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Implementation of methods and times to increase productivity in a textile company

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Resume.

The realization of the research project was carried out in the textile company KEYSHAR'AR SPORT in order to implement the study of methods and times to increase the productivity of this, the objectives set were to identify the problems in the realization of the dresses, implement tools of analysis of study of the work and increase the productivity of the company, this through analytical diagrams, travel, and the respective productivity calculations. In the methodological phase of the project, a description of the garment company KEYSHAR'AR SPORTS was initially made, a process was chosen and what was observed in the current material used in the company was explained step by step, it was observed that the production process begins with the storage of the raw material then goes to the design area where a process of specific patterns is made to the fabrics used in each design is then taken to a cutting machine, from there it is transported to the garment machines; then the dress goes to the inspection area where it is verified if the product has imperfections, then those that pass the inspection are transported to the ironing area and then they are labeled and packed, in this way having made each of the diagrams of the methods, both the initial and the proposed, we proceed to find the percentage of processes, initially 12 processes that are reduced to 9, in addition some improvements are formulated to increase the performance and productivity of the company.

Keywords: Methods and times, productivity, improvements, processes, optimization

Resumen

El proyecto de investigación se realizó en la empresa textil KEYSHAR'AR SPORT con el fin de implementar el estudio de métodos y tiempos para incrementar su productividad, los objetivos planteados fueron identificar los problemas en la realización de los vestidos, implementar herramientas de análisis de trabajo estudio e incrementar la productividad de la empresa, esto a través de diagramas analíticos, ruta, y los respectivos cálculos de productividad. En la fase metodológica del proyecto se realizó inicialmente una descripción de la empresa de indumentaria deportiva KEYSHAR'AR, se escogió un proceso y se explicó paso a paso lo observado en el material actual utilizado en la empresa, se observó que el proceso de producción se inicia con el almacenamiento de la materia prima luego se dirige al área de diseño donde se realiza un proceso de patronaje específico a las telas utilizadas en cada diseño, posteriormente se lleva a una máquina de corte, de ahí se transporta a las máquinas de confección; luego el vestido pasa al área de inspección donde se verifica si el producto tiene imperfecciones, luego los que pasan la inspección son transportados al área de planchado y posteriormente son etiquetados y empacados, habiendo realizado así cada uno de los diagramas de los métodos tanto iniciales y los propuestos, se procede a encontrar el porcentaje de procesos, inicialmente 12 procesos que se reducen a 9, además se formulan algunas mejoras para incrementar el rendimiento y productividad de la empresa.

Palabras Clave: Métodos y tiempos, productividad, Mejoras, procesos, optimización**.**

1. INTRODUCTION

In this work, the company KEYSHAR'AR SPORTS, a company dedicated to the manufacture of clothing, was taken as the basis of study. Through different methods such as the bimanual diagram, operations diagram, among others, the results that were sought to determine which areas of the company were presenting productivity deficiencies were obtained, because the objectives are to measure the levels of productivity that may be presented.

Analysis of the processes of elaboration of a dress was carried out, it was studied what type of materials were used, from the raw material, to the time it took to manufacture, and thus find what failures could occur when making these dresses, in this research the step by step of this process is explained, from the manufacture, what materials are used and how they are used, what problems were found and what solutions were found in this process.

Of the different problems found, several were captured in images in order to show the factors most likely to receive a change or an improvement, which is one of the objectives. It is evidenced and interpreted in a very simple way the type of work that is carried out in this company, in what type of spaces the operators carry out their work activities.

Productivity was analyzed , taking into account global productivity and by labor, important information should be collected such as the units manufactured per day, per week and per month, and thus have the accounts of the number of dresses or garments made in a day, as well as with that of labor.

The productivity of the monthly company was one of the different data found in this work, determining whether or not a productivity was achieved, if it was generating profits or on the contrary, losses, these data were captured and the answers that were needed to continue with the research were obtained.

The cost of manufacture was studied, from the materials to the final part of the product, since KEYSHAR'AR SPORTS is a clothing workshop that provides its same raw materials, they have no expenses in these materials, but through different operations the costs of the elaboration and the profits of the operators were determined, in order to determine the productivity of the products manufactured in this company, taking into account the profits per day of the operators, and the expenses per day. In addition, the study of time was carried out, which is a technique for the measurement of work and thus record the times and rhythms of the aforementioned company. Finally, the calculations of this technique were performed using standard time, which is the execution time of a task at the normal rate.

In the search and in the deep research the processes and the step by step of each one in this company were known, what materials are used, the cost of each one, the profits obtained, the productivity of the articles. Overall, an in-depth study about the activities of this company called KEYSHAR'AR SPORTS

2. LITERATURE REVIEW

The authors [1] in their work of study of methods and times of a poultry productivity company, develop analytical diagrams, productivity calculations, process analysis, and identify the variables that affect the production process, also through a study of times and movements if the tasks that were carried out in the established areas of the company are adequate for the number of employees with the machinery used, It was evidenced in this work there were problems in terms of lack of operators with the areas of selection and chopped viscera.

In this research work the authors [2] in their thesis work to improve productivity through the application of methods engineering tools in an automotive mechanical workshop, carried out a very complete and detailed work of methods and times, the study of work and various diagrams such as operations, activities and route, with this they made the improvement based on studies of times in the operations considering the concepts of engineering methods, to increase the productivity of the service and warehouse area. They showed that the functions and performance of the mechanics improved statistically and their attention span improved compared to previous months, favoring delivery times and profitability of the company.

In this study the authors seek to [3]improve productivity in the pad pressing section, in the automotive brake factory EGAR S.A, with the least investment, maintaining the same infrastructure, by optimizing the means of production. To do this, they carried out a work analysis, study of methods and times, measurement of productivity and evaluation in the area of pressing pills, they also carried out a human machine cursogram and identified that the current method allows more than 50% of the pressing cycle of pills to generate that the press is stopped.

In the following work the authors made a [4]proposal for the increase of productivity in the processes of elaboration of terno jean in the company Jb Worker by means of the standardization of times of operation, developing the methodology of study of times in the processes of elaboration of terno jean, in this way they realized that there is no system of planning of the production, which limits the dynamics of the processes, generating downtime and delays in delivery times, also the functions and responsibilities of the operators are not defined generating delays and reprocessing.

It was observed in this study that the authors generate a [5]proposal to improve productivity in the line of candied beans of the company super snacks silvanite through the standardization of operating times, productivity calculations, analysis of the production line, techniques for the measurement of work and its times are evidenced, the line of candied beans presented problems of non-compliance with demand that caused the company economic losses, through these tools of study of work and productivity they were able to detect the diagnosis of the production of each of the lines, as well as the forecasts of the demand, they could detect the need to increase the volume of production that the line of candied beans had from 136 800 to 164 169 productive units per year.

In this study the authors seek [6]to apply the study of work to improve productivity in the production area of the textile company Sirius Sport, where they carried out an analysis, in addition to the application of methods and times, evidence that the use of the tool of the study of work improves the efficiency of the company, it is determined that by measuring the work (study of times) carried out to the activities of the process of preparation of jackets, it is possible to reduce the time, thus saving 22 minutes per garment manufactured, consequently the efficiency was increased by 13.94%.

In the following work the authors [7] implement the study of methods and times of the production line of footwear type "classic lady" in the capricious footwear company to define a new production method and determine the standard manufacturing time, for this they perform various analysis of work and time in the manufacturing process of footwear, In addition to a productivity analysis, through this they defined a new manufacturing method, evidencing the decrease in labor costs and increase in productivity, also that some methods used for the execution of each task within the station are performed with inadequate instruments and tools, increasing the difficulty of the process and even the quality levels.

The authors in this study [8] seek to determine how the application of work study improves labor productivity in the production of wallets in the company Clavis Car, SJL, 202, implemented the bimanual diagram, operations diagram, process activity diagram, study of methods and times, managed to conclude that the study of methods agreed to renew the activities that harmed labor productivity identifying that 2.78% of the activities were unsuccessful in the proposed development applied.

In this study the authors make an [9] improvement proposal for the optimization of the productivity of the STK POWER workshop, by studying methods and times in the provision of the oil change service every 5000 km in a car, they carried out an analysis of times and methods, and identified through the study of times that the activities that generated a completely unnecessary delay, it was mainly the request for the new filter, since this is a process that should not be carried out at the time of the provision of the service and much less by the mechanic, among other aspects that increase the performance of operational productivity.

In this work the authors use [10] the study of methods and times to improve productivity in the harvesting system of a sugar mill, implement different diagrams for each process such as the diagram of routes, diagram of operations, the study of methods and times, through these tools they evaluated the operations developed in the processes of cutting and loading of chopped sugar cane, and the process of receiving long and chopped sugar cane from the harvesting system of a mill, in addition to identifying the downtimes and restrictions that arise, to propose control and improvement measures, they determined by means of the statistical analysis of the times taken in the factory yards that the cycle time of the process of reception of chopped cane and long cane are mainly affected by the times of waiting to unload and prolong the time of the mule tract at the service station.

3. METHODOLOGY

In **Phase 1** of the project, a description was made of the company KEYSHAR'AR SPORTS, which is dedicated its economic activity to the manufacture of clothes mostly in women's clothing; it also has contracts where it makes three different companies that market these products, apart from this it has its own brand, for this case study a process of this company was selected in which the project was focused to make the respective improvements, because there are different problems in the elaboration of the garments in this case it was in the process of making dresses.

In **Phase 2** the description of the selected process was made, in this case the elaboration of dresses was chosen; including their respective diagrams and current PMO calculations.

In **Phase 3** , the critical analysis of the elaboration of dresses was carried out; in which a series of problems could be observed that were evidenced in the study that was carried out to the company KEYSHAR' AR SPORTS.

In **phase 4** , an improvement proposal was developed that was implemented to the company, with the aim of improving it; as well as its production and the quality of its products.

In Phase 5, the proposed method was described and annexed with its respective diagrams with the aim of supporting the proposal that was implemented to the company KEYSHAR'AR SPORTS.

In **Phase 6;** Work measurement was performed.

In the **Step 7** was determined rest supplements o Start.

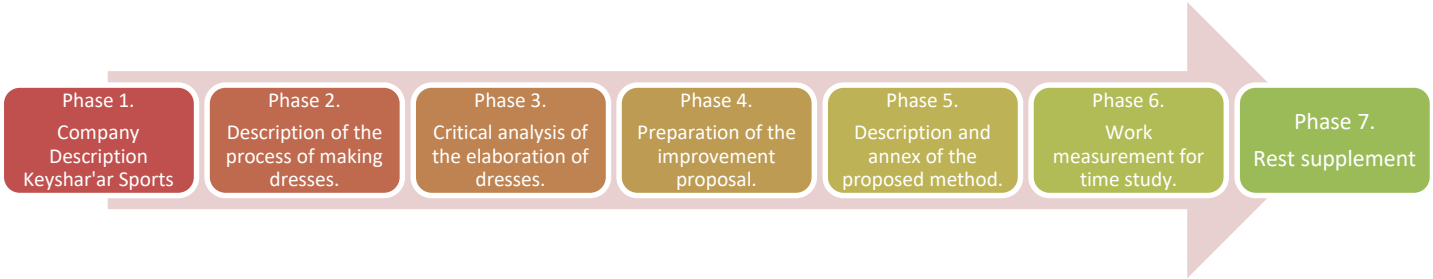


Illustration 1. Methodology of the Project. **Sources: Authors**

4. CASE STUDY

4.1 Description of the Current Process.

For this research, the process of making clothing in the company "KEYSHAR'AR SPORT" was chosen, this process was selected because the company has presented internal problems in terms of its organization, so it is intended to propose some improvements to increase its productivity and its times. The following are the machines and tools for the manufacture of clothing (see Table 1), and the raw material (see Table 2).

Machines and work tools	Units

Flat Machine	10
Two-needle machine	1
Coating Machine	1
Machine 20-u	1
Embroidery Machine	1
Cutting Machine	1
Iron	2
Polishing	10
Rule	10
Filleting Machine	1
Cutting scissors	10
Needles	-
Tape measure	12
Templates and molds	-
Total	**60**

Table 1. Machines and work tools for the manufacture of clothing.

Raw material
Screen
Threads
Buttons and/or accessories
Cotton
Nylon

Table 2. Raw material for the production of the finished product (clothing).

Taking into account the tables embodied, we proceed to explain the process of making dress in the company "KEYSHAR'AR SPORT".

1. **Design:** at this stage the number of steps that are necessary to make the dress is established, for this, characteristics and variables are defined such as: target market, type of textile, size, number of cuts, customization process and supplies, this step takes a time of (20 min).

2. **Pattern making:** at this stage the parts of the dress are drawn having as a reference the technical sheet. At this stage the reference points of the molds and the scaling of the necessary sizes to be cut are defined; it can be done in two ways: manual and industrial, in this case the company does it manually-mechanically, this stage takes a time of (300 min).

3. **Cutting:** at this stage the pieces that make up a dress are separated or divided with the help of the cutting machine and cutting scissors, this stage takes a time of (90 min).

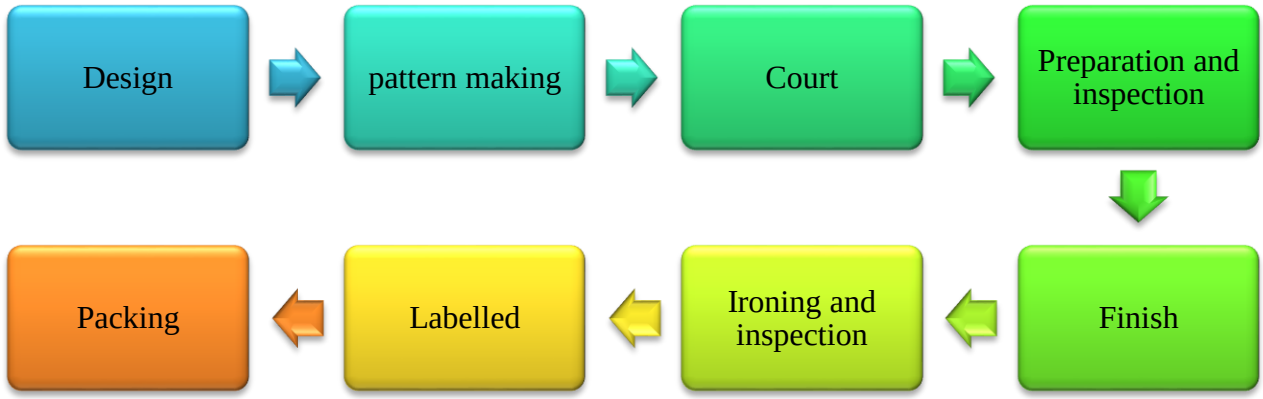
4. **Confection:** at this stage the fabrics are made and inspected, to be converted into a dress, to reach the finishing area of each garment, this stage takes a time of (90 min).

5. **Finishing and inspection:** in this step, which is an operation, the quality of the dress is inspected, and this, if it does not go through a defect is returned to confection, on the other hand, if it is well within the quality standards it goes to the next process, this stage takes a time of (10 min).

6. **Ironing and inspection:** at this stage the dress is ironed and inspected, it should be noted that in this step there may be certain parts of the garment, within which the polishing process is not enough to see defects, so the dress is inspected again to see if there is any deficiency in it, if there is any it is returned to confection, this stage takes a time of (30 min).

7. **Labeling:** in this stage the marking of each of the layers of blocks of pieces of the dress is carried out for its subsequent organization at the time of the confection, in this way it is possible to indicate lot, reference, size and consecutive of the piece, this stage takes a time of (10 min).

8. **packing:** in this last stage we proceed to pack the dress, within which it is saved for its respective shipment, this stage takes a time of (10 min).



4.1.1 Analytical diagram of current material.

Illustration 2. Stages of the process of making the dress of the company "KEYSHAR'AR SPORT". Source: Authors

The following is the current analytical diagram of the material for the garment making process:

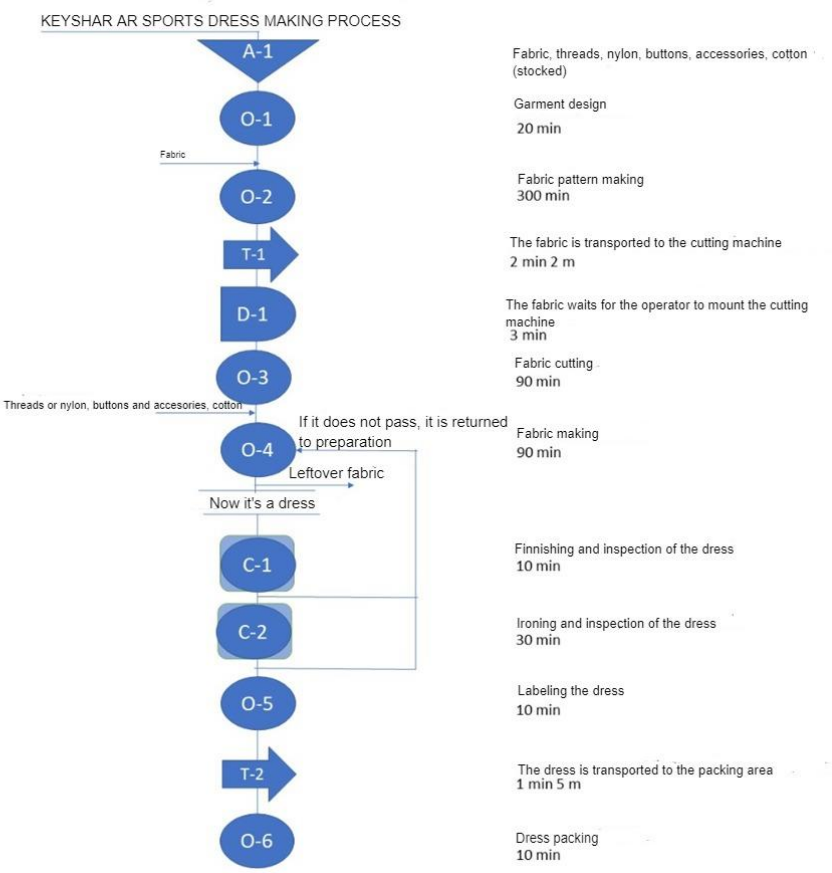


Figure 3. Current analytical diagram of the material for the process of making clothing. Source: Authors.

Analysis: in the analytical diagram of the material, it is observed that first a storage[1] is carried out in terms of the raw material, which would be (fabrics, threads, buttons or accessories, cotton and nylon), after this an operation[1] is carried out in terms of the design stage, which takes a time of (20min), followed by the fabrics for the elaboration of the dress and an operation is carried out[2] for the patternmaking stage, which takes a time of (300min). Then a transport1 is evident[1], when the fabric is carried to the cutting machine, this takes a time of (2min) and (2 m) away.

Then a problem is evidenced in terms of delay, where the fabric waits for the operator to mount the cutting machine so that it can be mutilated, taking a time of (3min), this is because the machine needs to be assembled and organized to be able to place the fabric to be cut and the same process is done with the other fabrics that enter to make cuts.

After this, an operation [3] is done for the cutting stage of the fabric, this takes a time of (90min). Then an operation[4] is performed for the fabric making process, this stage takes a time of (90min), the leftover fabric comes out, now the fabric becomes a dress after this stage.

Next, one (operation and inspection)[1] is evidenced in the finished stage, which takes a time of (10 min), at this stage at the time of inspecting the dress, if any defect is evident, it does not pass to the next operation and is returned to the confection operation[4]. Then one (operation and inspection) [2] is carried out in the ironing stage, which takes a time of (30 min), at this stage it is again inspected that there is no defect in the dress, because it is not enough only with the finishing stage, if in this any defect is evidenced, the dress does not go to the next operation and is returned to the confection operation[4].

After an operation[5] is performed in the labeling stage of the dress, this takes a time of (10 min). Now a transport[2] is carried out, for the dress, which is carried by the operator to the packaging area, this takes a time of (1min) and (5m) away. Finally, a packing operation[6] is carried out, where the dress will be packed to be taken to its destination.

It should be noted that the total time of the process of making the dress for the diagram of the material takes a total time of 566 min.

4.1.2 Analytical diagram of the current operator.

The current analytical diagram of the operator for the garment making process is reflected below:

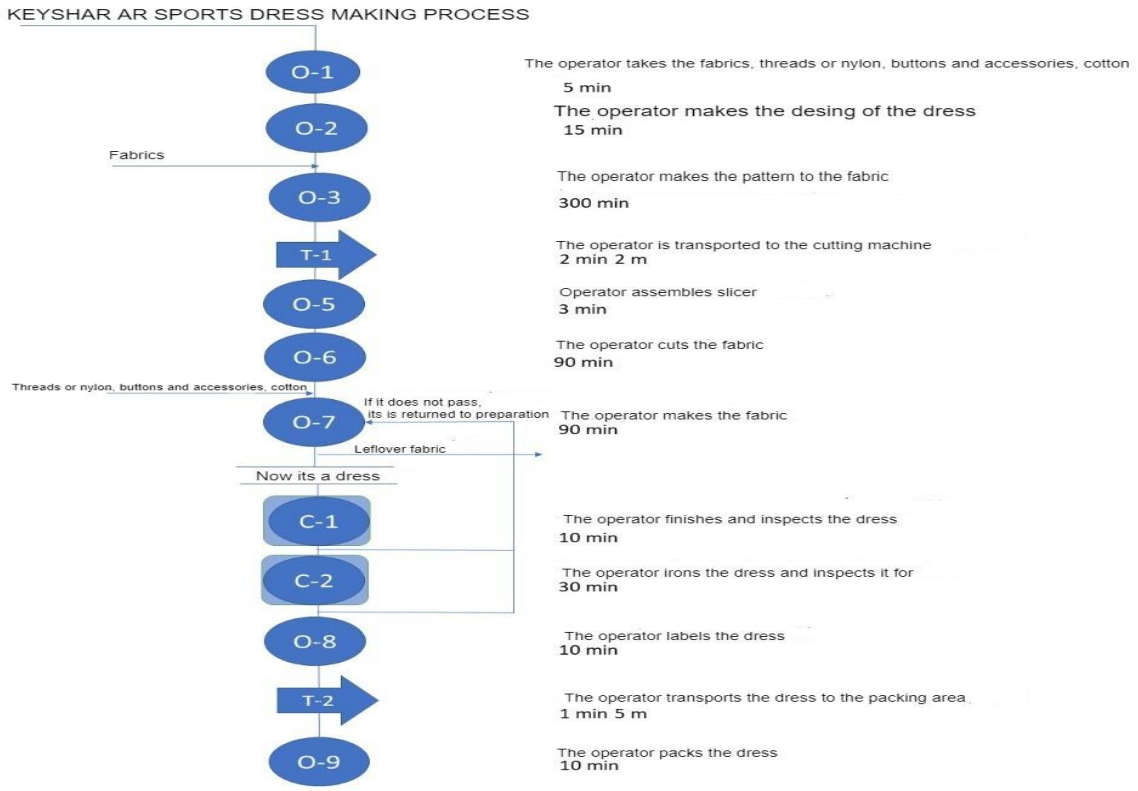


Figure 4. Current analytical diagram of the operator for the garment making process. Source: Authors.

Analysis: in the analytical diagram of the operator it is observed that first an operation[1] is carried in terms of the raw material, when the operator takes fabrics, threads, buttons or accessories, cotton and nylon, taking a time of (5min), after this an operation[2] is carried out in terms of the design stage, where the operator makes the previous design of the dress to be made, this takes a time of (15min), then the fabrics enter for the elaboration of the dress and an operation[3] is performed for the pattern stage, which takes a time of (300min). Then a transport[1] is evident, where the operator is transported to the cutting machine, this takes a time of (2min) and (2 m) away. Then an operation[5] is performed, where the operator assembles the cutting machine, this takes a time of (3min).

After this, an operation[6] is made for the cutting stage of the fabric, where the operator cuts the fabric, this takes a time of (90min). Then the threads, nylon, buttons or accessories and cotton enter, followed by an operation[7] for the fabric making process, where the operator begins to make the fabric, this stage takes a time of (90min), the leftover fabric comes out, now the fabric becomes a dress after this stage.

Next, one (operation and inspection)[1] is evidenced in the finished stage, which takes a time of (10 min), in this stage at the time of inspecting the dress, if the operator shows any defect, it does not pass to the next operation and the operator returns it to the clothing confection[7] .Then one (operation and inspection) [2] is carried out in the ironing stage, which takes a time of (30 min), at this stage the operator inspects again that the dress does not have any defect, because it is not enough only with the finishing stage, if in this the operator evidences a defect, the dress does not go to the next operation and is returned to the confection[7].

Then an operation[8] is performed in the labeling stage of the dress, where the operator begins to place the respective labels of the dress, this takes a time of (10 min). Now a transport[2] is carried out, where the operator takes the dress to the packaging area, this takes a time of (1min) and (5m) away. Finally, a packing operation[9] is carried out, where the operator packs the dress to be taken to its destination.

It should be noted that the total time of the process of making the dress for the operator diagram takes a total time of 566 min.

4.1.3 Initial route diagram.

Below is the diagram of the initial route of the process of making dress:

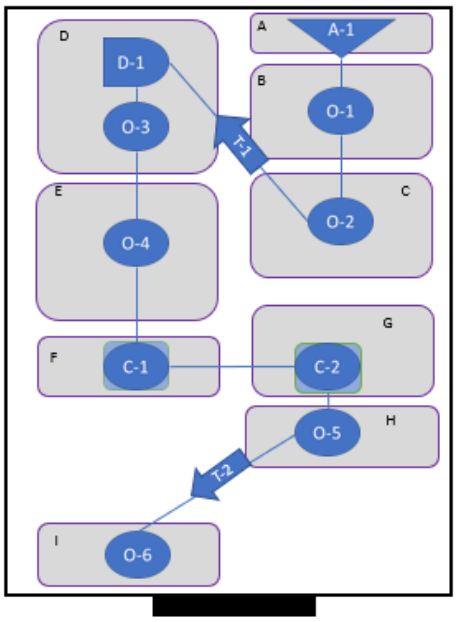


Figure 5. Initial route diagram for the dress making process. Source: Authors.

In the initial route diagram, each of the areas can be evidenced, which are:

The letter A: is the storage area of the raw material, which is where each of the inputs and materials used to reach the final product, which in this case is the dress, is stored.

The letter B: is the design area, which determines the number of steps that are necessary to make the dress.

The letter C: is the pattern area, in this they draw the parts of the dress having as reference the technical sheet.

The letter D: is the cutting area, which is made the division of the pieces that make up a dress.

The letter E: is the area of confection, which is made and, in addition, the fabrics are inspected.

The letter F: is the finishing area, which is inspecting the quality of the dress.

The letter G: is the ironing area, which is ironed and inspects the dress.

Letter H: is the labeling area, which is the marking of each of the layers of blocks of pieces of the dress.

The letter I: is the packaging area, which packs the dress for its respective shipment.

Also, in the route diagram the different activities that are carried out are evidenced, to reach the final product which are: First **A-1** which means that the raw material is stored, that is, the fabrics, threads, nylon, buttons, accessories, cotton. Then **O-1** which means that it is an operation, since the design of the garment is made. Then **O-2** which means that it is an operation, because the fabric pattern is performed. Now, it is evident that there is a **T-1** transport, Since the fabric is transported to the cutting area, this transport has a distance of (2meters). Then, the fabric waits for the operator to assemble the machine, so there is a delay that is **D-1**. Like 3 **O-3** operation. Here, the cutting of the fabric is carried out. Then all the raw material comes in, which was already mentioned above. Then, the **O-4** is made, which is the making of the fabric, so that it is already a dress. Then a combination is made that is **C-1**, since the finishing operation is done and likewise, it is inspected that the dress does not have any defects. Then, a combination is performed again that is **C-2**, since the ironing operation is done and likewise, it is inspected that the dress does not have any defects. Then, the **O-5** operation is performed which is done the labeling of the dress. Then, a transport is carried out that is **T-2**, since the dress is transported to the packaging area, this transport has a distance of (5 meters) And, finally, an operation is done that is **O-6**, which is to pack the dress so that the respective shipment is made.

	exercise	proposed
	OPERATION	6
	TRANSPORT	2
	DELAY	1
	INSPECTION	0
	STORAGE	1
	COMBINED	2
TOTAL ACTIVITIES		12
TOTAL DISTANCE		7 m
TOTAL TIME		566 min

Figure 6. Improved dress making process table. Source: Authors.

4.1.4 Productivity analysis.

For this part of the document, the overall productivity will be carried out, by labor and the increase of this, for the process of elaboration of dress of the company "KEYSHAR'AR SPORT". First, the units manufactured per day will be established.

Units manufactured per day:

- 250 units are made weekly
- They work 5 days, a week.
- 1 dress is made by 1 operator.

Initial method.
5 days----------250dresses
1day----------X

$$\boldsymbol{units\ manufactured\ per\ day} = \frac{250units/week \times 1dress}{5days} = 50\ units/day\ (1)$$

$$\boldsymbol{units\ manufactured\ per\ week}\ = 50units \times 5days = 250units/week\ (2)$$

$$\boldsymbol{Monthly\ manufactured\ units} = 50units \times 20days = 1000units/monthly\ (3)$$

It is evident that 50 dresses are made per day, that is, 250 units will be made weekly and monthly 1000 units of dresses.

Labor productivity.

$$\boldsymbol{PMO} = \frac{50units}{8operator} = 6{,}25\ units\ D-H\ (4)$$

$$\boldsymbol{PMO} = \frac{250units}{8operator} = 31{,}25\ units\ W-H\ (5)$$

$$\boldsymbol{PMO} = \frac{1000units}{8operator} = 125\ units\ M-H\ (6)$$

It is evident that, in the productivity of labor, an operator can make 6.25 dresses per day, that is to say that in one day the 8 operators make 50 units, in a week each operator will make 31.25 units, that is, that among the 8 operators will make 250 dresses per week and monthly an operator makes 125 units, which means that in a month the 8 operators would be making 1000 dresses.

Cost of materials.

There is no expenditure on raw material, as this is provided by the company. However, there is expenditure on supplies per dress, which is $2,000. the costs are found.

$$\boldsymbol{cost\ of\ daily\ materials} = \$2{,}000 supplies \times 50 units = \$100{,}000\ Cost/D \quad (7)$$

$$\boldsymbol{weekly\ material\ cost} = \$2{,}000 supplies \times 250 units = \$500{,}000\ Cost/W \quad (8)$$

$$\boldsymbol{monthly\ material\ cost} = \$2{,}000 supplies \times 1000 units = \$2{,}000{,}000\ Cost/M \quad (9)$$

It is evident that, the cost of daily raw material is .$ 100,000$, that is to say that the 50 units that are made daily together with the cost of inputs that is $2,000 for each unit, generates this cost, also the 250 units that are made weekly along with the value of the inputs ($2,000), generate a material cost of $500,000, finally the 1000 units that are made per month with the same value of inputs, generate a raw material cost of $2,000,000.

Operator's earnings.

It is important to note that an operator is paid.$10,000 for each dress he makes.

$$\boldsymbol{profit\ of\ an\ operator\ per\ day} = 6{,}25\ units/day \times \$10{,}000 = \$62{,}500\ gain\ OP/D \quad (10)$$

$$\boldsymbol{profit\ of\ an\ operator\ per\ week} = 31{,}25\ units/day \times \$10{,}000 = \$312{,}500\ gain\ OP/W \quad (11)$$

$$\boldsymbol{profit\ of\ an\ operator\ per\ month} = 125\ units/day \times \$10{,}000 = \$1{,}250{,}000\ gain\ OP/M \quad (12)$$

It is evident that in one day an operator making 6.25 dresses, is won $62,500, that is, an operator weekly is earned $312,500 and monthly is earned $1,250,000.

Company expenses per operator.

$$\boldsymbol{expense\ per\ operator\ per\ day} = \$62{,}500 \times 8 operator = \$500{,}000\ expense/D \quad (13)$$

$$\boldsymbol{expense\ per\ operator\ per\ week} = \$312{,}500 \times 8 operator = \$2{,}500{,}000\ expense/W \quad (14)$$

$$\boldsymbol{expense\ per\ operator\ per\ month} = \$1{,}250{,}000 \times 8 operator = \$10{,}000{,}000\ expense/M \quad (15)$$

It is evident that the company "KEYSHAR'AR SPORT", has a daily expense for the 8 operators of $500,000, that is to say that per week the company has an expense for the 8 operators of $2,500,000 and monthly has an expense of $10,000,000 for the 8 operators.

Global productivity.

It should be noted that the overall monthly productivity will be found.

$$\boldsymbol{P.G} = \frac{units\ manufactured \times sale\ price}{cost\ of\ material + workforce + rent/services} (16)$$

Data.

Units manufactured monthly = 1,000 units

Sale price = $35,000

Monthly material cost = $2,000,000

Monthly labor for the 8 POs = $10,000,000

Services = $180,000

We now proceed to replace data in the formula (16):

$$\boldsymbol{P.G} = \frac{1{,}000\ units \times \$35{,}000}{\$2{,}000{,}000 + \$10{,}000{,}000 + \$180{,}000}$$

$$\boldsymbol{P.G} = 2{,}87$$

$$2{,}87 > 1$$

It can be concluded that the company "KEYSHAR'AR SPORT", is being productive because the overall productivity is greater than 1, practically the company is earning twice as much.

4.2 Critical Analysis of the Process and Proposals for Improvement.

To make the critical analysis of the process, the interrogation technique will be used, which will be explained below:

4.2.1 Interrogation technique.

The technique of the questioning attitude consists of a series of critical questions applied systematically on the activities of an already detailed process. Initially, the questions seek to extract from the activities of a process, the following elements:

- ✓ Purpose
- ✓ Place
- ✓ Succession
- ✓ Person
- ✓ Media

And they do so through preliminary questions and substantive questions, the aim of which is the improvement of working methods. It is, therefore, vital that the method engineer or industrial engineer focuses on the real understanding of the process in order to evidence possible improvements through the interrogated.

Therefore, when applying the technique, it is part of the work that is already registered, that is, we must know the operations, inspections, waits, transports and storage of the process, which are the activities that will be examined with a critical spirit.

Now, the preliminary questions are asked systematically, that is, they are asked in the order that is exposed. What is done and why is it done? These are the first questions that are asked. The answers to these will allow to demonstrate the purpose of the work. Thus, if the interviewee does not manage to answer the PURPOSE questions in a reasonable way, it can begin to think that the activity under analysis is not justified, and if its existence is not justified, neither will the circumstances on which it is carried out; that is, it will NOT be necessary to analyze it with the other questions. In the event that you reasonably answer the purpose questions, we can proceed with the questions of place, succession, person and method.

In the second phase, substantive questions are asked that are nothing more than an extension of the preliminary questions. They seek to determine if to improve the process, it is feasible to modify the place, the succession, the person and / or the means. This is achieved by considering what else could be done?... then... what should be done? [11]

Guy	Question	Answer
Purpose		
Question Preliminary	What is actually done in the process of making dress?	A fabric is made to be converted into a dress.
	Why do you have to do the process of making a dress?	Because through this process the finished product (dress) is obtained.
Question from Bottom	What else could be done in the process of making a dress?	A cleaning stage could be implemented in the work area.
	What should be carried out in the process of making clothing?	Any remaining fabric or debris should be removed from the work area to keep everything organized.
Place		
Question Preliminary	Where is the dress making process done?	It is done in a place of solitude / Atlantic.
	Why is the dressmaking process done there?	Because there are all the machines and raw materials.
Question from Bottom	Where else could the dressmaking process be done?	In a place where the same machines and raw material are.
	Where should the dressmaking process take place?	It can be done anywhere taking into account that all the machines and raw material of the process are there.
Succession		
Question Preliminary	When is the dress process done?	He is already dressed when he goes through the stage of making.

	Why is the dress made at that time?	Because it is necessary to make the fabric to obtain the finished product.
Question from Bottom	When could the dress be made?	It can be done at any time if you have the necessary machines and the previous stages have already been completed.
	When should the dress be made?	When the design, pattern making and cutting stage has been completed.
Person		
Question Preliminary	Who makes the dress?	The dress is made by the operators.
	Why does that person make the dress?	Because they are people who are trained in the process of making clothes.
Question from Bottom	What else could make the dress?	People trained for clothing.
	Who should do it?	The operator must perform the process as he is trained to meet the objective.
Media		
Question Preliminary	How is the process of making a dress done?	It is carried out through a stage of design, pattern making, cutting, preparation and inspection, finishing, ironing and inspection, labeling and packaging.
	Why is the process of making a dress done in this way?	Because it is necessary to obtain the final product (dress).
Question from Bottom	How else could the process of making a dress be carried out?	It can be elaborated in the same way, but with a better organization.
	How should it be done?	Having within reach each machine necessary for the process, that the operator does not have to move, or assemble any machine.

Table 3. Interrogation technique for the process of making dress of the company "KEYSHAR'AR SPORT"..

Analysis of interrogation technique.

After having performed the technique of the questioning attitude, it is evident that the purpose of the process of making clothing of the company "KEYSHAR'AR SPORT", is the manufacture of a fabric that goes through different stages, such as design, pattern making, cutting, making and inspection, finishing, ironing and inspection, labeling and packaging, this is made by the hands of 8 operators who are trained in each stage that is carried out, in a place of solitude where the necessary machines for this process are located. In addition to this, it is verified that the process of making clothing can be carried out with the same stages, but having a better organization in them, specifically in the places where the cutting machine is located, which is distant from the work area of the operators and this generates delay, the process could be improved, placing the machine within reach of each stage and operator.

After seeing the respective analysis of the interrogation technique carried out, it can be concluded that:

Problems encountered	**Proposals for improvements.**
Lack of organization in the raw material, specifically in the fabrics. It is evident that in the work area the fabrics are disorganized by all spaces. (See Figure 7.)	It is proposed to make an investment in shelves (see figure 9) to store this raw material, in addition to placing them all in a specific place, it should be noted that there is a shelf, but only for threads.
Demotivation in employees for reasons of seating in their workplaces. The chairs on which the operators sit to do the work of making the dress are static and hard (see Figure 8).	It is proposed to buy more comfortable chairs, which have a sponge on the seat and back. We propose a chair style (see Figure 10).

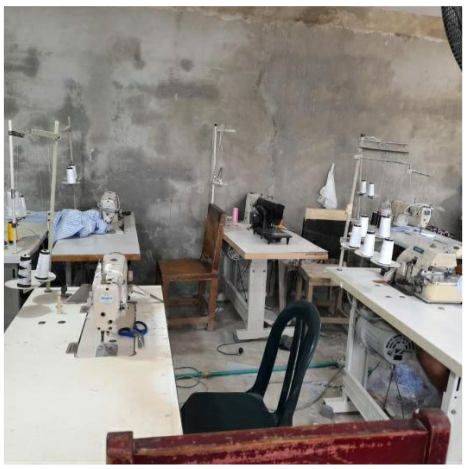
Deficiency in the hourly control by day of the workers.	It is proposed to make a daily control in terms of the schedules of each worker.
Isolation of the cutting machine, in terms of its position, which is centered away from each stage and this generates delay in the process.	It is proposed to place the cutting machine close to the work area of the operators, taking into account that this will be of great advantage for the reduction of time and distance.
Problems in the process of making, finishing and polishing, since there are too many garments the operators are oversaturated with work.	The implementation of intermittent operators is proposed when there is a lot of production.
Delay in cutting machine, because the operator has to first assemble the machine and organize it to be able to cut each fabric.	It is proposed to have the cutting machine organized and ready to perform the operation.
High time when packing the dress, that is, the operator took a time of 10min to pack a single dress and close the bag, because it was done manually.	A bag-closing machine is proposed, which is designed for quick packing (see Figure 11).
Transports in the initial method (see Figure 5), such as transporting the fabric to the cutting machine and transporting when the clothing is transported to the packaging area, it must be taken into account that this affects the workers.	These transports are eliminated as a reorganization is made in the workspace (see Figure 12)
Waste of time in operation and inspection for the finishing stage, in this part it was inspected that in the fabric there was no defect, however, in the ironing stage this same step was done again.	The inspection of the finishing stage is eliminated, since it is considered unnecessary, because after this stage an inspection is carried out again, within which the same review of defects is made that can be done in the same stage, which would be only in the ironing stage.

Table 4. Problems and proposals for improvements for the process of making clothing of the company "KEYSHAR'AR SPORT".

Problems found in pictures.

Illustration 7. Disorganized raw material Chairs used in the "KEYSHAR'AR SPORT" company. Source: Authors**.**

Illustration 8. Chairs used in the company "KEYSHAR'AR SPORT". Source: Authors.



Proposals for improvement reflected in images.

Illustration 9. Proposal of shelves for the organization of raw material. Source: Rejiplas.

Illustration 10. Chair proposal for operators. Source: Line.

Figure 11. Packaging machine. Source: free market.

4.2.2 Proposed analytical diagram of the material.

The following is the proposed analytical diagram of the material for the garment making process:

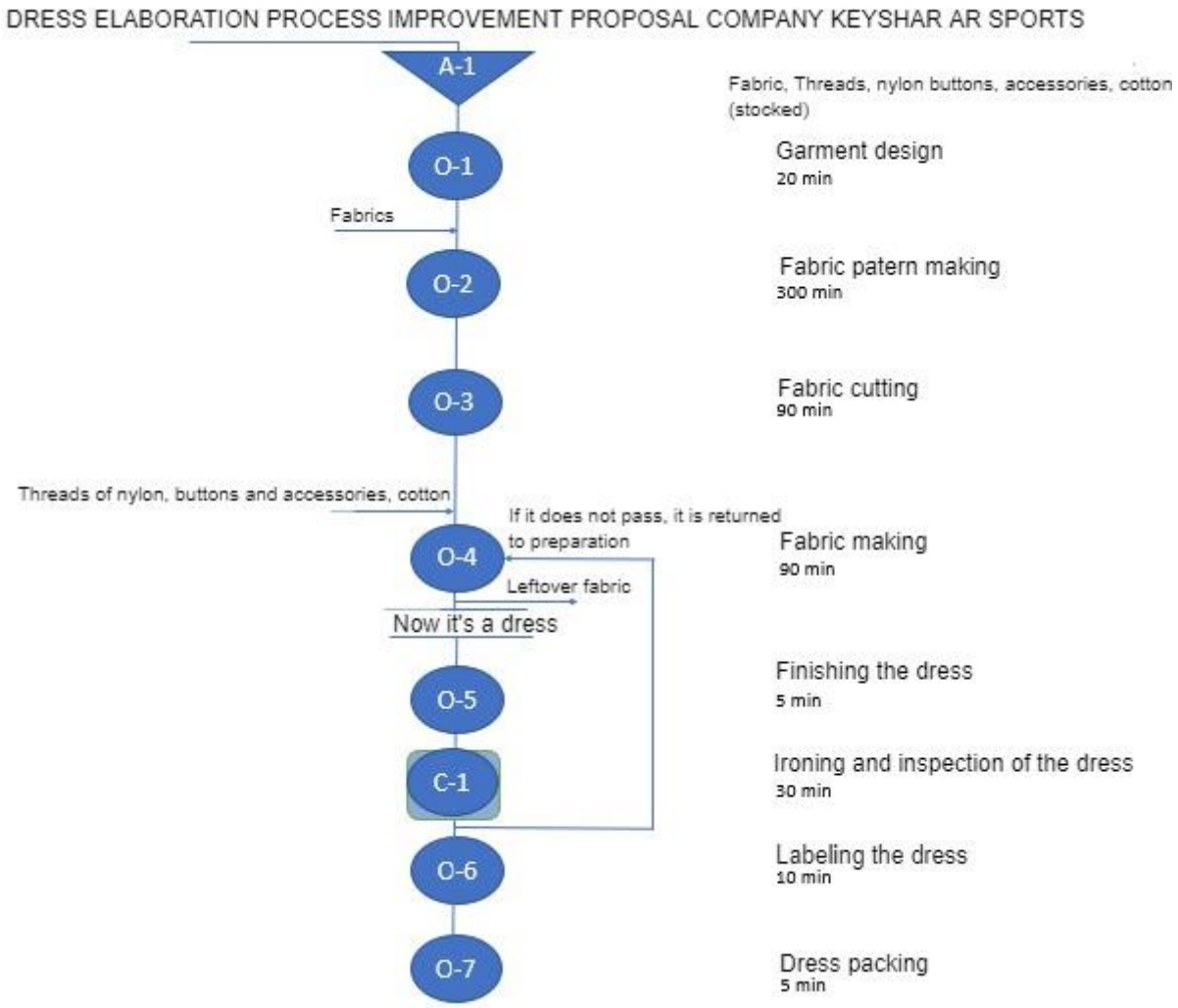


Figure 12. Proposed analytical diagram of the material for the garment making process. Source: Authors.

Analysis: in the analytical diagram of the improved material, it is observed that first a storage[1] is made in terms of the raw material, which would be (fabrics, threads, buttons or accessories, cotton and nylon), after this an operation[1] is carried out in terms of the design stage, which takes a time of (20min), then the fabrics for the elaboration of the dress enter and an operation[2] is carried out for the patternmaking stage, which takes a time of (300min). After an operation[3] is done for the cutting stage of the fabric, this takes a time of (90min). Then come the threads, nylon, buttons or accessories and cotton. Then an operation[4] is performed for the fabric making process, this stage takes a time of (90min), leftover fabric comes out, now the fabric becomes a dress after this stage.

Next, an operation[5] is performed in the finished stage, which takes a time of (5min). Then one (operation and inspection)[1] is performed in the ironing stage, which takes a time of (30 min), in this stage it is inspected that there is no defect in the dress, if in this any defect is evident, the dress does not pass to the next operation and is returned to the confection operation[4].

After an operation[6] is performed in the labeling stage of the dress, this takes a time of (10 min). Finally, a packing operation[7] is carried out, where the dress will be packed to be taken to its destination, this stage takes a time of (5min).

It should be noted that the total time of the process of making the dress for the diagram of the material takes a total time of 550 min.

4.2.3 Proposed analytical diagram of the operator.

The following is the proposed analytical diagram of the operator for the garment making process:

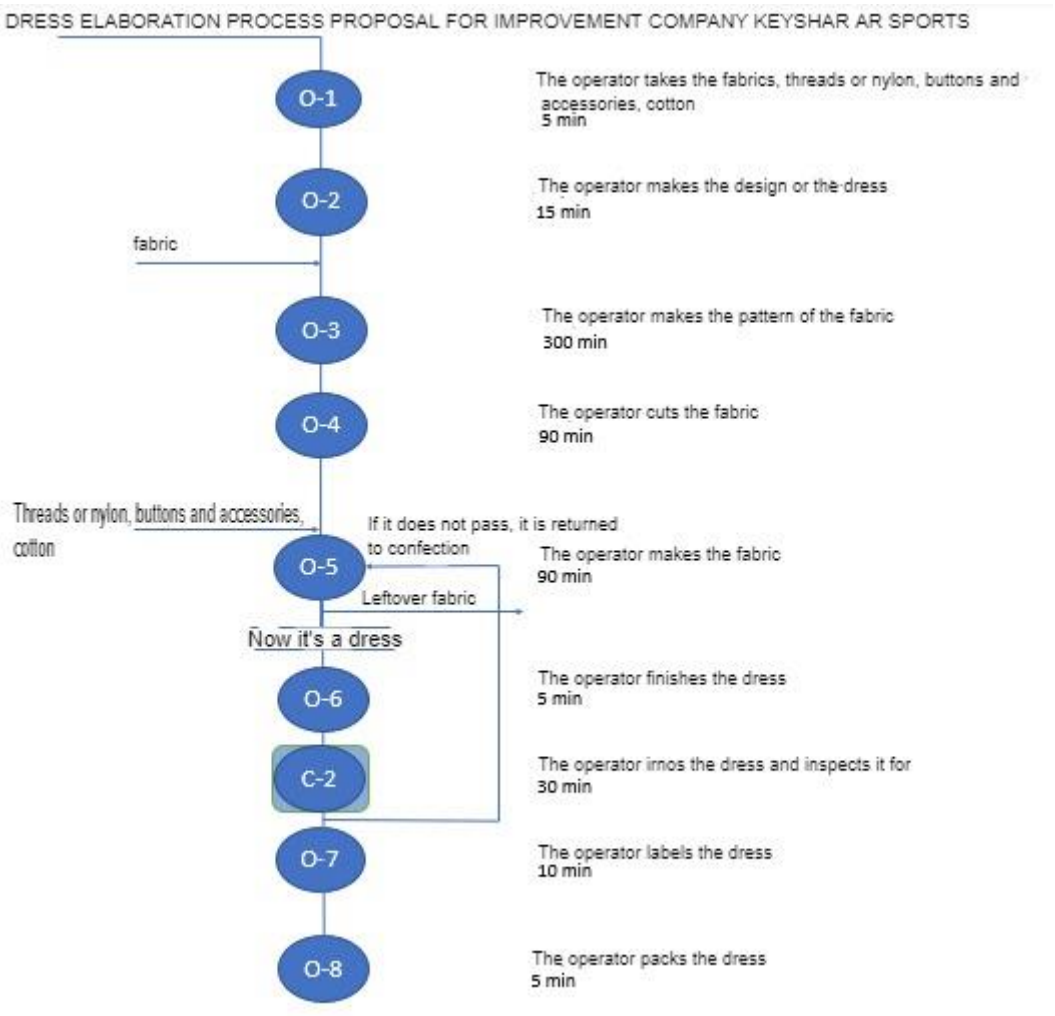


Figure 13. Proposed analytical diagram of the operator for the garment making process. Source: Authors.

Analysis: in the analytical diagram of the operator it is observed that first an operation[1] is carried in terms of the raw material, when the operator takes fabrics, threads, buttons or accessories, cotton and nylon, taking a time of (5min), after this an operation[2] is carried out in terms of the design stage, where the operator makes the previous design of the dress to be made, this takes a time of (15min), then the fabrics enter for the elaboration of the dress and an operation[3] is performed for the pattern stage, which takes a time of (300min). Then an operation[4] is performed in the fabric cutting stage, where the operator cuts the fabric, this takes a time of (90min).

Then the threads, nylon, buttons or accessories and cotton enter, followed by an operation[5] for the fabric making process, where the operator begins to make the fabric, this stage takes a time of (90min), the leftover fabric comes out, now the fabric becomes a dress after this stage.

Next, an operation[6] is performed in the finished stage, which takes a time of (5 min). Then one (operation and inspection) [2] is carried out in the ironing stage, which takes a time of (30 min), in this stage the operator inspects the dress, visualizing that it does not have any defect, if at this stage the operator shows any defect, the dress does not go to the next operation and is returned to the confection operation[5].

Then an operation[7] is performed in the labeling stage of the dress, where the operator begins to place the respective labels of the dress, this takes a time of (10 min). Finally, a packing operation[8] is carried out, where the operator packs the dress to be taken to its destination, this stage takes a time of (5 min).

It should be noted that the total time of the process of making the dress for the diagram of the proposed operator takes a total time of 550 min.

4.2.4 Proposed route diagram.

Next, the proposed route diagram will be captured, for the process of making a dress.

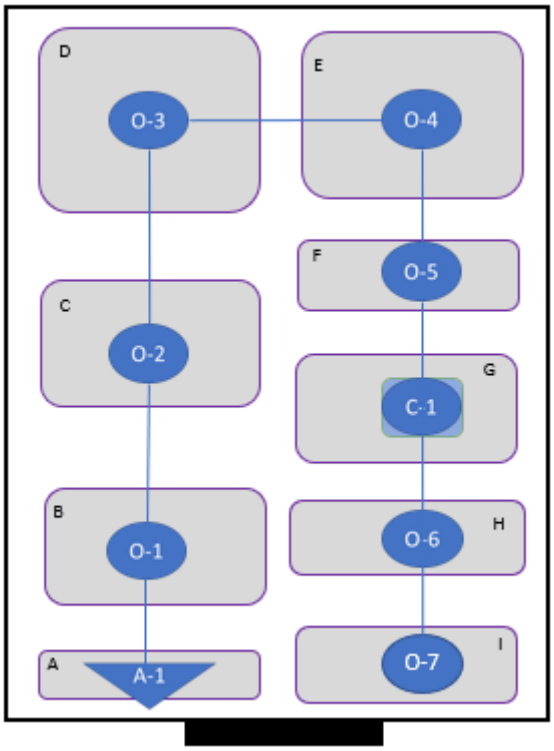


Figure 14. Proposed route diagram for the dress making process. Source: Authors.

In the proposed route diagram, each of the areas can be evidenced, which are:

The letter A: is the storage area of the raw material, which is where each of the inputs and materials used to reach the final product, which in this case is the dress, is stored.

The letter B: is the design area, which determines the number of steps that are necessary to make the dress.

The letter C: is the pattern area, in this they draw the parts of the dress having as reference the technical sheet.

The letter D: is the cutting area, which is made the division of the pieces that make up a dress.

The letter E: is the area of confection, which is made and, in addition, the fabrics are inspected.

The letter F: is the finishing area, which is inspecting the quality of the dress.

The letter G: is the ironing area, which is ironed and inspects the dress.

Letter H: is the labeling area, which is the marking of each of the layers of blocks of pieces of the dress.

The letter I: is the packaging area, which packs the dress for its respective shipment.

In the diagram of improved route is evidenced the different activities that are carried out, to reach the final product which are: First **A-1** which means that the raw material is stored, that is, the fabrics, threads, nylon, buttons, accessories and cotton. Then this **O-1** which means that it is an operation, since the design of the garment is made. Then, there is **O-2** which means that it is an operation, because the fabric pattern is performed. As a third operation we have **O-3**, here, the cutting of the fabric is carried out. Then all the raw material comes in, which was already mentioned above. Then, the **O-4** is made, which is the making of the fabric, so that it is already a dress. Then an operation is done that is **O-5** which is the finishing stage. Then, a combination is made that is **C-1**, since the ironing operation is done and likewise, it is inspected that the dress does not have any defects. Then, the **O-6** operation is performed which is done the labeling of the dress. Finally, an operation is done that is **O-7**, which is to pack the dress so that the respective shipment is made. It should be noted that in this improved method there is no transport, that is, there is a distance of (0 meters).

It should be noted that a U-shaped distribution of the production line was made where the operator does not make considerable travel between the specified areas (see Figure 14).

	exercise	proposed
	OPERATION	7
	TRANSPORT	0
	DELAY	0
	INSPECTION	0
	STORAGE	1
	COMBINED	1
TOTAL ACTIVITIES		9
TOTAL DISTANCE		0 m
TOTAL TIME		550 min

Figure 15. Improved dress making process table. Source: Authors.

4.2.5 Comparison between initial method and proposed method.

After having made the initial and proposed models for the process of making clothing of the company "KEYSHAR'AR SPORT", it is necessary to make a comparison to show what savings there were in the processes, in addition to the elimination of operations, transports and others after having prepared the respective studies of the same.

Next, the tables of the initial and proposed model respectively.

	exercise	proposed
	OPERATION	6
	TRANSPORT	2
	DELAY	1
	INSPECTION	0
	STORAGE	1
	COMBINED	2
TOTAL ACTIVITIES		12
TOTAL DISTANCE		7 m
TOTAL TIME		566 min

	exercise	proposed
	OPERATION	7
	TRANSPORT	0
	DELAY	0
	INSPECTION	0
	STORAGE	1
	COMBINED	1
TOTAL ACTIVITIES		9
TOTAL DISTANCE		0 m
TOTAL TIME		550 min

Figure 16. Comparison between initial and proposed models. Source: Authors.

Visualizing the two tables, it is evident that after having made the improved analytical diagram, there were changes in this new model proposed with respect to the initial one, since a transport that was in the initial diagram is eliminated, where the fabric was transported to the cutting machine with a time of (2 min) and (2 meters) away, in this new improved model the transport of the fabric is no longer necessary, since a reorganization was made in the work areas (see figure 14). After this, the delay that refers to the fabric waiting for the operator to assemble the cutting machine that was initially there, which had a time of (3min), is eliminated, since in the improved method it would not be necessary to assemble the machine because the machine and the work area should be ready for operation and there would be no delay.

Likewise, the operation and inspection (combined) which was in the initial model is eliminated, this had a time of (10min), however, in the improved method this would change for an operation, because it is considered an unnecessary inspection, since after this stage an inspection is carried out again, in which the same review of defects is made, that can be done in a single stage in a meticulous way, in this way the time would be reduced.

In addition to this, a transport that was in the initial model is eliminated, which is when the dress is transported to the packaging area with a time of (1min) and (5 meters), for the improved model it is considered that the transport of the dress is no longer necessary, since a reorganization was made in the work areas (see figure 14).

Finally, the time in the packaging stage of the dress was reduced, because in the initial model this had a time of (10min) and in the improved one it was reduced to (5min), since a packaging machine was proposed, which is designed to pack quickly.

4.2.6 percentage of processes reduced or won.

After having made each of the diagrams of the methods, that is, both the initial and the proposed, together with the tables, we proceed to find the percentage of reduced or won processes, using equation 17.

$$\frac{number\ of\ initial\ processes - number\ of\ final\ processes}{number\ of\ initial\ processes} \times 100\% \quad (17)$$

Data

Number of initial processes = 12 processes

Number of final processes = 9 processes.

We now proceed to replace the data in the formula (17):

$$\%\ \boldsymbol{of\ processes R/G} = \frac{12\ initial\ processes - 9\ \ final\ processes}{12\ initial\ processes} \times 100\%$$

$$\%\ \boldsymbol{of\ processes\ R/G} = 25\%$$

It is evident that there was a reduced percentage or cattle of 25%, for the process of making clothing of the company "KEYSHAR'AR SPORT".

4.2.7 Savings in distance travelled.

Next, the percentage of savings in distance traveled for the initial and improved methods will be found, using equation (18).

$$\%\ \boldsymbol{of\ savings\ in\ distance\ traveled} = \frac{7\ meters - 0\ \ meters}{7\ meters} \times 100\% \ = 100\%\ (18)$$

It is evident that there was a 100% saving in terms of the distance traveled in the process of making clothing, which is favorable for the company and for employees.

4.3 Measurement of Work.

Next, the process selected for the study of times will be captured in detail, explaining the respective division of the elements to be timed. But first, a brief explanation will be given about the study of times, since it is the technique that will be implemented in the case study regarding the process of making clothing of the company "KEYSHAR'AR SPORT".

Study of times.

The time study is a work measurement technique used to record the times and rhythms of work corresponding to the elements of a defined task, carried out under certain conditions, and to analyze the data in order to find out the time required to perform the task according to a pre-established execution standard.

The main thing that must be taken into account to carry out a time study, is that this must be done to a qualified person. In addition to this, you must have different tools, such as formats for taking times, which can be physical or digital, also, you must take into account stopwatches, electronic devices to collect information and materials such as pencils, tachometers, speedometers, among others, which depend on the study that is being carried out. On the other hand, you must have a basic procedure for the study of the work, in which first the work that will be done object of study is selected, then the recorded data are examined, then a measurement of the amount of work of each element is made, then the time is compiled and the series of activities and the method of operation to which the computed time corresponds is defined, these steps can be clearly evidenced in the illustration (17).

Figure 1. Basic procedure for the measurement of work. Source: Autores.

4.3.1 Tailoring operation, for the process of making clothing of the company "KEYSHAR'AR SPORT".

The operation selected for the realization of the study of times, corresponds to the operation of making the process of elaboration of dresses.

The manufacturing process is a complex process that begins with the design of the piece and culminates with the union of the textile pieces generated in the manufacture and the addition of the finishes. Mainly, it is based on the creation of final products, such as garments and complex pieces by sewing. It is the most artistic part of the entire textile manufacturing or production process. Now, in the stage of making dress, in the company "KEYSHAR'AR SPORT",, this step is carried out so that the fabrics are converted into dresses, in order to be able to move to the finishing area, it should be noted that this is one of the most important and indispensable steps for this process, because here the fabric is transformed into a dress, with the union of these.

However, the confection operation, as already mentioned is one of the main activities in this process, it was selected because it does not have a standardized time, since different operators can perform this activity at different times, therefore, there is no stipulated time to be able to do the task.

4.3.2 Elements of clothing operation.

Therefore, the tailoring operation is divided into three elements. It is important to mention that this division is carried out to be able to make a better time taking in each element and in this way to be able to establish an average time at the end of the operation.

Elements:

1. **Make the details such as the pockets and join the fabrics with their accessories:** in this part the details of the dress are executed first, such as the pockets. After this, the fabrics are joined with their respective details that would be the accessories such as buttons, pearls.

2. **Realization of straight seams and circular seams:** here the straight seams that are possible and then the circular seams are made.

3. **Union of all the telas:** in this last part, all the fabrics are joined so that they are converted into a dress.

4.3.3 ***timed observations of the elements for the tailoring operation.***

After having divided the confection operation into three elements, it is important to take initial observations for each of the elements, usually 5 observations are always taken and then calculate the sample size, in this case there are five observations, which will be reflected in a clear and detailed way with their timed times, using Table 5.

TIMED OBSERVATIONS OF CLOTHING OPERATION LEMENTOS.					
ELEMENTS	**OBSERVATIONS (Real time in minutes)**				
	1.	**2.**	**3.**	**4.**	**5.**
1. Make the details such as the pockets and join the fabrics with their accessories	30,94	31,51	30,17	30,14	31,35
2. Realization of straight seams and circular seams.	13,56	12,66	14,60	14,52	12,36
3. Union of all fabrics.	44,45	44,69	44,17	44,32	45,39
TOTAL	88,95	88,86	88,94	88,98	89,10

Table 5. Timed observations for the elements of the tailoring operation. *Source: Authors*.

Through Table 5, it can be evidenced that the confection operation does not have a standardized time, since in each element five observations are made, within which, different times are reported for each one, which indicates that at the end of the operation an average time will be established.

In the same order of ideas, the confection operation on average has a time of 5402.44 seconds, that is, 90 minutes on average.

4.3.4 Calculation of Sample Size.

Before finding the sample size, it was taken into account to make the observations to a qualified worker, that is, an operator who works with a normal rhythm, who works with ease of movements, reacts sooner to the signals, foresees difficulties and executes his task without forcing attention was taken into account.

To find the sample size, first, 5 observations were taken into account for the three elements of the confection operation. Now, we proceed to find the sample size with equation (19).

$$N = \left(\frac{40\sqrt{n'\sum x^2 - (\sum x)^2}}{\sum x}\right)^2 \quad (19)$$

In the equation of the sample size only the five initial times are taken into account, in addition to the sum of the values, also, the values squared, the sum of the values squared and also a constant taking into account the level of confidence that is required to be found in the study, usually always takes a confidence level of 95.45% whose constant has been 40 , then in the present study the contante will make 40 since it is asking for a confidence level of 95.45%.

In the first element that is **to make the details such as the pockets and join the fabrics with their accessories**, se finds N taking into account the following data:

$n' = 5$

$\Sigma x^2 = 4751{,}63$

$(\Sigma x)^2 = 23749{,}89$

$\Sigma x = 154{,}11$

Now, we proceed to replace the data in equation (19)

$$N = \left(\frac{40\sqrt{(5)(4751{,}63) - 23749{,}89}}{154{,}11}\right)^2$$

$$N = 0{,}55$$

In the second element that is **realization of straight seams and circular seams**, It is N taking into account the following data:

$n' = 5$

$\Sigma x^2 = 920{,}9$

$(\Sigma x)^2 = 4583{,}29$

$\Sigma x = 67{,}7$

Now, we proceed to replace the data in equation (19)

$$N = \left(\frac{40\sqrt{(5)(920{,}9) - (4583{,}29)}}{67{,}7}\right)^2$$

$$N = 7{,}40$$

And finally, in the third element that is **union of all fabrics**, N is found taking into account the following data:

$n' = 5$

$\Sigma x^2 = 9948{,}5$

$(\Sigma x)^2 = 49737{,}92$

$\Sigma x = 223{,}02$

Now, we proceed to replace the data in equation (19)

$$N = \left(\frac{40\sqrt{(5)(9948{,}5) - (49737{,}92)}}{223{,}02}\right)^2$$

$$N = 0{,}14$$

Now we find the sample size for the 3 elements, adding N of each element:

$$N = 0{,}55 + 7{,}40 + 0{,}14$$

$$N = 8$$

After finding the sample size of each of the elements and the 3 elements, we proceed to make a table which has all the data given above:

MANUFACTURING OPERATION		1	2	3	4	5	6	7	8	SUM X	SUM (X)2	SUM X2	n´	N	T PROM
Make the details as they are pockets and match the fabrics with their accessories	R	30,94	31,51	30,17	30,14	31,35	31,56	32,05	31,02	154,11	23749,89	4751,63	5	0,55	31,0925
	A	30,94	31,51	30,17	30,14	31,35	31,56	32,05	31,02						
Making straight seams circular seams	R	13,56	12,66	14,60	14,52	12,36	13,26	13,44	13,36	67,7	4583,29	920,9	5	7,4	13,47
	A	44,5	44,17	44,77	44,66	43,71	44,82	45,49	44,38						
Union of all frabrics	R	44,45	44,69	44,17	44,32	45,39	44,26	44,49	44,33	223,02	49737,92	9948,5	5	0,14	44,5125
	A	88,95	88,86	88,94	88,98	89,1	89,08	89,98	88,71						
														8	89,08

Table 6. Elements with their observations to find the sample size. *Source: Authors*

Taking into account Table 6, it can be evidenced that 8 observations must be taken for each of the elements. This is taken into account, to calculate a more accurate average time. This is done taking into account the sampling above.

4.3.5 Basic Time Calculation.

To find the basic time for each of the observations of the elements, the British valuation scale was taken into account (Figure 18)

ESCALE	DESCRIPTION	COMPARABLE RUNNING SPEED (KM/H)
0	No activity	0
50	Very slow, unsteady movements, seems asleep, no interest.	3.2
75	Steady, determined, unhurried, like an unpaid pieceworker, but well-directed, seems slow but does not waste time.	4.8
100 (ritmo tipo)	Active, capable, average skilled operator, quietly achieves the level of quality and precision set.	6.4
125	Very fast,performs with confidence, dextery and above average coordination.	8.0
150	Exceptionally fast , intense concentration and effort, not likely to last for several periods.	9.6

Hildegard Sármiento Klapper

Figure 18. British rating scale. Fountain: [11]

Now, we proceed to find the basic time of each of the observations of the three elements with equation (20).

$$basic\ time = observed\ time * (\frac{attributed\ value}{100}) \quad (20)$$

The first element that is **to make the details such as the pockets and join the fabrics with their accessories**, is the basic time for each of the observations:

The first observation is considered that the operator obtained an attributed value of 105 since he was a little fast and had coordination of movements at the time of performing the respective activity, taking into account the attributed value that is 105 and the observed time that is 30.94, we proceed to replace the data in the equation (20)

$$basic\ time = 30{,}94\ min * (\frac{105}{100})$$

$$basic\ time = 32{,}49\ min$$

The second observation is considered that the operator obtained an attributed value of 100 since the operator was active, capable, since he calmly achieves the level of quality and precision set. Taking into account the attributed value which is 100 and the observed time which is 31.51, it is processed to replace the data in equation (20)

$$basic\ time = 31{,}51\ min * (\frac{100}{100})$$

$$basic\ time = 31{,}51\ min$$

The third observation is considered that the operator obtained an attributed value of 105 since he was a little fast, acted safely and had coordination of movements at the time of performing the respective activity, taking into account the attributed value that is 105 and the observed time that is 30.17, we proceed to replace the data in the equation (20)

$$basic\ time = 30{,}17\ min * (\frac{105}{100})$$

$$basic\ time = 31{,}68\ min$$

The fourth observation is considered that the operator obtained an attributed value of 105 since he was a little fast, acted with great security and had coordination of movements at the time of performing the respective activity, taking into account the attributed value that is 105 and the observed time that is 30.14, we proceed to replace the data in the equation (20)

$$basic\ time = 30{,}14\ min * (\frac{105}{100})$$

$$basic\ time = 31{,}65\ min$$

The fifth observation is considered that the operator obtained an attributed value of 95 since it was constant, resolved and unhurried at the time of performing the respective activity, taking into account the attributed value that is 95 and the observed time that is 31.35, we proceed to replace the data in equation (20)

$$basic\ time = 31{,}35\ min * (\frac{95}{100})$$

$$basic\ time = 29{,}78\ min$$

The sixth observation is considered that the operator obtained an attributed value of 95 since it was constant, resolved and unhurried at the time of performing the respective activity, taking into account the attributed value that is 95 and the observed time that is 31.56, we proceed to replace the data in equation (20)

$$basic\ time = 31{,}56\ min * (\frac{95}{100})$$

$$basic\ time = 29{,}98\ min$$

The seventh observation is considered that the operator obtained an attributed value of 90 since it was constant, resolved and unhurried at the time of performing the respective activity, taking into account the attributed value that is 90 and the observed time that is 32.05, we proceed to replace the data in equation (20)

$$basic\ time = 32{,}05\ min * (\frac{90}{100})$$

$$basic\ time = 28{,}85\ min$$

And finally, **the eighth observation** is considered that the operator obtained an attributed value of 100 since the operator was active, capable, since he calmly achieves the level of quality and precision set. Taking into account the attributed value which is 100 and the observed time which is 31.02, it is processed to replace the data in equation (20)

$$basic\ time = 31{,}02\ min * (\frac{100}{100})$$

$$basic\ time = 31{,}02\ min$$

For the second element that is **realization of the straight seams and circular seams**, there is the basic time for each of the observations:

The first observation is considered that the operator obtained an attributed value of 100 since the operator was active, capable, since he calmly achieves the level of quality and precision set. Taking into account the attributed value which is 100 and the observed time which is 13.56, it is processed to replace the data in equation (20)

$$basic\ time = 13{,}56\ min * (\frac{100}{100})$$

$$basic\ time = 13{,}56\ min$$

The second observation is considered that the operator obtained an attributed value of 105 since he was a little fast and had coordination of movements at the time of performing the respective activity, taking into account the attributed value that is 105 and the observed time that is 12.66, we proceed to replace the data in the equation (20)

$$basic\ time = 12{,}66\ min * (\frac{105}{100})$$

$$basic\ time = 13{,}29\ min$$

The third observation is considered that the operator obtained an attributed value of 95 since it was constant, resolved and unhurried at the time of performing the respective activity, taking into account the attributed value that is 95 and the observed time that is 14.60, we proceed to replace the data in equation (20)

$$basic\ time = 14{,}60\ min * (\frac{95}{100})$$

$$basic\ time = 13{,}87\ min$$

The fourth observation is considered that the operator obtained an attributed value of 90 since it was constant, resolved and unhurried at the time of performing the respective activity, taking into account the attributed value that is 90 and the observed time that is 14.52, we proceed to replace the data in equation (20)

$$basic\ time = 14{,}52\ min * (\frac{90}{100})$$

$$basic\ time = 13{,}07\ min$$

The fifth observation is considered that the operator obtained an attributed value of 95 since it was constant, resolved and unhurried at the time of performing the respective activity, taking into account the attributed value that is 95 and the observed time that is 12.36, we proceed to replace the data in equation (20)

$$basic\ time = 12{,}36\ min * (\frac{95}{100})$$

$$basic\ time = 11{,}74\ min$$

The sixth observation is considered that the operator obtained an attributed value of 100 since the operator was active, capable, since he calmly achieves the level of quality and precision set. Taking into account the attributed value which is 100 and the observed time which is 13.26, it is processed to replace the data in equation (20)

$$basic\ time = 13{,}26\ min * (\frac{100}{100})$$

$$basic\ time = 13{,}26\ min$$

The seventh observation is considered that the operator obtained an attributed value of 100 since the operator was active, capable, since he calmly achieves the level of quality and precision set. Taking into account the attributed value which is 100 and the observed time which is 13.44, it is processed to replace the data in equation (20)

$$basic\ time = 13{,}44\ min * (\frac{100}{100})$$

$$basic\ time = 13{,}44\ min$$

And **the eighth observation** is considered that the operator obtained an attributed value of 100 since the operator was active, capable, since he calmly achieves the level of quality and precision set. Taking into account the attributed value which is 100 and the observed time which is 13.36, it is processed to replace the data in equation (20)

$$basic\ time = 13{,}36\ min * (\frac{100}{100})$$

$$basic\ time = 13{,}36\ min$$

Finally, for the third element which is **union of all fabrics**, there is the basic time for each of the observations.

The first observation is considered that the operator obtained an attributed value of 100 since the operator was active, capable, since he calmly achieves the level of quality and precision set. Taking into account the attributed value which is 100 and the observed time which is 44.45, it is processed to replace the data in equation (20)

$$basic\ time = 44{,}45\ min * (\frac{100}{100})$$

$$basic\ time = 44{,}45\ min$$

The second observation is considered that the operator obtained an attributed value of 100 since the operator was active, capable, since he calmly achieves the level of quality and precision set. Taking into account the attributed value which is 100 and the observed time which is 44.69, it is processed to replace the data in equation (20)

$$basic\ time = 44{,}69\ min * (\frac{100}{100})$$

$$basic\ time = 44{,}69\ min$$

The third observation is considered that the operator obtained an attributed value of 105 since he was a little fast and had coordination of movements at the time of performing the respective activity, taking into account the attributed value that is 105 and the observed time that is 44.17, we proceed to replace the data in the equation (20)

$$basic\ time = 44{,}17\ min * (\frac{105}{100})$$

$$basic\ time = 46{,}38\ min$$

The fourth observation is considered that the operator obtained an attributed value of 105 since he was a little fast and had coordination of movements at the time of performing the respective activity, taking into account the attributed value that is 105 and the observed time that is 44.32, we proceed to replace the data in the equation (20)

$$basic\ time = 44{,}32\ min * (\frac{105}{100})$$

$$basic\ time = 46{,}54\ min$$

The fifth observation is considered that the operator obtained an attributed value of 90 since it was constant, resolved and unhurried at the time of performing the respective activity, taking into account the attributed value that is 90 and the observed time that is 45.39, we proceed to replace the data in equation (20)

$$basic\ time = 45{,}39\ min * (\frac{90}{100})$$

$$basic\ time = 40{,}85\ min$$

The sixth observation is considered that the operator obtained an attributed value of 105 since he was a little fast and had coordination of movements at the time of performing the respective activity, taking into account the attributed value that is 105 and the observed time that is 44.26, we proceed to replace the data in the equation (20)

$$basic\ time = 44{,}26\ min * (\frac{105}{100})$$

$$basic\ time = 46{,}47\ min$$

The seventh observation is considered that the operator obtained an attributed value of 100 since the operator was active, capable, since he calmly achieves the level of quality and precision set. Taking into account the attributed value which is 100 and the observed time which is 44.49, it is processed to replace the data in equation (20)

$$basic\ time = 44{,}49\ min * (\frac{100}{100})$$

$$basic\ time = 44{,}49\ min$$

And finally **the eighth observation** is considered that the operator obtained an attributed value of 100 since the operator was active, capable, since he calmly achieves the level of quality and precision set. Taking into account the attributed value which is 100 and the observed time which is 44.33, it is processed to replace the data in equation (20)

$$basic\ time = 44{,}33\ min * (\frac{100}{100})$$

$$basic\ time = 44{,}33\ min$$

Taking into account the above information, it is organized in table 7

ACTIVITY : CONFECTION - ELEMENTS : 3		OBSERVATIONS N=8									
		ELEMENT TIME									
		1	2	3	4	5	6	7	8	AVERAGE OBSERVED TIME	AVERAGE BASIC TIME PER ITEM
Making details such as pockets and joining fabrics with accessories	R	30,94	31,51	30,17	30,14	31,35	31,56	32,05	31,02	31,0925	30,87
PACE OF WORK	Val.	32,49	31,51	31,68	31,65	29,78	29,98	28,85	31,02		
Making straight seams and circular seams	R	13,56	12,66	14,60	14,52	12,36	13,26	13,44	13,36	13,47	13,20
PACE OF WORK	Val.	13,56	13,29	13,87	13,07	11,74	13,26	13,44	13,36		
joining of all fabrics	R	44,45	44,69	44,17	44,32	45,39	44,26	44,49	44,33	44,5125	44,77
PACE OF WORK	Val.	44,45	44,69	46,38	46,54	40,85	46,47	44,49	44,33		
CYCLE TIME		88,95	88,86	88,94	88,98	89,1	89,08	89,98	88,71		
AVERAGE CYCLE TIME = AVERAGE OBSERVED TIME		89,08									
AVERAGE BASIC TIME		88,84									

Table 7. Basic time and pace of work of each of the observations. *Source: Authors.*

Taking into account the above table, it can be evidenced that the average of the observations without taking into account the operating pace of work is 89.08 minutes and when the operator's rhythm is taken into account. The worker should take 88.84 minutes to perform the tailoring operation taking into account his general work rhythm.

4.3.6 Determine rest supplements

To identify and calculate the additional rest items present in the garment company "KEYSHAR'AR SPORT" we take into account the ILO table.

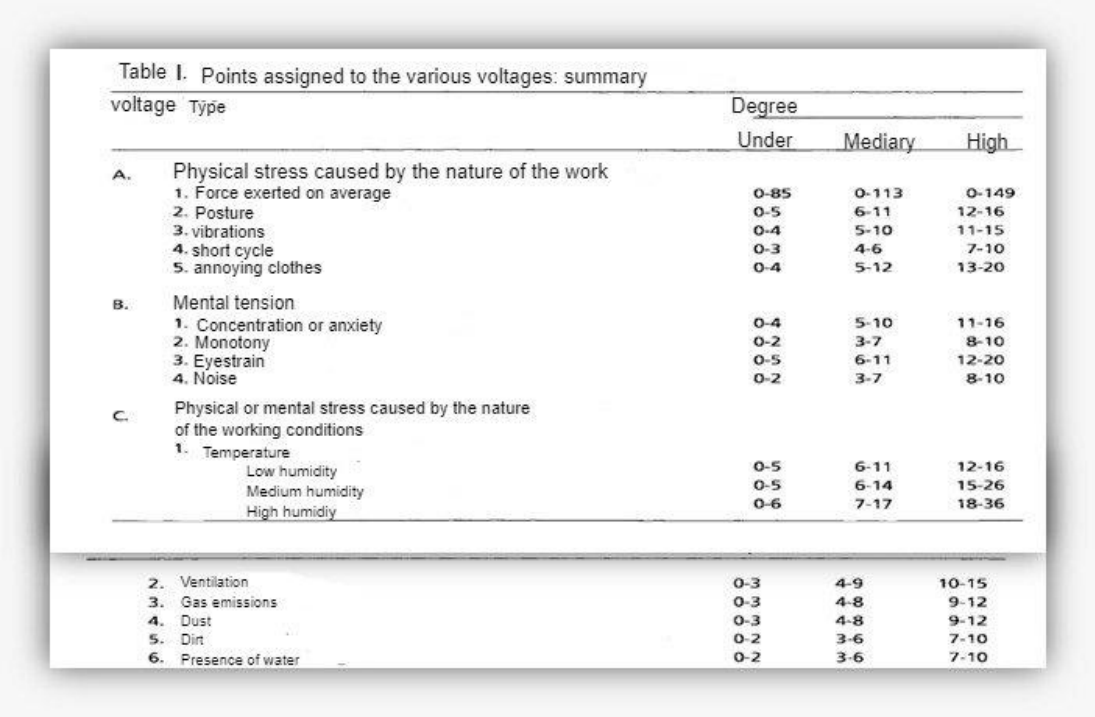
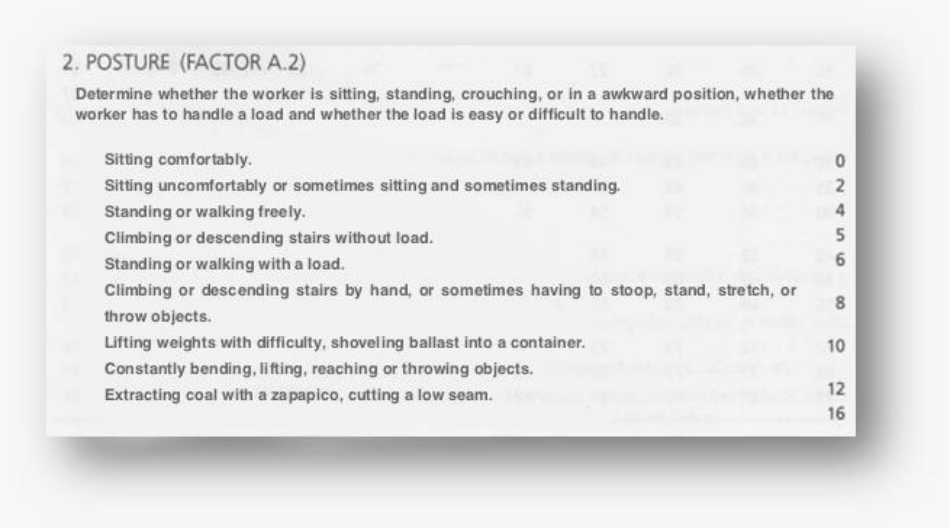


Table I. Points assigned to the various voltages: summary

voltage	Type	Degree		
		Under	Mediary	High
A.	Physical stress caused by the nature of the work			
	1. Force exerted on average	0-85	0-113	0-149
	2. Posture	0-5	6-11	12-16
	3. vibrations	0-4	5-10	11-15
	4. short cycle	0-3	4-6	7-10
	5. annoying clothes	0-4	5-12	13-20
B.	Mental tension			
	1. Concentration or anxiety	0-4	5-10	11-16
	2. Monotony	0-2	3-7	8-10
	3. Eyestrain	0-5	6-11	12-20
	4. Noise	0-2	3-7	8-10
C.	Physical or mental stress caused by the nature of the working conditions			
	1. Temperature			
	Low humidity	0-5	6-11	12-16
	Medium humidity	0-5	6-14	15-26
	High humidiy	0-6	7-17	18-36
	2. Ventilation	0-3	4-9	10-15
	3. Gas emissions	0-3	4-8	9-12
	4. Dust	0-3	4-8	9-12
	5. Dirt	0-2	3-6	7-10
	6. Presence of water	0-2	3-6	7-10

Figure 19. ILO table for calculating rest supplements. Fountain: [12]

Below is evidenced the tables of the factors selected for consideration and their respective valuations taking into account the nature of the company.



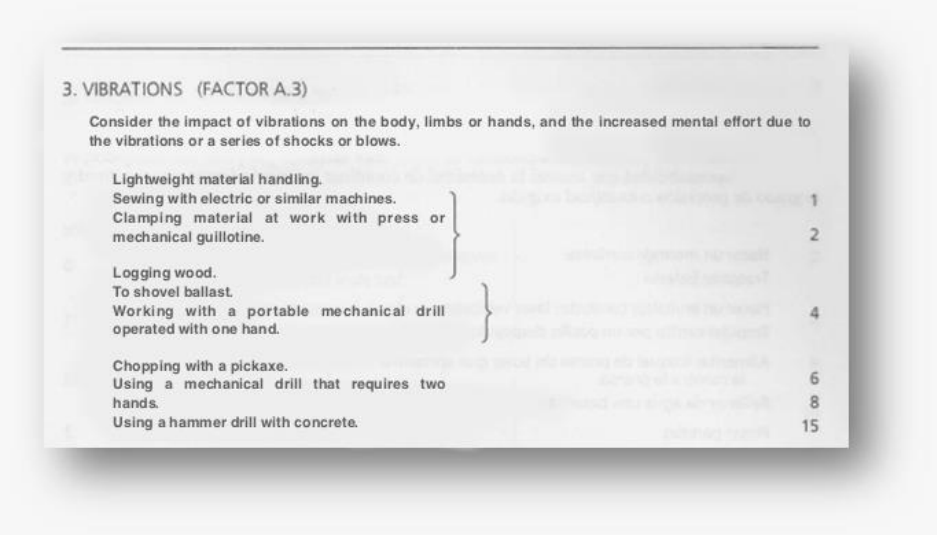
2. POSTURE (FACTOR A.2)

Determine whether the worker is sitting, standing, crouching, or in a awkward position, whether the worker has to handle a load and whether the load is easy or difficult to handle.

Sitting comfortably.	0
Sitting uncomfortably or sometimes sitting and sometimes standing.	2
Standing or walking freely.	4
Climbing or descending stairs without load.	5
Standing or walking with a load.	6
Climbing or descending stairs by hand, or sometimes having to stoop, stand, stretch, or throw objects.	8
Lifting weights with difficulty, shoveling ballast into a container.	10
Constantly bending, lifting, reaching or throwing objects.	12
Extracting coal with a zapapico, cutting a low seam.	16

Figure 20. Table of the ILO's position factor with its assessments. Fountain: [12]

Posture: the position of the operator according to the posture factor is considered to be as follows, he is sitting uncomfortably or sometimes standing and sometimes standing which is equivalent to 2 points according to the posture factor table in the ILO book.



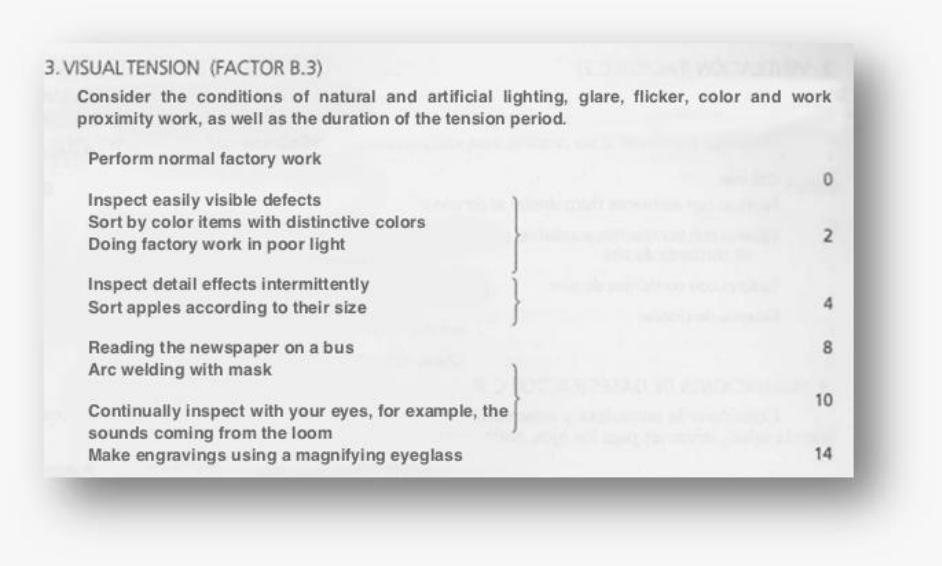
3. VIBRATIONS (FACTOR A.3)

Consider the impact of vibrations on the body, limbs or hands, and the increased mental effort due to the vibrations or a series of shocks or blows.

Lightweight material handling.	
Sewing with electric or similar machines.	1
Clamping material at work with press or mechanical guillotine.	2
Logging wood.	
To shovel ballast.	
Working with a portable mechanical drill operated with one hand.	4
Chopping with a pickaxe.	
Using a mechanical drill that requires two hands.	6
Using a hammer drill with concrete.	8
	15

Figure 21. Tabla of the ILO vibration factor. Fountain: [12]

Vibrations: In the clothing workshop it was identified that the electric machine used to sew fabric has a vibrational level of 2 points, due to the characteristics of its mechanism and position of the same.



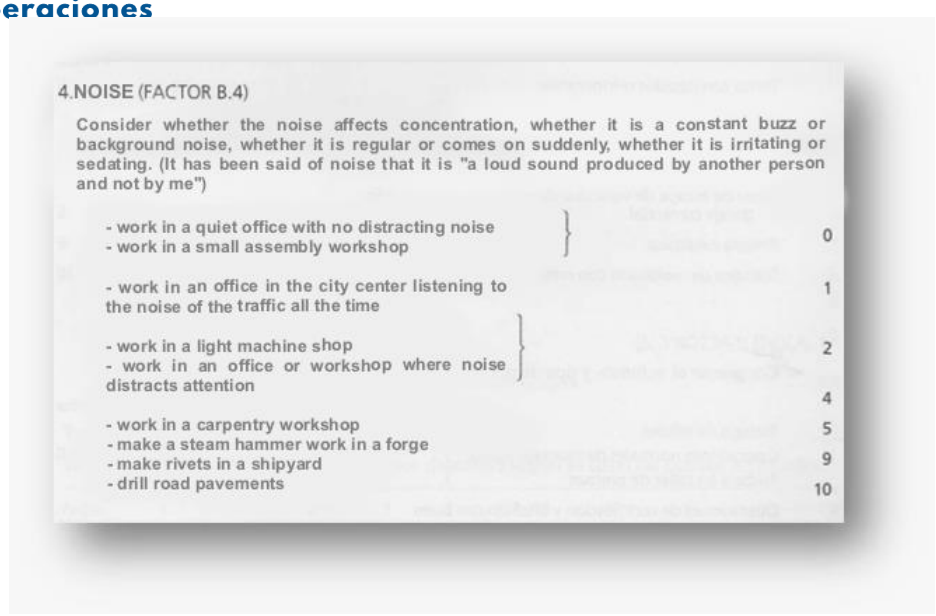
3. VISUAL TENSION (FACTOR B.3)

Consider the conditions of natural and artificial lighting, glare, flicker, color and work proximity work, as well as the duration of the tension period.

Perform normal factory work	0
Inspect easily visible defects	
Sort by color items with distinctive colors	
Doing factory work in poor light	2
Inspect detail effects intermittently	
Sort apples according to their size	4
Reading the newspaper on a bus	8
Arc welding with mask	
Continually inspect with your eyes, for example, the sounds coming from the loom	10
Make engravings using a magnifying eyeglass	14

Figure 22. Tabla of the ILO's visual tension factor. Fountain: [12]

Visual tension: the conditions and arrangement of natural or artificial light present in the production area were identified, and it was considered to be equivalent to 10 points.



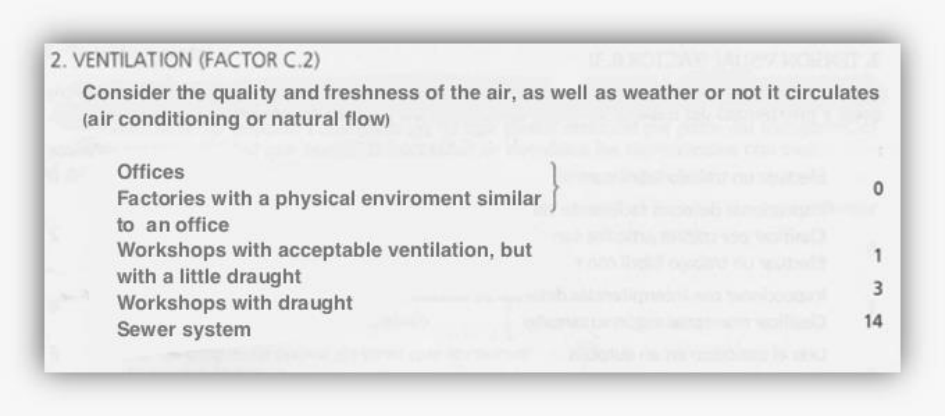
4.NOISE (FACTOR B.4)

Consider whether the noise affects concentration, whether it is a constant buzz or background noise, whether it is regular or comes on suddenly, whether it is irritating or sedating. (It has been said of noise that it is "a loud sound produced by another person and not by me")

- work in a quiet office with no distracting noise - work in a small assembly workshop	0
- work in an office in the city center listening to the noise of the traffic all the time	1
- work in a light machine shop - work in an office or workshop where noise distracts attention	2
	4
- work in a carpentry workshop	5
- make a steam hammer work in a forge	9
- make rivets in a shipyard - drill road pavements	10

Figure 23. Tabla of the noise factor with its ILO assessments. Fountain: [12]

Noise: Being a clothing workshop it was observed that there are machines that generate noise especially the fillet with safety stitch, according to the noise factor table the factor of working in a light machine workshop was identified which is equivalent to 2 points.



2. VENTILATION (FACTOR C.2)

Consider the quality and freshness of the air, as well as weather or not it circulates (air conditioning or natural flow)

Offices Factories with a physical enviroment similar to an office	0
Workshops with acceptable ventilation, but with a little draught	1
Workshops with draught	3
Sewer system	14

Figure 24. Tabla of the ventilation factor with its ILO assessments. Fountain: [12]

Ventilation: It was observed that the air quality in the workshop is considerable we determined that the supplement factor for rest present, is that of workshops with acceptable ventilation but with a little air heat equivalent to 1 points.

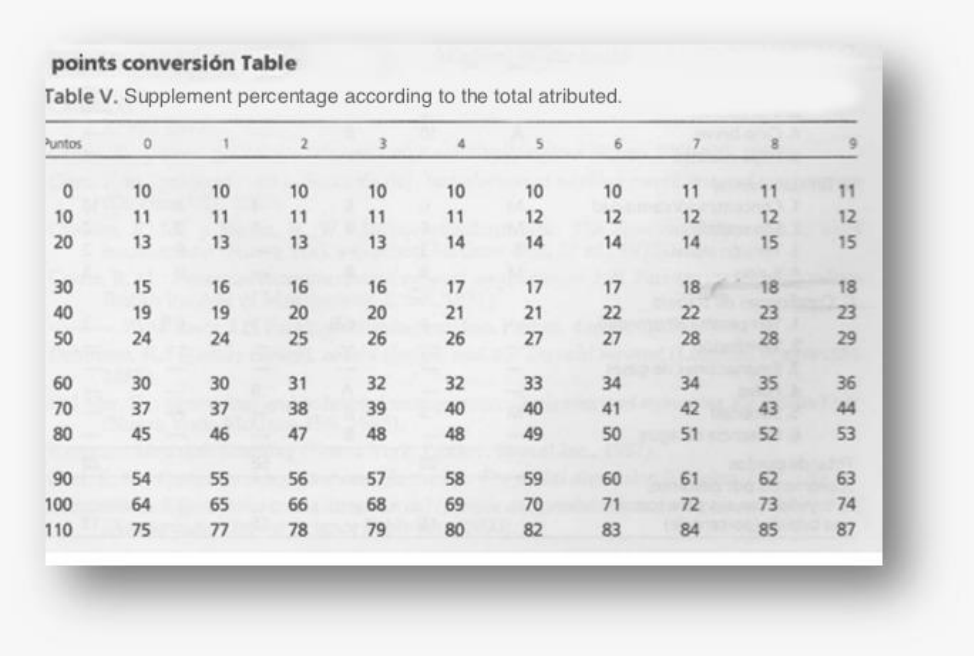
The following table illustrates the assessment of each of these factors of rest supplements identified in the company "KEYSHAR'AR SPORT".

Rest supplements determined in the clothing company	
Supplements	Points

Vibration	2
Visual tension	10
Ventilation	1
Posture	2
Noise	2
Sum	17

Table 8. Supplements identified in the clothing company and their points. . Source: *Authors.*

Taking into account that the sum of punctus of the supplements, results in (17), making the respective conversion in the table of percentage of supplements of the ILO equals **12%.**



points conversión Table

Table V. Supplement percentage according to the total atributed.

Puntos	0	1	2	3	4	5	6	7	8	9
0	10	10	10	10	10	10	10	11	11	11
10	11	11	11	11	11	12	12	12	12	12
20	13	13	13	13	14	14	14	14	15	15
30	15	16	16	16	17	17	17	18	18	18
40	19	19	20	20	21	21	22	22	23	23
50	24	24	25	26	26	27	27	28	28	29
60	30	30	31	32	32	33	34	34	35	36
70	37	37	38	39	40	40	41	42	43	44
80	45	46	47	48	48	49	50	51	52	53
90	54	55	56	57	58	59	60	61	62	63
100	64	65	66	68	69	70	71	72	73	74
110	75	77	78	79	80	82	83	84	85	87

Figure 25. Conversion of supplement points to percentage. Fountain: [12]

4.3.7 Working content

To perform these calculations, the basic time and the supplements for rest are taken into account, the respective multiplication is made using the following equation (21).

$$work\ content = basic\ time \times rest\ supplements \quad (21).$$

Taking into account the three elements represented in Table 7 and that the value of the total percentage of supplements corresponds to 12% is passed to 1.12, then it has to:

The first element that is to realizar the details such as the pockets and join the fabrics with their accessories has a basic time according to its work rhythm of 30.87 min, then.

$$work\ content = 30{,}87 \times 1{,}12\% = 34{,}57\ min$$

The second realization element of straight seams and circular seams has a basic time according to its working pace of 13, 20 min.

$$work\ content = 13{,}20 \times 1{,}12\% = 14{,}78\ min$$

The third element of all fabrics has a basic time according to its working pace of 44.77 min.

$$work\ content = 44{,}77 \times 1{,}12\% = 50{,}14\ min$$

Supplement times for personal, special and contingency needs - managed by the company

Because the clothing company does not have the valuation of these supplements, the following approximate reference values were used. The company handles supplements for personal needs 1%, special supplements 5%, contingency supplements 3% for a total of 9% equivalent to 1.09.

4.3.8 Standard time

For the realization of calculations for the standard time, the work content and the percentage of the supplements for personal, special needs and contingencies - handled by the clothing company were taken into account through the following equation (22).

$$standard\ time = sum\ of\ the\ content\ of\ the\ work \times \%\ of\ the\ company (22).$$

$$standard\ time = 34{,}57 + 14{,}78 + 50{,}14 \times 1{,}09 = 108{,}46\ min$$

The following table was then plotted with the data required for the standard time calculation

Work elements	Average observed time (min)	Average basic time per item (min) = take into account the pace of work	Suplementos por descanso - ILO tables	Working content	Time supplements for personal, special and contingency needs - handled by the company	Standard time (min)	Analysis of the results
Make the details such as the pockets and join the fabrics with their accessories	31,092	30,87	1,12	34,57	The company handles supplements for personal needs 1%, special supplements 5%, contingency supplements 3%.	108,46	When analyzing the time spent by the operator when performing the operations it was observed how the data vary, when comparing the content with the basic time taking into account the pace of work it is evident that the minutes increased considerably, that is, the realization of details with the pockets and join fabrics with their accessories has a basic time of 30.87 and with the work content that includes the supplements Specials ranges from 34, 57 minutes, increasing noticeably. Likewise, the realization of straight and circular seams was calculated a basic time of 13.20 minutes compared to the work content increased a little more than 1 minute and in the third element of joining fabrics the basic time is 44.77 minutes while the work content of 50.14 minutes a slightly wide difference. The standard time calculated from the sum of the work content and multiplied by the percentage of supplements for personal,
Realization of straight seams and circular seams.	13,47	13,20	1,12	14,78	The company handles supplements for personal needs 1%, special supplements 5%, contingency supplements 3%.		
Union of all fabrics	44,5125	44,77	1,12	50,14	The company handles supplements for personal needs 1%, special supplements 5%,		

					contingency supplements 3%.		special and contingency needs gives us a time of 108, 46 minutes.

Table 9. Standard time of the garment company KEYSHAR'AR SPORT. Source*: Authors.*

The time spent by the operator when relegalizing the operations was analyzed, it was observed how the data vary, when comparing the content with the basic time taking into account the pace of work it is evident that it considerably increased the minutes, that is, the realization of details with the pockets and join fabrics with their accessories has a basic time of 30.87 and compared to the working content that includes the special supplements ranges from 34, 57 minutes increasing noticeably. Likewise, the realization of straight and circular seams was calculated a basic time of 13.20 minutes compared to the work content increased a little more than 1 minute and in the third element of joining fabrics the basic time is 44.77 minutes while the work content of 50.14 minutes a slightly wide difference. The standard time calculated from the sum of the work content and multiplied by the percentage of supplements for personal, special and contingency needs gives us a time of 108, 46 minutes.

THANKS

The gratitude of this Classroom Project is addressed first to God since in these times of pandemic he kept us alive and filled us with all his love, also for our Docente Samir Umaña Ibáñez that thanks to his knowledge and help could be concluded successfully. Finally a very special mention for the company of the Textil Sector KEYSHAR'AR SPORT, who opened the doors of their company and collaborated to make this project a reality.

CONCLUSION

Once the visit was made to the clothing company KEYSHAR'AR SPORT, different approaches were observed within this and especially problems from the organization to the process of making a dress all the above can be visualized in the following project which sought the way to implement studies of methods and times to increase the productivity of this, which can be evidenced in the results that the company, which is being productive because the overall productivity is greater than 1, practically the company is earning twice as much.

As well as objectives were drawn and with which the problems in the realization of the dresses were identified, for this purpose, analysis tools were implemented to study the work and increase the productivity of the company, this through analytical diagrams, route, and the respective productivity calculations. In the methodological phase of the project, a description of the garment company KEYSHAR'AR SPORTS was initially made, a process was chosen and what was observed in the current material used in the company was explained step by step, it was observed that the production process begins with the storage of the raw material then goes to the design area where a process of specific patterns is made to the fabrics used in each design is then taken to a cutting machine, from there it is transported to the garment machines; then the dress goes to the inspection area where it is verified if the product has imperfections, then those that pass the inspection are transported to the ironing area and then they are labeled and packed, in this way having made each of the diagrams of the methods, both the initial and the proposed, we proceed to find the percentage of processes, initially 12 processes that are reduced to 9, in addition some improvements were made to increase the performance and productivity of the company; which has the necessary and sufficient information to conclude that the objectives that had been set were taken to cabo and on these were fulfilled. However, it is important to highlight these results from the calculations of time study for this first it is evidenced by table 5, that the confection operation does not have a standardized time, because in each element five observations are made, within which, they report different times for each one, which indicates that at the end of the operation an average time will be established.

In the same order of ideas, the confection operation on average has a time of 5402.44 seconds, that is, 90 minutes on average. After this, we proceed to calculate the basic time of each of the observations found in Table 5; so that in Table 7 you can see the basic time and work rate of each of the observations; which show an average of these without taking into account the operator's work rate which is 89.08 minutes and when the operator's rhythm is taken into account. The worker should take 88.84 minutes to perform the tailoring operation taking into account his general work rhythm. Finally, analyzing the time spent by the operator when performing the operations, it was observed how the data vary, when comparing the content with the basic time taking into account the pace of work it is evident that it considerably increased the minutes, that is, the realization of details with the pockets and join fabrics with their accessories has a basic time of

30.87 and with the work content that includes Special supplements range from 34, 57 minutes increasing noticeably. Likewise, the realization of straight and circular seams was calculated a basic time of 13.20 minutes compared to the work content increased a little more than 1 minute and in the third element of joining fabrics the basic time is 44.77 minutes while the work content of 50.14 minutes a slightly wide difference. The standard time calculated from the sum of the work content and multiplied by the percentage of supplements for personal, special and contingency needs results in a time of 108.46 minutes. All the above concludes that the study that had been addressed since the beginning of this project is reflected in the development of this in order to give some improvements to the company KEYSHAR'AR SPORT with the aim of improving the elaboration of dresses and with which it has been satisfactorily fulfilled.

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