of only by the person who is to carry out the study, measurement and application of improving the Organization of work in the company XIOMAC, with the help of the Manager and the head of production

**2.1.2. STEP 3: CHARACTERIZATION OF THE ENTITY**

**MISSION**

We are a company dedicated to the production and marketing of clothing garments of quality that we innovate with the current fashion trends.

**VISION**

Consolidate ourselves as a company that knows and understands very well the needs of its consumers; providing the best in quality and fashion.

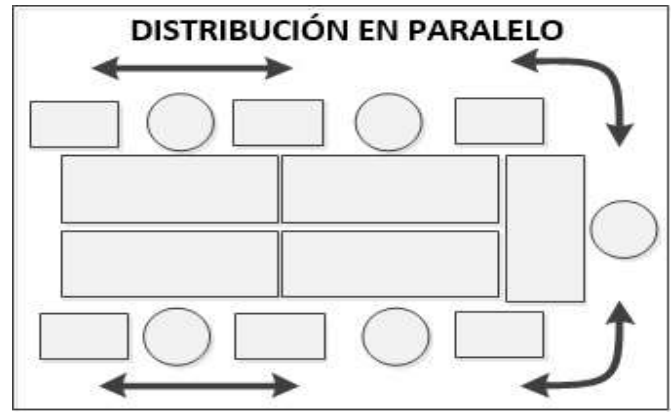


Figure 3: DISTRIBUTION AREA PACKAGE (modules in parallel)

Source: (Vallhonrat Bou, 2009)

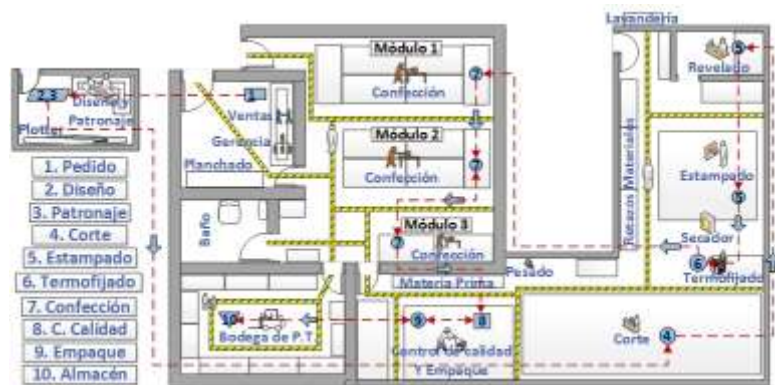


Figure 4: DIAGRAM TRAVEL THROUGH THE FLOOR

Prepared by: Jonathan Bolaños



Figure 2: ORGANIZATIONAL STRUCTURE

Prepared by: Jonathan Bolaños

**DESCRIPTION OF SPACE IN THE DIFFERENT AREAS OF WORK**

**➤ PRODUCTION DEPARTMENT**

**• AREA PACKAGE**

Making area has 13 machine, the same as are distributed modules in parallel as shown below.

**2.2. PHASE II: DIAGNOSIS OF THE MEASUREMENT OF WORK**

**2.2.1. STEP 4: ANALYSIS OF THE MEASUREMENT OF WORK IN THE STATE**

**Applied technique: SAMPLING FOR INSTANT COMMENTS**

Below are the tables and graphs obtained with the application of the MOI.

Table 2: SUMMARY MODEL MOI

Día	TN	TTNR	TIDO	Tamaño
1	80	4	16	100
2	84	2	14	100
3	90	3	7	100

Source: MedTrab/Procesador de Datos

Number of observations to be carried out according to the first day  $Nd = 1600 * \frac{1-p}{p} = 400$  Observations.

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Table 3: RECALCULATION NUMBER OF NUMBER OF OBSERVATIONS NECESSARY

Días	P	N	pai	Paj	Naj	paj	Ndj
1	80	100	0,80	80	100	0,80	400
2	84	100	0,84	164	200	0,82	351,22
3	90	100	0,90	254	300	0,85	282,35

Source: MedTrab/Procesador de Datos

As the  $N_{aj} > N_{dj}$  stops the MOI in the 3th day

CUMULATIVE GRAPH CONTROL OF MOI:

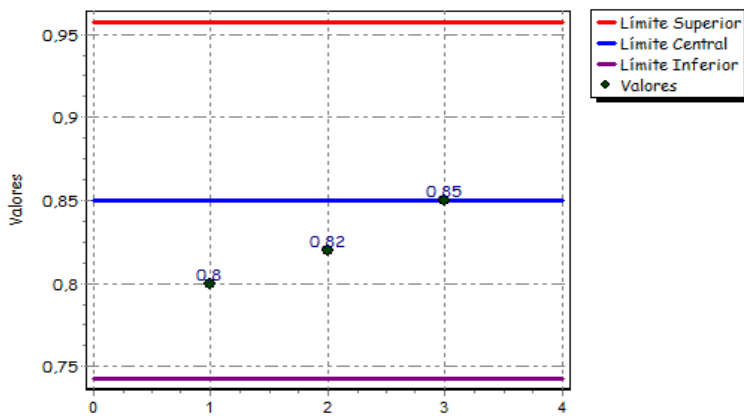


Figure 5: Control of the MOI

Source: MedTrab/Procesador de Datos

**USE OF THE WORKDAY AJL**

The general AJL is:  $AJL = p_{aj} * 100\% = 84,67\%$

**Results obtained by applying the technique of sampling instantaneous observations**

AJL = 84.67 %      TN = 381.000 min  
 TNN = 69.000 min      TO/uM It wasn't determined  
 TTNR = 13.500 min      JL It wasn't determined  
 TIDO = 55.500 min      VP It wasn't determined  
 JLE = 450 min

**2.2.2. STEP 5: SELECTION OF THE AREA UNDER STUDY**

The object of study is located in the area of preparation of production department, because that area is that mark the pace of work of the company.

**2.2.3. STEP 6: CHARACTERIZATION OF THE AREA UNDER STUDY**

**PROCESS STRATEGIES**

**FOCUS ON THE PROCESS**

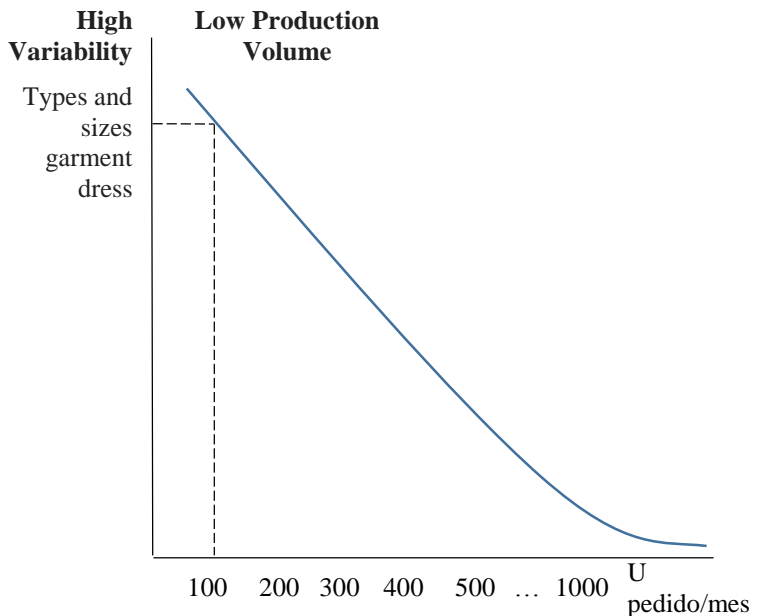


Figure 6: PROCESS APPROACHES XIOMAC

Prepared by: Jonathan Bolaños

Processes for the production of products that are made internally in XIOMAC, are defined by packaging or batch runs ordering manufacture of clothing.

Which means that the process strategy the company adopts for the manufacture of its products is based on the process approach, because they have high variety of products, they vary in sizes and models, but production volume with records standard is not constant and no products are produced in large quantities.

**LIFTING AND ANALYSIS OF PROCESSES USED IN THE AREA OF APPAREL**

The general process of the work area flow here.

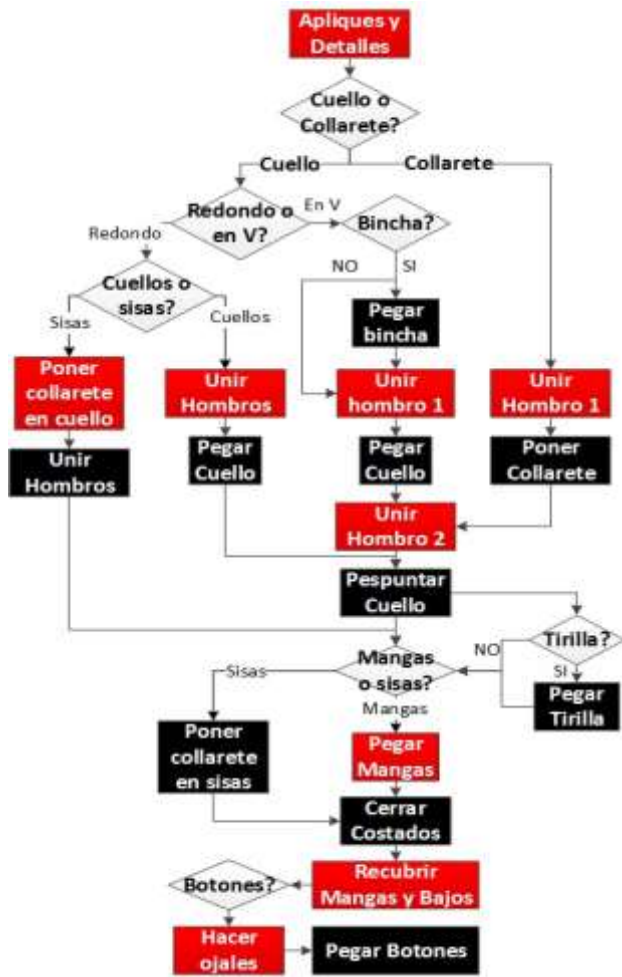


Figure 7: PROCESSES EMPLOYED IN THE CLOTHING AREA

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**2.2.4. STEP 7: DIAGNOSIS OF THE MEASUREMENT OF THE WORK OF THE AREA UNDER STUDY**

Below are the average time calculation table.

Table 4: AVERAGE TIME OF PRODUCTION

Month	u/month	u/day	u/hour	60 min/u hour
January	555	27,75	3,47	17,30
February	1395	69,75	8,72	6,88
March	1299	64,95	8,12	7,39
April	856	42,80	5,35	11,21
May	1012	50,60	6,33	9,49
Jun	644	32,20	4,03	14,91
July	1478	73,90	9,24	6,50
August	644	32,20	4,03	14,91
September	1575	78,75	9,84	6,10
October	3222	161,10	20,14	2,98
November	1160	58,00	7,25	8,28
December				
<b>PROMEDIO</b>				<b>7,7</b>

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**ASSESSMENT RATING FACTOR**

Below are the performance rating and clearances of the workspace table.

Table 5: CALCULATION OF THE VALUATION FACTOR

EVALUATION FACTOR AREA OF MANUFACTURE						
FV	OP. V	OP. G	OP. J			
SKILLS	C1	0,06	B2	0,08	B2	0,08
EFFORT	C2	0,02	C2	0,02	C2	0,02
TERMS	E	-0,03	E	-0,03	E	-0,03
CONSISTENCY	E	-0,02	C	0,01	D	0
<b>Sub Total FV</b>		0,03		0,08		0,07
<b>TOTAL FV</b>		0,06				
<b>TOTAL FV + I</b>		1,06				

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**RATING CLEARANCES AND SUPPLEMENTS.**

Following are the qualification of supplements of the workspace table.

Table 6: QUALIFICATION OF TOLERANCES OR SUPPLEMENTS

SUPPLEMENTS IN THE AREA OF MANUFACTURE	
Supplements (%)	Woman's (%)
<b>CONSTANT SUPPLEMENTS</b>	
A. Supplement for personal needs.	7%
B. Supplement basics fatigue	4%
<b>SUPPLEMENTS VARIABLES</b>	
B. Supplement abnormal posture.	1%
C. Use of force - muscle energy (lifting, pulling, and pushing) Lifted weight [kg]. 2.5 kg	1%
D. Poor lighting.	2%
E. Temperature.	0%
F. Intense concentration.	0%
G. Noise.	0%
H. Mental strain.	1%
I. Monotony.	4%
J. Ennui.	2%
<b>TOTAL</b>	<b>22%</b>
<b>TOTAL Tolerance (Supplement+I)</b>	<b>1,22</b>

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**2.2.5. STEP 8: ANALYSIS OF MEASURING OPERATIONS**

**TECHNIQUE OF TIMING WITH QUALIFICATION OF THE ASSESSMENT FACTOR AND SUPPLEMENTS**

Here is the table for the calculation of the number of observations

Table 7: TABLE WESTINGHOUSE WHICH PROVIDES THE NUMBER OF OBSERVATIONS NECESSARY

WHEN TIME FOR PART OR CYCLE IS:	MINIMUM NUMBER OF CYCLES TO STUDY		
	ACTIVITY OVER 10,000 TO YEAR	1000 A 10000	LESS THAN 1000
1,000 hours	5	3	2
0,800 hours	6	3	2
0,500 hours	8	4	3
0,300 hours	10	5	4
0,200 hours	12	6	5
0,120 hours	15	8	6
0,080 hours	20	10	8
0,050 hours	25	12	10
0,035 hours	30	15	12
0,020 hours	40	20	15
0,012 hours	50	25	20
0,008 hours	60	30	25
0,005 hours	80	40	30
0,003 hours	100	50	40
0,002 hours	120	60	50
Less than 0,002 hours	140	80	60

Prepared by: Jonathan Bolaños

Below are tables of average time observed, obtained with the technique of the timing.

Table 8: AVERAGE TIME OBSERVED PRODUCTION

OPERATIONS (unit)	QUANTIT Y (unit)	MACHINER Y	MINIMUM TIME OBSERVED (min/u)
Join Shoulders	1	Overlock	0:00:15
Make necks	1	Overlock	0:00:08
Paste necks	1	Overlock	0:00:34
Coat collars (stitching )	1	Wrapping	0:00:28
Paste strip	1	Tirilladora	0:00:26
Paste sleeves	1	Overlock	0:00:24
Close sides	1	Overlock	0:00:43
Coat sleeves and low	1	Wrapping	0:01:09
<b>TOTAL TIME</b>			<b>0:04:07</b>

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Table 9: TIME OF CALIBRATION OF MACHINES AND THE OBSERVED LOT NECKBAND

PROCESS	QUANTITY (lot)	MACHINES	AVERAGE TIME (u)	TIME LOT
Make strip	10	Short collarete	0:05:15	0:52:30
Prepare machines, to threads	13	---	0:02:05	0:27:05
<b>TOTAL</b>				<b>1:19:35</b>

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Table 10: TOTAL BATCH AND TOTAL TIME UNIT OBSREVADO

Lot observed total time (hours )	0:04:07*2430 =	22:57:16
Lot total time (hours )	22:57:16+1:19:35 =	24:16:51
Average time Total Observed	24:16:51/2430 =	0:04:09

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**TECHNIQUE OF STATISTICAL SOFTWARE MEDTRAB TIMING**

Below the table of cronoserie of the number of observations necessary to apply the technique and obtained with the same graphics.

Table 11: TABLE OF THE CRONOSERIE

Subgrupo	Cronoserie		Recorridos	$\bar{X}$
1	4,15	4,07	0,08	4,11
2	4,12	4,06	0,06	4,09
3	4,19	4,11	0,08	4,15
4	4,07	4,04	0,03	4,05
5	4,18	4,07	0,11	4,13
6	4,07	4,16	0,09	4,12
7	4,06	4,20	0,14	4,13
8	4,06	4,11	0,05	4,08
9	4,11	4,17	0,06	4,14
10	4,15	4,14	0,01	4,15
11	4,17	4,13	0,04	4,15
12	4,16	4,23	0,07	4,20
13	4,17	4,15	0,02	4,16

Source: MedTrab/Procesador de Datos

THE GRAPHIC OF THE TIMING CHART

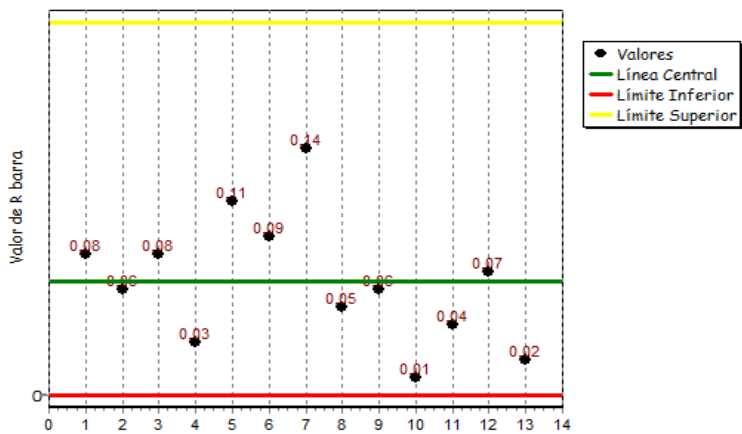


Figure 8: TIMING TRAVEL  
Source: MedTrab/Procesador de Datos

THE GRAPHIN MEDIA TIMING

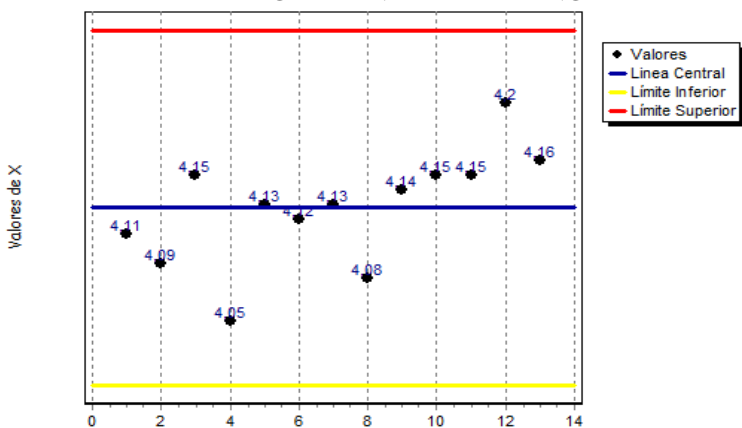


Figure 9: TIMING TRAVEL  
Source: MedTrab/Procesador de Datos

**COMBINATION OF THE TECHNICAL MOI MEDTAB SOFTWARE TIMING TECHNIQUE**

**Applied technique: COMBINATION TIMING - MOI**

Below are the tables obtained with the combination of statistical timing and MOI.

Table 12: SUMMARY MODEL MOI

Día	TO	TPC	TS	TTNR	TIDO	Tamaño	VP
1	72	2	6	4	16	100	102
2	74	2	8	2	14	100	102
3	84	2	4	3	7	100	102

Source: MedTrab/Procesador de Datos

Table 13: RECALCULATION NUMBER OF NUMBER OF OBSERVATIONS NECESSARY

Días	P	N	pai	Paj	Naj	paj	Ndj
1	80	100	0,80	80	100	0,80	400
2	84	100	0,84	164	200	0,82	351,22
3	90	100	0,90	254	300	0,85	282,35

Source: MedTrab/Procesador de Datos

As the  $N_{aj} > N_{dj}$  stops the MOI day 3

Table 14: THE CRONOSERIE TABLE

Subgrupo	Cronoserie	Recorridos	$\bar{X}$	
1	4,15	4,07	0,08	4,11
2	4,12	4,06	0,06	4,09
3	4,19	4,11	0,08	4,15
4	4,07	4,04	0,03	4,05
5	4,18	4,07	0,11	4,13
6	4,07	4,16	0,09	4,12
7	4,06	4,20	0,14	4,13
8	4,06	4,11	0,05	4,08
9	4,11	4,17	0,06	4,14
10	4,15	4,14	0,01	4,15
11	4,17	4,13	0,04	4,15
12	4,16	4,23	0,07	4,20
13	4,17	4,15	0,02	4,16

Source: MedTrab/Procesador de Datos

The results obtained by applying the Timing -MOI combination were:

MOI	Cronometraje
AJL = 84,67% TN = 381.00 min TNN = 69.00min TO = 345.00min TS = 27.00min TPC = 9.00min TTNR = 13.50min TIDO = 55.50min JL = 480min TO/uM = 3.38min/unidad VP = 102unidades	TO/uC = 4.13min/unidad

The standard time is calculated:  $N_t = 4.55841$  min / unit

The standard performance is calculated:  $N_r = 105$  u / JL

**2.2.6. STEP 9: DEFINITION AND ANALYSIS FOUND DEFICIENCIES**

Mono-factorial calculated at the rate of the standard time productivity varies as the time varies. In this case the greater efficiency of processes for making basic t-shirts girl, gets developed them in the shortest possible time as shown in the calculation of the time using the technique of statistical timing, but it cannot be since this technique only takes into account the working time of the operators and not taking time off due to tolerances or supplements.

### 2.3. PHASE III: PROJECTION OF CORRECTIVE MEASURES

#### 2.3.1. STEP 10: DEFINITION OF CORRECTIVE MEASURES

Below the table of supplements after the improvement.

Table 15: RATING OF SUPPLEMENTS (IMPROVEMENT OF LIGHTING)

SUPPLEMENTS IN THE AREA OF MANUFACTURE	
Supplements (%)	Woman's (%)
<b>CONSTANT SUPPLEMENTS</b>	
A. Supplement for personal needs.	7%
B. Supplement basics fatigue	4%
<b>SUPPLEMENTS VARIABLES</b>	
B. Supplement abnormal posture.	1%
C. Use of force - muscle energy (lifting, pulling, and pushing) Lifted weight [kg].	1%
2.5 kg	
D. Poor lighting.	0%
E. Temperature.	0%
F. Intense concentration.	0%
G. Noise.	0%
H. Mental strain.	1%
I. Monotony.	4%
J. Ennui.	2%
<b>TOTAL</b>	22%
<b>TOTAL Tolerance (Supplement+1)</b>	<b>1,20</b>

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### 2.4. PHASE IV: IMPLEMENTATION AND MONITORING MEASURES

#### 2.4.1. STEP 11: IMPLEMENTATION AND CONTROL

- To make a better control of the daily activities in the production processes intends to carry out and establish the descriptive of position, functions, powers and responsibilities of each work area.
- To check the status of production, processes, use of materials and supplies in the area of clothing proposes the next tab of production, based on the control card (KANBAN).

It should be noted that XIOMAC already has a tab that used in the cutting area, making area also boasts a production tab, but it does not control the necessary records; It is proposed to modify it so that to take over control of the use of materials and materials premiums, carry out the time control in general processes of preparation, with the calculated times.

### 3. Current analysis

Table 16: COMPARISON OF THE CURRENT PROPOSAL

COMPARISON OF THE CURRENT PROPOSAL			
APPLIED TECHNIQUES	PERIODS		Trend
	Current	Proposal	
Qualification of supplements	$S = 0,22 + 1 = 1,22$	$S = 0,20 + 1 = 1,20$	↓
Standard time (technique of timing with score of factor assessment and supplements)	$TE = 7,7min \approx 0:07:42$	$TE = 5,28min \approx 0:05:17$	↓
Use of the workday.	$AJL = 84,67\%$	$AJL = 90,94\%$	↑
Performance standard (production volume 3 operators)	$Nr_{conf.} = 102u/Jl$	$Nr_{conf.} = 315u/Jl$	↑
Mono-factorial with the SAM time productivity	$Prd. = 315,58$	$Prd. = 460,23$	↑

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Below is the changes made to the improvement of facilities.

Before



Photo 1: IMPROVEMENT OF THE LUMINAIRES



Then



Photo 2: IMPROVEMENT OF LIGHTS

Before



Photo 3: JOBS UNCOMFORTABLE

Then



Photo 4: CHANGES IN JOBS

#### 4. Conclusions

Through the initial diagnosis XIOMAC Company Fashion & Style, the collection of historical data, gathering information, preliminary observations on the company and interviews with the owner of the company (manager), he reached the following conclusions:

- The company did not have records to do the job.
- There was no organization at work to carry out their activities during the workday.

- No controls operating times wearing clothing in the area which is the area that sets the pace of work of the company.

So it was necessary to make the application procedure for the measurement of work in the company, focusing on organization and time study to improve the productivity of the production line of the company star.

In applying the techniques to study the work with the knowledge acquired in its development, it was possible:

- Identify all the flaws of the operators and the environment in the work area.
- Identify critical situations in production processes.

By applying the method of instantaneous observations to improve the AJL, it was detected

- Downtime and bottlenecks.
- Losses of time doing not relevant actions to activities pertaining to production processes.

To identify deficiency operating time was applied.

- Techniques timing.
- Technical qualification of the work of the operators and the infrastructure of the company.

The facilities are not suitable for work within the company, since the beginning of distribution of an effective plant and uncertainty parameters are violated are increasing day by day because:

- Spaces with which it is counted in each of the jobs in the area are considered unsuitable clothing.
- Each machine operator has its own space to work and store your work materials, but this is very small.
- You can move easily, there are many obstacles that prevent the movement from one area to another.

#### 5. Thanks

Jesus for giving me the blessing of life, for giving the best of him to all who accept it in our heart.

To my mother Ximena Encalada which much sacrifice and dedication has given me all the support that a mother can give to your child.

To my grandparents Luis Encalada and Hilda rooms throughout their host had to me.

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My father Alberto Bolaños who despite the circumstances, somehow has managed to support me during my life and in the process of my training as a professional.

To the engineer Carlos Machado who has been my guide in the development of my thesis and has shared their knowledge and experiences to enrich my knowledge.

The company XIOMAC FASHION and STYLE, who have opened their doors for the development of the project and for giving me the necessary support since my arrival in the company to me.

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- Support the "III Conference of safety and health in the working" (with emphasis on agro-industry), organized by the General risk insurance of IESS.
- Assistance to the Ecuadorian Congress IX of students of Industrial Engineering, with the theme: "Innovation, management and conservation - sources for sustainable development", with 40 academic hours.
- Assistance to the XXII Latin American Congress of students of Industrial Engineering "CLEIN Perú 2013", with 40 academic hours.
- Participation and approval of the course of "Training of Auditors internal' and health work safety" low resolution C.D. 333 SART, duration 40 academic hours.
- Approval of the Manager of quality course of 120 academic hours, under the competency approach, within the implementation of the "program of training in management of the quality in the organizations and companies of ECUADOR" organized by the technical secretariat of training and vocational training.
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