UNIVERSIDAD RICARDO PALMA

ENGINEERING FACULTY

PROFESSIONAL SCHOOL OF INDUSTRIAL ENGINEERING

INDUSTRIAL AUTOMATION

RESEARCH WORK

"Design of a sealing machine"

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SUMMARY

In this project we will try to develop a program that, with the help of a programmable microcontroller such as PLC, performs actions automatically such as: Receiving process, stamping process and finally the storage process of the already stamped wood pieces.

To achieve this goal the PLC will be the most efficient device because its technical specifications give us the great advantage of being very user friendly so that when programming, or translate ideas from a physical medium to a digital medium LADA programming language would be the most friendly providing a vast amount of utilities, which after reviewing your user manual will be even easier to understand and develop the needs we have.

After outlining the process we want to carry out, we will proceed to programming, which will allow us to establish time parameters, as well as to see in a general way the process we are carrying out, generating a constant automation, which in the long run will cause that the benefits will be greater and the optimization of the process we are carrying out will be achieved.

As an initial point, the simulation of our process will be carried out with the help of Autodesk Inventor software, where after collecting information from previous works with similar operations to ours, we carried out the structuring of the same and with this we found the best arrangement for each of the elements and devices that we will use in the process. Then we carried out the structuring of the processes and for continuous improvement, we used DOP and DAP diagrams in which the inputs, outputs and processes involved in the sealing of the boxes are considered, which will then be used for programming in LADA in the PLC.

Keywords: automation, PLC, sealing machine.

ABSTRACT

In the present project will be sought to make a program that through the help of a programmablemicrocontroller such as PLC, perform actions automatically as are those of: Reception process,stamping process and finally the storage process of the already stamped wood pieces.

To achieve this objective the PLC will be the most efficient device because its technical specifications give us the great advantage of being very user friendly so that when programming, or translate ideas from a physical medium to a digital medium LADA programming language would be the most friendly providing us with a large number of utilities, which after reviewing its user manual will be even easier to understand and develop the needs we have.

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INTRODUCTION

The following improvement proposal is a product of reducing time and personnel in the box stamping area, and also helps us to become familiar with new devices such as the PLC and the LADA programming language. The use of these new devices will help us to reinforce previous knowledge of Methods Engineering, Electrical Engineering, Process Engineering and other areas, which are necessary for the implementation of this vast area such as Industrial Automation.

The prototype that we will make in this subject, will allow us to annex knowledge of different areas, as well as the tools that are used every day, with the new knowledge of devices in programmable machines such as the PLC, which, aided by known processes, to standardize them will generate a new form of much more efficient and less obsolete process.

At the time of the elaboration of this project, only materials that are within everyone's reach were used, since it was a prototype; even with this we were able to meet the objectives we set out.

CHAPTER 1: THEORETICAL FRAMEWORK

1.1. Theoretical basis

1.1.1 Description of automation:

Automation is a term which refers to the transfer of tasks that are normally done by the human operator, which will be replaced by a machine capable of performing the same task in a shorter time.

The term automaton has been applied since ancient times, especially to those machines in which energy powered some ingeniously created mechanism, which allowed the machines to imitate the movements of animate beings.

Automation in the past was a not so indispensable tool for the production within any industry, nowadays due to the high global competitiveness, automation is indispensable for the emergence of a company as well as helping this organization with a higher production.

1.1.2 Definition of Sealing:

According to the RAE, the verb sellar refers to stamp, print or leave a mark on something else, and also refers to put a seal on an object.

1.1.3 PLC History:

In 1969 the first PLC was installed in order to replace its production system. By 1971, the PLC had already dominated other industries which allowed operations with a maximum of 16 bits and this helped to become popular around the world, and by the 90s and the advancement of technology came to create micro processors up to 32 bits this allows these machines to perform even more complex operations than those previously performed, in addition to optimizing communication, over the years and the improvement of these technologies, in conjunction with PCs opened a path in the industry, which allowed its automation and communication between areas in real time.

1.1.4 Historical background:

When referring to automation, we can take as a first example the use of the term automaton, which has been applied since ancient times to machines that, after activating certain intelligently planned mechanisms, allow us to simulate movements that resemble our reality.

Following this premise, the first people who developed automated processes (Automatons) come from ancient times; as far back as Greece and Rome there were already this type of gadgets as toys.

The author Moreno, E. G. (2001) in his book Automation of industrial processes, details the following:

One in particular worth mentioning is Vaucanson, who created "supernatural toys" in his youth: one of them was the flute player represented by a faun inspired by the Coysevox, which represented the statue of Coysevox. However, Vaucanson's fame is a product of his famous duck, which produces a movement similar to the flapping of that animal, diving, swimming, swallowing seeds and even excreting. Apparently, a wing consists of about 2,000 parts. In all this automatism, however, the problem is not to replicate life, but simply to imitate some of its various behaviors (Moreno, 2001, p. 23).

In addition to this, there are several factors that produce the automation of a process such as imitation, one of the key factors because thanks to it, a series of established processes can be carried out that allow us to quantify the stages involved in this process and develop opportunities for improvement in each of the stages, causing what is currently called "continuous improvement", which is why the author Moreno, E. tells us about the importance of imitation in the following paragraph:

Of all the famous automobiles of the 18th century, the imitation essay was repeated in the 18th century, among them: Abbé Mical's Talking Heads; android escritoque

Frédéric de Knauss presented in Vienna in 1760; automobiles exhibited in France and Switzerland by the Droz brothers; The Panharmonic was built in 1808 by Leonard Maelzel, in Regensburg; clocks from Lyon and Cambrai, and from Strasbourg, from Schwilgue (182), as well as the numerous pendulum clocks, automaton animators, originals of Russian craftsmen, which can still be seen today in the showcases of the Kremlin; by Robert Houdin deserve special mention: the Scampeteer, the Tumbler, the Singing Bird, the Drawing Writer, the Cake Maker, etc. (Moreno, 2001, pp. 24)

In addition to this, the emergence of new technologies such as the use of electricity, as well as the technification of more complex processes such as a game of chess took automation to another level, so Moreno (2001) suggests that "The development of electricity and electronics allowed the emergence of a new generation of automatons, capable of actually imitating some intellectual functions and not only to reproduce certain behaviors" (p.24) which demonstrates the above mentioned.

Fundamentals of automation

When we refer to automation, the author Moreno (2001) defines it as "the Science and Technique of automation, which groups the set of theoretical and technological disciplines involved in the conception, construction and use of automatic systems" (p. 25). (p. 25), so it is understood as everything that is linked to mathematics, computer science and engineering techniques; and that uses them to improve them.

On the other hand, automation is defined as the use of rules, states or conditions that are used for the characterization of an established process, in other words, the quantification of tangible processes. The author Moreno (2001), tells us the following:

Based on the mathematical concept of automata. Units consisting of a set of rules that define states and state change conditions are sequentially automated, a typical example is an elevator, the state information is usually provided by a binary sensor and the information is a more logical property. A program consists of a set of operational phases that are linked together according to a set of logical rules. These systems make up the bulk of industrial automation, especially those dedicated to factory automation. Computers are arguably one of the most advanced forms of automation (Moreno, 2001, pp. 26).

In addition, the author introduces concepts that will be used for the determination of forms or actions as detailed below:

In servo systems, the state information takes the form of one or more quantities that characterize the state of the system. The energy transferred to the actuator is quantized according to the difference between these quantities and the desired value, and the tuning ring acts as a continuous automatic null system, tending to compensate for the difference between the actual value and the desired state. This principle of dependence tends to reduce the effects of disturbances. In holding regulators, it is assumed that a specific quantity maintains at best an assigned value in spite of disturbance, whereas in corresponding regulator or service arrangements, an input quantity The output must be better adjusted to adapt to variations of a given quantity. Sala. (Moreno, 2001, p. 26).

1.1.5 PLC functionality:

The PLC is the abbreviation for Programmable Logic Control which is widely used in industries that require or wish to automate their processes in a significant way, the PLC is immersed in the industries in different ways.

Terzi, Regber and Löffler (2000) pointed out that, the PCL is a system which has a digital operation, which was designed in order to be developed and used in any industry, also this device has a memory in which it will store the programming that will indicate the specific processes that it must perform, that is why the PCL should be easily coupled to industry that needs to be automated.

Likewise, Mendoza, Cortés and Muriel (2011), pointed out that in general, the PLC is connected to the process or system that needs to be automated effectively The system that is controlled by the PLC works with signals, which parts of the project, such as the sensor, sends so that it meets the objective.

1.1.6 Description of materials:

Double acting cylinders:

Figure 1: Double acting cylinder

Source: Google

Operation:

The cylinder performs a reciprocating motion, changing direction as compressed air is added to one side of the cylinder. Dampers in the end positions prevent the pistons from hitting the cylinder heads too hard. The damping can be adjusted with two screws

Technical data:

Parte neumática	
Fluido	Aire comprimido filtrado, con o sin lubricación
Construcción	Cilindro con émbolo
Presión máx. de funcionamiento	1000 kPa (10 bar)
Diámetro del émbolo	20 mm
Carrera máx.	100 mm
Fuerza de avance con 600 kPa (6 bar)	189 N
Fuerza de retroceso con 600 kPa (6 bar)	158 N
Conexión	QS-G1/8-4 para tubo flexible PUN-4x0,75

Solenoid valves:

The function of solenoid valves is to control liquids or gases in positive, fully closed or fully open mode. They are usually used to replace manual valves or to control them remotely. The operation of a solenoid valve is to open or close an orifice in the valve.

valve body, allowing or blocking flow through the valve. The piston opens or closes the air outlet by moving it up or down inside the tubular handle when the coil is energized with an electric current.

Solenoid valves consist of a coil, a piston and a guide tube. Normally in closed valves, the return spring maintains the pressure of the piston in the orifice, preventing flow. When energized, the magnetic field generated causes the piston to rise, allowing flow. When the normally open valve coil is energized, the piston closes the air outlet, preventing flow.

Why are solenoid valves used?

For the flow control process, it is necessary to start or stop the flow in a circuit to control the presence of any fluid in the system. A solenoid valve is often used for this. Operated by a solenoid, solenoid valves can be located in remote locations and can be easily controlled by simple electrical switches.

F

Source: Google

Solenoid valves are the most widely used control element in the control technology. fluids. They are commonly used for cutting, releasing, dosing, dispensing or mixing fluids. This is the reason for their presence in many application areas. The solenoid valve provides fast and safe switching, durability, high reliability, low control force and a compact design.

PNP capacitive sensor:

The main objective of the capacitive sensor is the detection of objects of various natures, are composed of electrodes which have magnetic fields, this field will allow the detection of the object, since, when interrupted, this changes capacitance consequently changes are generated in the oscillator circuit, the oscillation conditions will differ if the circuit is opened or closed.

Figure 3: PNP Capacitive Sensor

Source: Google

LOGO PLC:

LOGO! is an intelligent logic program that is mostly used in automation projects for industrialized companies, this program is mostly used thanks to the simplicity of its programming, in turn is also used in domestic areas such as lighting or canopies, in the field of engineering is used in automation projects is applicable in various fields, such as machinery or control systems, this program works in conjunction with the PLC which allows the automation of common processes effectively.

Figure 4: PLC

Source:

Google

Power supply:

The power supply is an essential component in any machine since it is in charge of providing the necessary energy for its operation, these convert the alternating current into energy for the correct operation of the machine, this direct energy is known as direct current, as mentioned above this power supply makes the entire system to work, this power supply is according to the voltage required by the system.

Specifications:

Tipo de fuente de alimentación:	Conmutada
Tensión de alimentación:	100 ... 240 V AC
Voltaje de salida:	13.8 V DC
Ajuste de la tensión de salida:	12 ... 14.5 V
Carga máxima de la fuente de alimentación:	10.5 A
Corriente de carga de la batería:	0.5 A
Potencia de la fuente de alimentación:	145 W
Eficiencia:	80 %
Número de salidas:	1 uds.
Protecciones:	• Contra sobretensiones • Protección contra sobrecargas
COLD START - Arranque en frío de la fuente de alimentación:	✓
Temperatura de funcionamiento / humedad relativa:	-10 °C ... 60 °C / 20 % ... 90 %
Estándares soportados:	UL60950-1, TUV EN60950-1
Conducción y radiación EMI:	Cumple la norma EN55022 (CISPR22) clase B
Armónico:	Compatible con la norma EN61000-3-2,-3
Resistencia a EMS:	Compatibilidad con normas EN61000-4-2, 3, 4, 5, 6, 8, 11, ENV50204, EN55024, EN61000-6-1
Peso:	0.8 kg
Dimensiones:	199 x 111 x 50 mm
Garantía:	2 años

Chokes

Inductors are available in many configurations for fixed and adjustable modes of operation. Adjustable (adjustable) chokes allow changing pressure and fluid flow settings to m e e t process or production requirements. Stationary stirrers do not provide this flexibility, although they are more resistant to abrasion under prolonged conditions of production or operation of abrasive fluids.

Stabilizer:

A device designed to maintain a constant current in order to protect the electrical equipment connected to it from problems such as overvoltages, voltage sags and voltage swings.

1.1.7 Reasons for automating a process:

Worldwide industries observed that the automation of processes is very good for production or other tasks, because with this you can improve the quality in terms of production of products, another important factor about automation was the reduction of production losses, these are some of the reasons why large companies worldwide rushed to automate all possible processes, as it was obtained greater stability in the processes, In addition to working in production almost non-stop because these automatic machines have no set schedule and in some cases only stop working when maintenance of its parts is carried out to avoid failures when they are working, although it is true, these automatic machines mostly do not depend on any operator for its operation, that does not mean that there will be no people in charge of supervising its proper functioning because of these depends on the production process of the entity.

As mentioned above, automation offers many advantages over disadvantages, some of them are:

- The reduction of time is one of the main factors for which the entities implement this system, since in comparison to humans, these machines do not require rest times and it is easy for them to perform repetitive tasks.
- In case of advanced automation the machines will generate reports which will inform the person in charge about the status of the process, this information is taken in real time and is accessible at any time.
- There are processes and tasks that require a moderate number of employees, thanks to automation it is possible to combine all these tasks in o n e , this will influence in a direct saving in the long term for the company.

These machines can also accomplish these tasks with fewer resources.

- The flexibility of these systems makes them much more efficient, since with a non-automated system a small change could cause a variation which must be reported to its constituents, in an automated process the robot can be reprogrammed in order to perform the new task.
- Another important point is safety, using only robots in a production line is much easier because they adapt to all conditions, some of which can be dangerous for humans.

1.1.8 Definition of prototype:

A prototype is a model that represents the initial form of a project, that is to say that it is the basis of an initial orientation of the model which will be improved over time, but future models will be made based on this pilot, this pilot is therefore a model that executes the functions that are in mind, they must also have the condition of being easily adaptable, to make a prototype there are 2 fundamental phases which must be, first. An analysis must be made where the needs that the future user will have at the moment of using the machine will be observed and in the second phase there is the design phase, which is used to define the functioning and operability of the product, in addition the aspect of the implementation must be taken into account, which is fundamental for the creation and functionality of the product.

The definition of this word varies and depends on the conception of each individual, but most agree that it is an important part in the creation of any project or machine you want. There are many factors that will influence the elaboration of this. As mentioned above its development is important because it is the starting point for the development of the project, if there is not a good development of the prototype of this product or project, it may acquire certain flaws when there is a final product, as in all things the flaws may be slight or serious depending on the problem.

In case the product requires manual use, the ergonomics of the people who will use it must be taken into account, since it is necessary to provide a good process, but at the same time, the customer's well-being must be prioritized.

who uses this machine must have a good organization in his work place since most of the work accidents are caused by manual machines.

In the case of this project, automation will be applied, therefore there will be no operator to control the machine, but there will be one who will supervise the correct operation of this, so the supervisor has a low risk of suffering an accident, being a prototype this machine still has many points to improve, especially the design as it is a prototype of a low cost in relation to a machine developed by a company dedicated to the development of this type of machines.

a) Procedures for the development of a prototype:

As well as the definition of the word prototype, the procedures that must be taken into account for its development depend on each person, the important thing at this point is to develop it in an orderly manner as this will avoid a conflict in a poor implementation, then, steps to follow will be shown to take into account in terms of development:

- The first step is to define the needs and requirements of the users, based on which the design will take shape.
- Secondly, the pilot is developed, which will be used as a test so that any shortcomings can be observed when the process is being developed. As mentioned above, this prototype must be flexible, i.e. it must adapt to the changes that are made in the development process. These changes will be made as the needs of the future user are satisfied.
- Last but not least, the costs of the development of this prototype should be determined, so that if in the future it is decided to bring the machine to the market, an estimate of the final cost can be obtained.

b) Classifications of a prototype:

The author Badinas establishes that the prototype can be divided according to some classifications, which will be presented below:

● Based on trust:

This type of classification is divided into two, the first division is a prototype of low confidence, this type of confidence is aimed at anyone who

prototype that is the result of some sketches and is a static design. In second place, we have the high confidence prototype, this type of prototype is a dynamic one, that is to say, it has a continuous movement, in addition to the fact that

the system operates according to the planning that was done prior to execution.

- Vertical-Horizontal:

  Like the previous classification this has two types of division, the first is the vertical one, this term refers to the prototypes that have few aspects of the system, but in turn has a variety of details, i.e., this prototype has much to improve in terms of technical specifications. Secondly, this is the horizontal type, this type is the opposite of the previous one presented, this one has many developed aspects but little level of development in detail.

- Experimental (Exploratory and Operational):

  This type of classification is used to validate the correct functioning and design of the prototype, it is composed of:

  - Exploratory:

    At this stage, this type of analysis is used in order to locate the shortcomings of the prototype, and then correct and improve them over time.

  - Operational:

    This prototype will be reviewed and progressively refined in order to arrive at a final system in which errors are minimized.

1.1.9 Design of automatic machines:

As in any definition of concepts, each person or author sometimes has a different perspective of the same concept. The design can be understood by the execution of an activity which can become innovative, since in this phase everything must be thought of to offer the best product or service, having as main resource a creative mind in charge of this process.

The creative mind must also have knowledge of the technology to be used, and the economic factor must also be taken into account as it is an important part of the sale of this machine.

According to Rondón (2002), design is a modeling process in engineering that contains a series of consecutive steps aimed at satisfying the client's needs.

user. For the design process, a conflict is created in which the basic sciences and engineering sciences have to agree for the proper functioning of the designed machine, it must meet the goals set at the time of the idealization of the machine, likewise must optimize the spaces and resources used in the development of this product in order to achieve a balanced price and in turn meet the expectations of the end user.

1.1.10 Methodologies of a design:

For the study of design methodologies, it is necessary to have views from different perspectives for which it is necessary to take into account the notions and skills that must be had to develop this action, as its name indicates the purpose is to design objects establishing a correct structuring to carry out the defined process, at the same time it is necessary to try to develop new techniques and possible effective procedures before the presentation of some problem regarding the design.

a) Design method:

For a methodical design four steps are contemplated, of which the first 3 are primordial at the time of designing, the first step is to show the things and methods to be used, these for a better result must be innovative and with sophisticated techniques developed. The second step is a good organization to give way to a good management of the process in general, the third is the complete conception of the design developed since a new design must have a greater complexity than the traditional design.

b) Design modeling:

The design modeling has a concentrated focus on the sketches made, these sketches can be classified into large groups which are descriptive and prescriptive, each one has a quality. The descriptive sketch shows in an orderly manner the process of the activities to be performed.

in the design. For prescriptive designs, the process prescription will be made in an outline which will detail the tasks to be performed for the design.

c) Design process:

The design process is one of the most complex to carry out, therefore, some problems may arise in the process and this must be solved in order to

Therefore, it is best to follow certain steps when trying to identify this problem, so it is necessary to follow the following steps:

1. The creation of any machine or product tries to satisfy the needs that the user or customer has, therefore it is essential to recognize these needs in this way it will be clear why the product.
2. You must think of a design which is visually pleasing and in turn this should represent the solution to the need set in the previous step.
3. To avoid excessive use of resources, especially financial resources, a pilot model should be prepared in a simple way, so that the idea can be understood and its feasibility can be discussed.
4. Once the pilot has been created, it should be tested in the daily environment, only in this way it will be possible to observe the deficiencies of the product, in this case the design, that is why it is important to have a good supervision in order to improve the design.
5. After seeing the shortcomings of the product in its use, it is necessary to proceed to improve the points that were observed in the test. To do this, the observations, whether qualitative or quantitative in terms of design, must be taken into account, the purpose of this point is to find an improvement in terms of its design.
6. Finally, it is important to define the product development sector, i.e., to establish the specific areas in which the product will be able to operate without any problem, in addition to being quickly coupled to the general process of which it will be a part.

1.1.11 Production costs:

The cost of production is the total amount of money that has been invested to manufacture the product in question, and should take into account both direct and indirect costs, the materials used and the labor that is produced in the time to manufacture it. This is the type of cost that is difficult to perceive when the product is finished, so when designing the product it is important to consider the cost at which the selling price could have been subsequently determined.

1.1.12 Gantt chart:

It is a project management tool that shows how to make a project planning. It usually consists of 2 parts: on one side there is a list of tasks and on the right side there is a timeline with data representing the tasks.

This diagram can also include start and end dates of activities to be performed, milestones, dependencies between activities and responsible parties. To meet new software and hardware needs, various paper-based routing tools such as Jira Software include features such as collapsible activity databases and task management sections. These paper-based routing activities support modern teams to maintain a project plan that meets their preferences despite naturally repeating software processes.

Project managers use this diagram for 3 fundamental purposes:

1. Produce and manage complete projects.

This diagram is used to look at the basic elements of a thought and arrange it into smaller, more manageable tasks. These resulting smaller activities are performed on the timeline of this diagram, along with the things that are dependent between activities, natural, responsible persons.

2. Explore the logic and submissions of operations.

This diagram can be used to maintain the logic of an activity. Activity dependency means that a new activity can only be scheduled after another activity has been completed. If a task is delayed (which can happen with other tasks), the related problems are automatically rescheduled into it.

This is very useful when programming in a multi-computer environment.

3. Control the progress of a scheme.

When components have a duration to devote to planning issues, you can track the progress of the schematics and make adjustments accordingly. This diagram can enter start dates and other key features to track schema progress. There are several reasons why these diagrams are so popular in schema management. For one thing, they are accessible for assigning difficult plans, especially those involving a variety of equipment and changing deadlines. These diagrams help machines to correctly plan work according to periods and to correctly consign goods.

	DIAGRAMA DE GANT																																				
	MAYO																	JUNIO																			
ACTIVIDADES	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Elaboración del presupuesto	■	■																																			
Presentación del presupuesto			■																																		
Compra del PLC y todos los materiales				■	■																																
Elaboración del programa						■	■	■	■	■																											
Montaje e instalación de componentes											■	■	■	■																							
Intalación de sensores															■	■	■																				
Cableado final																	■	■																			
Prueba y simulación del programa																			■	■																	
Simulación final																					■	■	■	■													
Prueba de los sistemas de seguridad																									■	■	■										
Corecciones y prueba final																														■	■						
Presentación del presupuesto																																■	■				
Finalización y presentación del proyecto																																				■	■

The project called "Design of a sealing machine", will be developed in the month of May and in the month of June. Elaboration of this budget will be from May 15 to 16, the presentation of the budget will take place on May 17, the purchase of the PLC and all the materials and/or components will take place from May 18 to 19, the elaboration of the program will take place from May 20 to 24, the assembly and installation of components will take place from May 25 to 28, the installation of sensors will take place from May 29 to 31, the final wiring will take place from May 31 to June 1, testing and simulation of the program will take place from June 2 to 3, the final simulation will take place from June 4 to 7, testing of the security systems will take place from June 8 to 10, corrections and final testing will take place from June 13 to 14, presentation of the project budget will take place from June 15 to 16 and the finalization and presentation of the project will take place from June 19 to 20.

1.1.13 Diagram of flow

The use of flowcharts to document business processes dates back to the 1920s. In 1921, industrial engineers Frank and Lillian Gilbreth submitted a "Process Diagram" to ASME. In the early 1930s, Alan H. Morgensen used Lillian Gilbreth's tools to lecture on productivity to his company's subcontractors. In the 1990s, two of Morgensen's students, Spinanger and Graham, popularized these styles more widely. Spinanger introduced ways to simplify work at Procter and Gamble. Graham, director of Standard Register Industrial, revised process diagrams for information processing. In 1977, ASME adopted a classification system for process diagrams derived from Gilbreth's early work. In addition, in the late 20th century, Hermann Goldstein and John Van Neumann used drawings to develop computer programs. Before long, diagrams became increasingly popular for computer programs and algorithms. Programming flowcharts are still used today. However, pseudocode, a mixture of words and markup intended for the reader, is often used to represent more specific levels of detail and achieve a closer version of the final product.

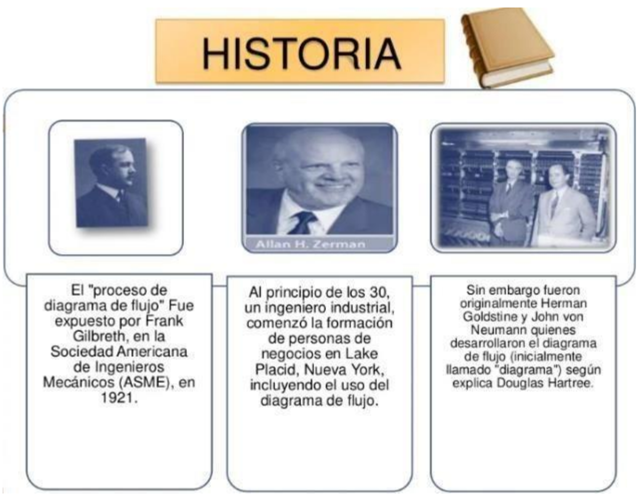

Figure 5: Flowchart History Map

Source: University for Research and Development (UDI)

In Japan, Kaoru Ishikawa (1915-1989), a key figure in the quality process in the manufacturing sector, planned to design one of the essential tools in the field of quality control. Quantitative, plus additional tools such as graphs, checklists and cause and effect diagrams, also known as fishbone diagrams. A flowchart is a graphical representation of the steps we follow to execute a process, system or algorithm on a computer. They are widely used in many areas to document, investigate, plan and improve complex processes, often communicating in a clear and understandable plan. Flowcharts use rectangles, ovals, diamonds and other shapes to identify types of steps, as well as connected arrows to create flows and sequences. These can range from simple hand-drawn diagrams to fully computer-generated diagrams that describe different steps and paths. Considering all the diagram forms, it is one of the most common diagrams in the world and is used by people with or without technical knowledge in many fields.

Símbolo	Nombre	Función
	Inicio / Final	Representa el inicio y el final de un proceso
	Linea de Flujo	Indica el orden de la ejecución de las operaciones. La flecha indica la siguiente instrucción.
	Entrada / Salida	Representa la lectura de datos en la entrada y la impresión de datos en la salida
	Proceso	Representa cualquier tipo de operación
	Decisión	Nos permite analizar una situación, con base en los valores verdadero y falso

Table 1: "Flow chart". A

Source: Editorial team, Etecé. From: Argentina.

Example of a flowchart

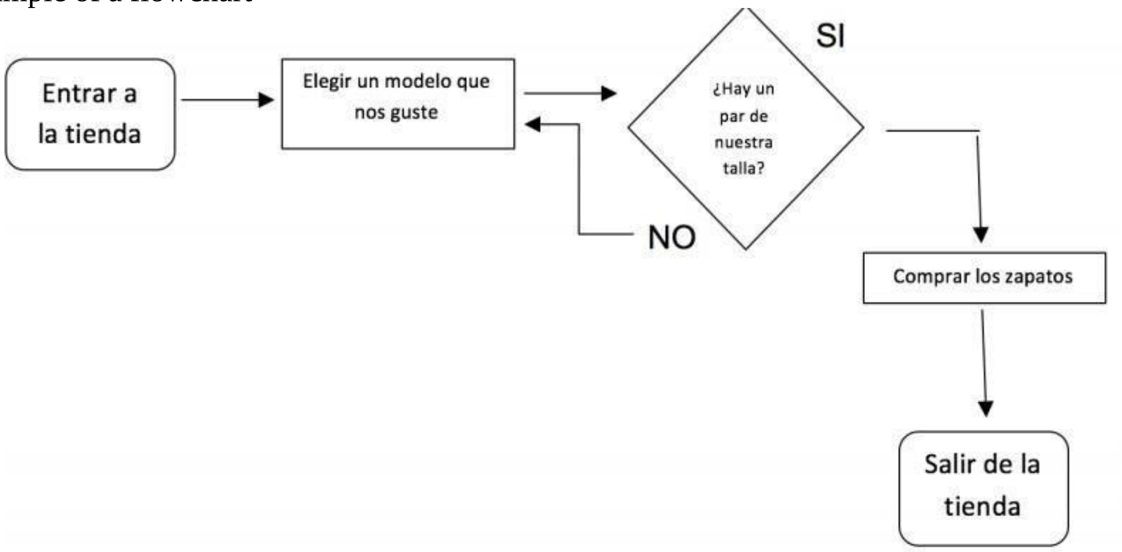

Figure 6: Example of a flowchart for a shoe purchase

Source: "Flowchart". Author: Editorial team, Etecé. From: Argentina.

This flowchart shows that the user enters the store and has the option to choose a shoe model that he likes, here we find a decision variable, where he indicates whether or not there is a model of his size, if it is positive he buys the shoes and leaves the store, if it is negative, he chooses again a model that is of his size and then buys the shoes and leaves the store.

Types of flow charts

Different authors point out different types of flowcharts. Among these published experts are Alan B. Sterneckert, Mark A. Fryman, Marylin Bohl, Andrew Veronis. Sternecker, in his 2003 book Critical Incident Management, discusses four common types of flow diagrams, indicated by the concept of control flow, not by the flow i t s e l f : that of the system. The diagrams are read from left to right and details are shown. Document flow between various business units.

- Data flow diagram: these diagrams are mainly used to show the channels through which data is transmitted where the system is visualized rather than how the flow is controlled.
- Process Flow Diagram: show how a process will achieve results. Such a flowchart can be created to improve an existing process or to implement a new process.

- Program flow diagram: These diagrams teach the instructions of a program in the system.

1.1.14 Process Activity Diagram

For Garcia (2015) "This analysis tool is a graphical representation of the next steps of a series of activities that make up a process or procedure, identified by symbols according to their nature; In addition, it includes all the information considered necessary for the analysis, such as the distance traveled, the quantity considered and the time required".

A process activity diagram that graphically shows all operations, transportation, inspections performed, process delays and storage occurring in the production process, identified by symbols.

It is a useful tool because it gives us a better overview of all possible problems during production, unnecessary transfer or buffering. You can analyze the whole process and make improvements.

Objectives of the Process Activity Diagram:

- It helps to identify the phases of the process.
- The complete sequence of the process and the order in which it is carried out can be determined.
- Optimizes the use of equipment and machinery.

Advantages of using the Process Activity Diagram:

- We understand the processes.
- The processes are summarized and illustrated.
- Identification of the onset of problems.
- Delimits and defines the processes.
- It makes it easier for us to apply the best in critical activities.

Symbols used in the Process Activity Diagram:

The symbols used to develop and correctly elaborate the Process Activity Diagram are the following.

- Operation:

  It is used when modification is made to the chemical or physical characteristics of an object. An operation also occurs when the operator provides information or when calculating or planning.

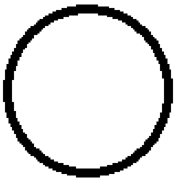

Figure *7*: Figure "Operation"

Source: Own elaboration

- Transportation:
  When there is an object in movement or transfer.

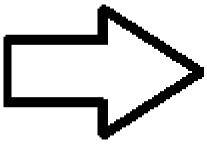

Figure 8: Figure "Transportation" Source: Own elaboration

- Inspection:
  When an object is examined or inspected, looking at its qualities or characteristics.

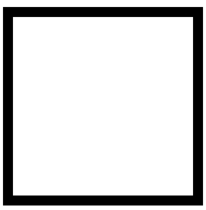

Figure 9: Figure "Inspection"

Source: Own elaboration

- Delay:

  When the next planned action is expected.

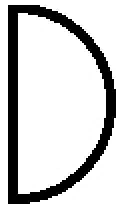

Figure 10: Figure "Delay"

Source: Own elaboration

- Storage:

  When the object is saved, it is almost always at the beginning and end of the diagram.

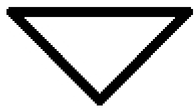

Figure 11: Figure "Storage" Source: Own elaboration

1.1.15 Process Operation Diagram

The process diagrams of methods are used to design new work centers to improve the process in operation is useful to present in a clear and logical way the processes. First you must collect all the necessary information about the product that we are going to manufacture as the quantity of parts, specifications, times and tools that we will use, all this must be contemplated in the process diagrams, there are 8 types of diagrams for the analysis of methods with specific applications among them is the process diagram of operations in which we will mention in this paper, the process flow diagram.

what in the companies is known as fléchard, the path diagram complements the flow process diagram, the man machine diagram is to know how many machines an operator can work with without can work with 1,2,3,4 etc, the group process diagram is to determine how many operators a machine needs the process diagram for the operator is more for material or administrative.

What is mentioned about the PDO we will always see much of it in industrial engineering, the process flow diagram, the path diagram and the man-machine diagram. The operation process diagram shows a chronological sequence of operations, it also shows the inspections, times and materials for the manufacturing processes. The information is cited in Niebel's book which is a bedside book of the industrial engineer all careers in all universities in the world that offer the career of Industrial Engineering we refer to this book to standardize the criteria with all industrial engineers to perform the DOP is necessary to know the symbols used for operations.

To develop a PDO it is essential to know the 6 symbols used, which are the following:

- OPERATION:

  A circle is used which means operation means transformation when in the process the product is transformed it is an operation that transformation gives the company a gain when we transform the product and we are building it the company is gaining there are activities such as the materialists that only move components from one place to another it is not a transformation they do not give a gain to the company.

- INSPECTION:

  The following operation has as a symbol the square which is an inspection, what they do is to review what others have already done, they do not transform the product, the company pays for it, not the customers, so we must be very careful every time we set up a station to inspect what others have done, this diagram uses these two symbols.

- COMBINED ACTIVITY:

  A combination of the two this symbol both the square and the circle together is for self-inspection which is to check what the operator did if the

  operator makes a part he checks himself is self-inspection, but it is also used for successive inspection when the operator makes his product he checks what he did, but he also checks what the previous operations did.

- TRANSPORTATION:

  Transportation has a characteristic, it indicates when one makes a movement of materials, but not any type of movement of materials, to this we must add that it is said when one mobilizes more than 1.5 meters we can consider that a transportation has occurred, but if you move less than 1.5 is not considered a transport operation, the movements can be done with a cart or be carried in the hand everything that involves the transfer of materials.

- WAITING:

  In this process it indicates some kind of delay that may be occurring in the process, for example, it may be waiting for another operator with the car to move some things or waiting for the bread to finish baking. These are waits for the process to stop momentarily.

- STORAGE:

  In this case, the storage symbol, which is an inverted triangle, is often used to indicate the beginning of storage, implying the storage of raw materials, including materials in process or finished products.

The structure of a DOP should have a header and the header should have information such as the name of the product who made the diagram the date it was made the specifications such as drawing numbers and if it is a current method or a better method another important part is the diagram and the summary of the diagram so the structure of a DOP should have a header a diagram and the summary in the order that best suits but those are the general structures that the day should have.

As we well know, every process has an objective, so according to the investigations, an agreement was reached where we will mention the points that are considered in the operations diagram.

- ✓ Deliver a presentation where the sequence that corresponds to the process being presented can be identified in detail.
- ✓ Investigate about the operation and inspection that goes hand in hand a process within the same process.
- ✓ Systematically analyze the stages of the process being worked on.
- ✓ Decrease process times, therefore a comparison of two
  In this way, we will be able to obtain an important point, which would be to discard the time that is not productive.

In order to have more in-depth knowledge about the operation process diagram, we will indicate its importance.

What is the importance of PDO?

- ✓ The events of the process being carried out should be clarified for all follow-up.
- ✓ It is of great help due to the fact that it gives us a better disposition in the use of our materials.
- ✓ Identify the types of raw materials.

Now that we have mentioned all the content about what can be indicated on the PDO, we can correctly elaborate a good diagram. Certain indications must be followed in order not to make mistakes in its development so that the processes we are mentioning can be correctly identified. Coming to the conclusion we can indicate that the operations diagram is an instrument that is needed to be able to carry out in tasks, projects and companies with it in order to its revisions in functions. Applying its correct use of the operations diagram of processes will help them to detect all that problem that is causing in their work, but not only the DOP but all the diagrams that one employs, all this with the purpose of finding the solution to the problem in a fast and effective way.

We have found it useful as a tool for our present work to have a better presentation in terms of identification in the processes with greater clarity in the activities that are carried out in our project, using the knowledge obtained in our training as students we have been able to develop the present DOP that will allow us to visualize the operations, inspections, transports, waiting, storage and combined activities that we have executed in our sealing machine project with the purpose that we will analyze all the relationships that may exist between the operations.

Thanks to this tool we have been able to use a complete analysis of our sealing machine project in its sealing procedure.

1.1.16 Indicators:

1) Production cycle time indicator:

The production cycle or production cycle is the time from the starting point of a production process, such as an idea and an investment in raw materials, until payment is received for the finished product sold in the marketplace.
Although this

cycle determines how long an entity (such as a production

unit) regulates its costs and revenues, there is no single answer a s to how long this process will take, as capacities tend to vary over time.

One of the most common questions asked by stakeholders is "How long will this take?" This is a fundamental question, because it supports better pricing and market forecasting. But having to reply to that question is often frustrating for sales teams, who often end by saying, "It's going to take a long time." But these comments do not allow for any customer planning and represent the incompetence of the transfer team. Simply put: if the transfer team doesn't know how to refute this, the customer turns to a supplier who knows how and can respond satisfactorily.

Cycle times are not only important for the customer, but also for the supplier. It is a great indication of how the business is doing. If the team's cycle time changes, know that this information indicates a problem with the team's workflow or skills.

2) Calculate the cycle time:

The way to measure the cycle time on the physical board is to write down the date and time of start of the element from "pending" to "in progress". The cycle time is measured only when work begins on the item. After an item goes through the entire table, the responsible team member records the time and time at which the item arrived in the "Completed" column.

To know the cycle time of a particular element, the following formula should be used:

$$tiempo\ de\ ciclo = fecha\ de\ terminacion - fecha\ de\ inicio\ (+1)$$

3) Calculate the average cycle time of the process:

Knowing the individual cycle times after the final product is not very useful. The advantage of making these measurements is that you can use them to predict the average cycle time of your process. Teams that have used Kanban in their operations over a period of time can predict cycle times by dividing the total work in progress by the average completion rate. For example, if there are 10 items in progress and it takes the team an average of two weeks to complete one item, then the cycle time will be 20 weeks.

$$tiempo\ de\ ciclo\ promedio = \frac{trabajo\ en\ progreso\ (WIP)}{tasa\ de\ terminacion}$$

Where:

$$tasa\ de\ terminacion = \frac{1}{tieempo\ de\ terminacion}$$

4) Competitiveness indicator:

In actuality, capacity is realized as the just basis for national increase and the expression has been applied in economic series since the era of physicists and advanced in its most notable form by Smith and Ricardo, who invented the expression 'favorable comparison'. Thus, from a purely economic point of view, capacity is seen as a question of yield-prices and exchange rates; and although this idea is not entirely negative, it may be considered incomplete, because it does not take into account other causes which indirectly affect the productive capacity of the country.

The capacity indicators are instruments that allow us to see the performance of a territory in areas such as education, health, institutions, environmental protection, schools, infrastructure, etc. There are a series of indicators established by organizations

and national standards to measure these competencies on the basis of consistent data analysis**.**

5) Competitiveness indicator methods They consist of two methods:
   - Calculate simple average of the value of the variables, converted to the same scale.
   - Weightings of factor development levels.

This method is based on the approach proposed by each national or international organization that is developing it. In this sense, there are many different views of the concept of competitiveness, whether it is economic growth linked to investment, talent or even an individual's level of production. Therefore, there is no single definition of competitiveness.

Many authors indicate that capacity depends on factors linked to effectiveness, innovation and inflation that vary from one country to another. "Competitiveness is determined by productivity, as a function of product quality (on which price depends) and production efficiency" (Porter, 1990).

6. Time delivery indicator:

In order to understand the on-time delivery indicator, it is necessary to know the Lead Time in logistics. Lead time is known as delivery time and is the time that elapses from the issuance of an order requiring goods until the supplier sends the goods to the customer. It is usually given in days, but this meaning may vary depending on the company involved.

In terms of sourcing, inventory is critical to the proper management of the distribution system; the total inventory will always be higher if the lead time is longer and the reduction of lead time also reduces the amount of inventory created during the production time of the product.

What results can be found in Lean Time reduction?

- Reduction of preparation time.
- Reduction of execution time.
- Determination of the actual capacity of the organization.
- Approval to adjust waiting times and transfer funds.

OTD (En-Time Delivery) measures the percentage of orders delivered during the period a company announced at the time of purchase. The objective of this

The main goal of this indicator is to understand and act in a timely manner to ensure that the customer is satisfied and then, as a company, to improve delivery methods and practice delivery planning, since these are aspects that can improve this metric.

From a logistics point of view, customer service is seen as an asset to meet customer needs in the areas of information, product quality and timeliness. In all logistics operations, the customer is important at the end of the supply chain, so on-time delivery efforts must focus on providing the right service levels to meet demand.

7. Performance indicator:

Productivity or efficiency obtained by dividing the number of parts actually produced by the number of parts that can be produced as a result. The number of parts that can be produced by multiplying production time by production capacity or machine speed.

Performance metrics are nothing more than monitoring tools that allow you to control your company's performance in terms of productivity and goal pursuit, all in a well-structured and in-depth manner.

These criteria can be determined individually by each company, obviously according to its segments, criteria and objectives, as long as they are objective, i.e., they should reflect statements, not opinions.

These indicators provide the information that quality management needs to know whether the company is close or far from achieving its goals and objectives.

Some performance indicators simply have to be accepted by any company, regardless of its size or sector of activity. This is the case, for example, with the raw material waste index, which indicates the stages of production in which the company can lose money through the misuse of available resources. It is also important to measure customer satisfaction and frequency, which says a lot about a company's quality standards. This is especially true for service providers that have a of the most powerful performance analysis measures of customer impressions.

1.2 Objectives

- Recognize and identify concepts on the use of PLC (Models, how it works, programming).
- To generate critical thinking so that with the use of the PLC it is possible to solve day-to-day problems and automate them.
- Perform DOP and DAP diagrams to identify problems and solve them logically and graphically.
- Identify and analyze new PLC programming languages such as the LADA language.
- Adapt to new interfaces in order to master them in a user-friendly way.
- To promote teamwork values in the elaboration of models and their coordination.
- To develop skills that allow us to work as a team and the predisposition to face possible future problems.

CHAPTER 2: DETAILED DESCRIPTION OF THE CURRENT PROCESS

2.1. Detailed description of the process

This traditional stamping process contains a sequence of repetitive activities. It begins with the person lining up the part to be stamped, then covering the stamp to be used with ink, and then pressing the part. This is a physically and mentally monotonous process, which can cause long-term fatigue.

2.2. Flowchart

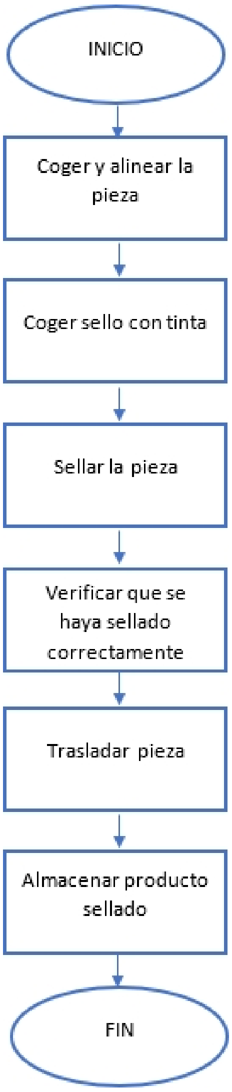

Figure 12: Flowchart of the current process for sealing. Source:

Own elaboration

2.3. Diagram of operations

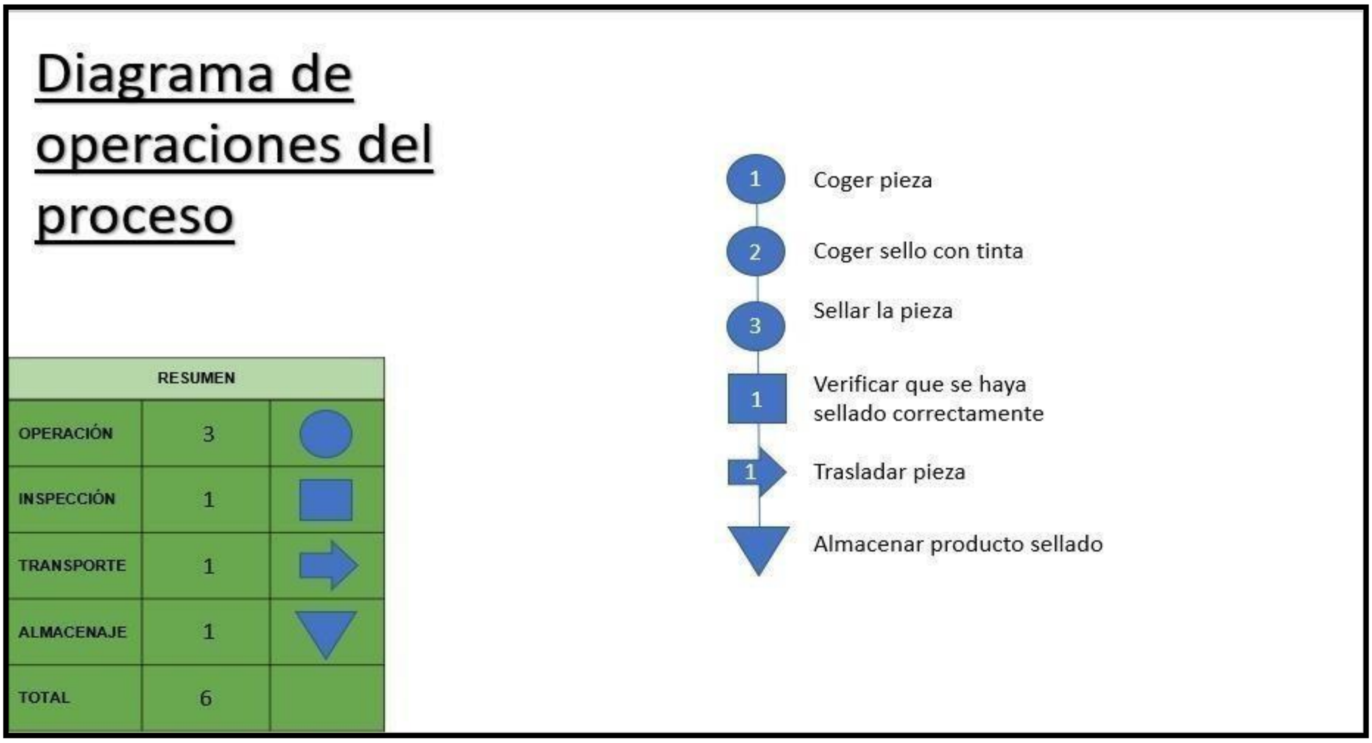

Fig. 13. Diagram of operations of the current process for sealing.

2.4. Process analysis diagram

Diagrama de análisis del proceso del funcionamiento de una maquina selladora						
Nº	**Descripcion**	●	■	➡	D	▼
1	Sacar pieza de almacén					X
2	Trasladar al area de trabajo			X		
3	Coger sello con tinta	X				
4	Sellar la pieza	X				
5	Verificar que se haya sellado correctamente		X			
6	Trasladar pieza			X		
7	Almacenar de producto sellado					X
TOTAL		3	1	1		1

Table 1. Analysis diagram of the current process.

2.5. Automation plan Gantt

	DIAGRAMA DE GANT																																				
	MAYO																	JUNIO																			
ACTIVIDADES	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Elaboración del presupuesto	■	■																																			
Presentación del presupuesto			■																																		
Compra del PLC y todos los materiales				■	■																																
Elaboración del programa						■	■	■	■	■																											
Montaje e instalación de componentes											■	■	■	■																							
Intalación de sensores															■	■	■																				
Cableado final																	■	■																			
Prueba y simulación del programa																			■	■																	
Simulación final																					■	■	■	■													
Prueba de los sistemas de seguridad																									■	■	■										
Corecciones y prueba final																														■	■						
Presentación del presupuesto																																■	■				
Finalización y presentación del proyecto																																				■	■

Table 3. Gantt Chart

2.6. Description and detail of the production indicators before automation

Production cycle time indicator: this indicator measures the time it takes to manufacture the required production, from the moment the sales order is released until the finished products are delivered. According to our project, it can be observed that a bottleneck occurs that delays the production manually, when in automation a shorter time is seen.

Competitiveness indicator: this indicator relates the manual machine to the already automated one. Thanks to the PLC incorporated in our automated project, it achieves a programmable logic controller with numerous high performance functions.

Time delivery indicator: this indicator aims to reach the production target of products produced by this machine and provides an important way to establish performance benchmarks. According to our project we can visualize that several inconveniences occurred with the manual production, since this machine did not reach the objective of producing a certain amount of products, when an automated one meets and even exceeds the required time.

Performance indicator: this production indicator is the rate of how many units on average a machine, cell or line is producing over time. According to our project, we can see reflected the great difference in the amount of production that is achieved with the automation of the machine, reaching up to double its production in the same time as the manual one.

CHAPTER 3: CURRENT PROCESS DESIGN

3.1 3D CAD drawings of the current situation

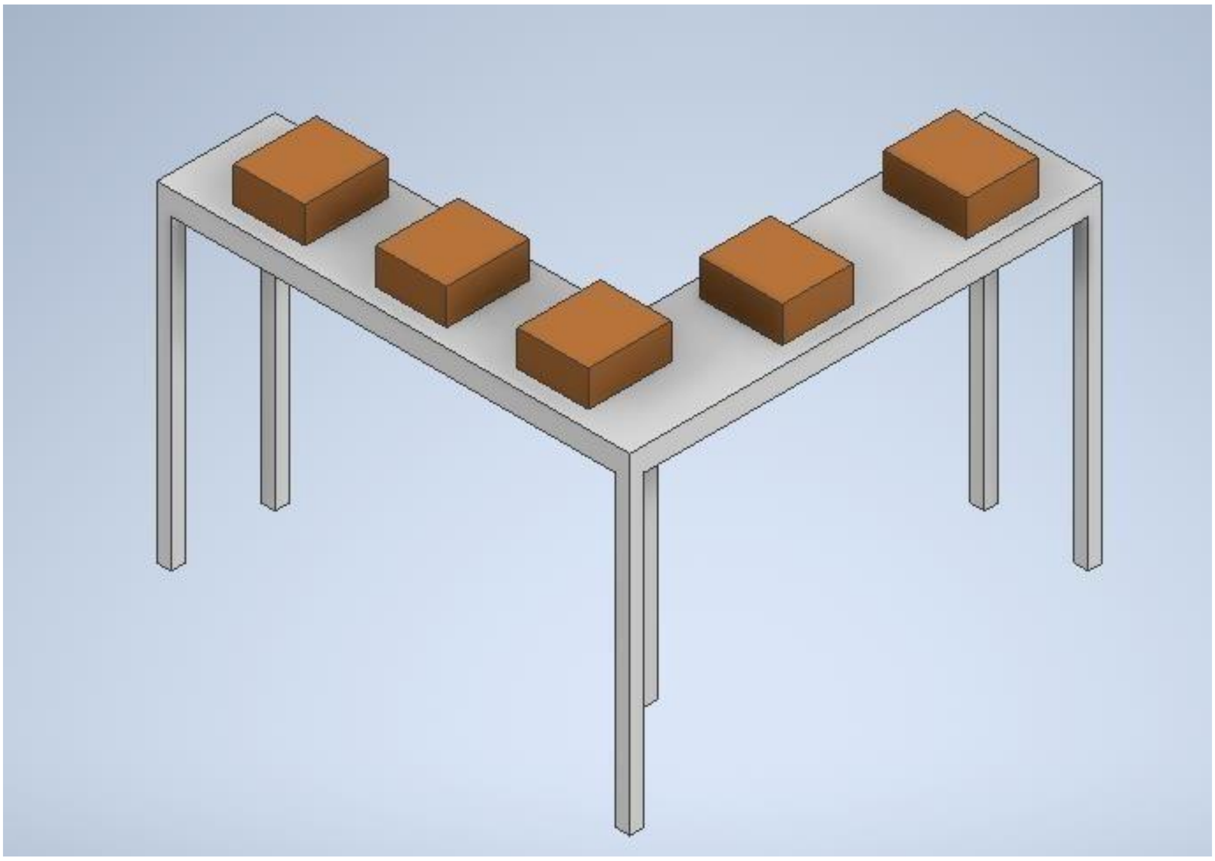

Figure 14: Drawing of conventional sealer.

Source: Own elaboration

This is the drawing of a conventional sealing machine, that is, a manual sealing machine, as its name indicates, this type of sealing is performed by one person.

CHAPTER IV: DESIGN OF A PROPOSAL TO AUTOMATE THE PROCESS

4.1 Detailed description of the proposed process

To minimize manpower and human induced errors in manufacturing industries, PLC based systems are used for automation of various industrial processes. The sealing machine is a programmable system that allows the user to automate the process of sealing materials.

In this system one of the cylinders picks up the piece and holds it, and with this condition the second cylinder will perform the respective sealing process, once this process is finished this second cylinder will return to its original position, followed by the first cylinder releases the piece and does the same, that is, it returns to its initial position. Finally, the third and last cylinder hits the piece in such a way that it frees the working space for the following pieces.

4.2 3D CAD drawings of the chosen proposed situation (must show each component in a different color)

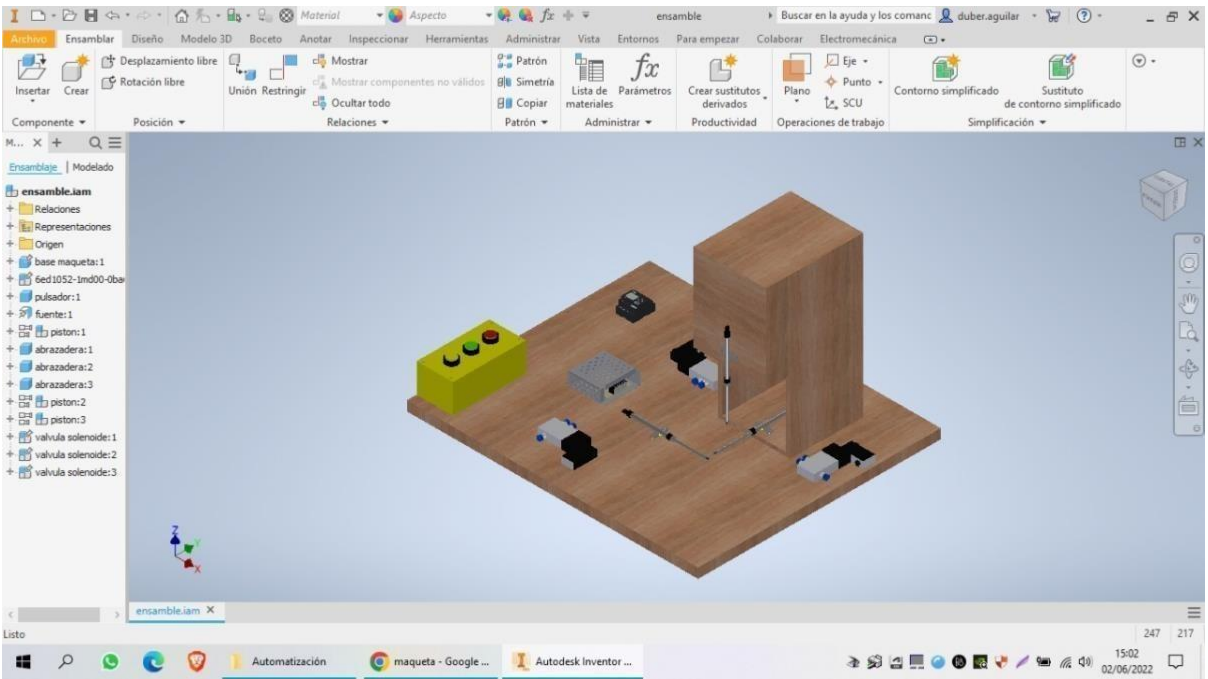

Fig.4.3D CAD drawing of the box sealing machine.

4.3 Flow diagrams of the proposed process

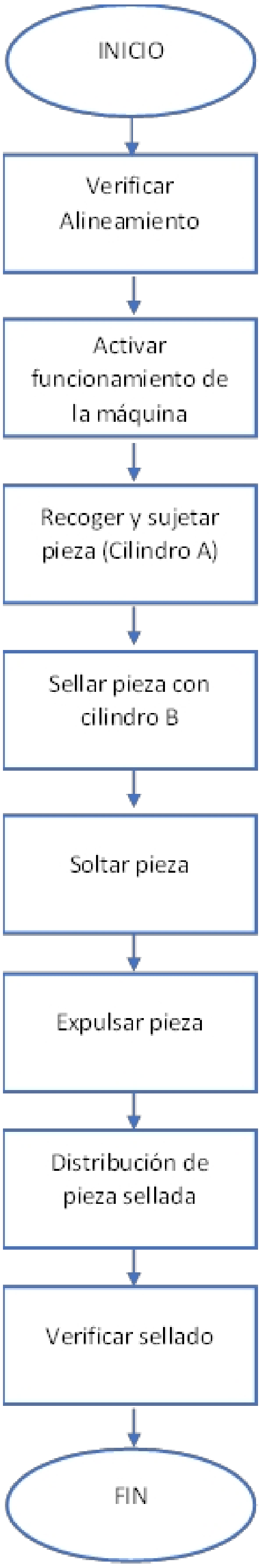

Fig. 16. Diagram of process operations.

4.4 Operations Diagram of the proposed process

Fig. 16-1. Diagram of process operations.

4.5 Process analysis diagram of the proposed process

Diagrama de análisis del proceso del funcionamiento de una maquina selladora						
Nº	**Descripcion**	●	■	➡	D	▼
1	Colocar pieza para su sellado	X				
2	Verificar alineamiento de pieza		X			
3	Activar el funcionamiento de la maquina	X				
4	Cilindro A traslada pieza a posicion de sellado			X		
5	Cilindro B baja y sella la caja	X				
6	Cilindro B sube a posicion inicial	X				
7	Cilindro C se activa y traslada la pieza fuera de posicion			X		
8	Verificar su correcto sellado		X			
9	Almacenar de producto sellado					X
TOTAL		4	2	2		1

Table 4. Diagram of analysis of the proposed process

4.6 Detailed description of the materials to be used (sensors, pre-actuators, actuators, motors, PLC, etc).

- 3 double acting cylinders
- 3 solenoid valves
- 1 PNP coactive sensor
- 1 plc box
- 1 power supply
- 2 flow restrictors
- 3 recores and 2 stabilizers

4.7 Design of the electro-pneumatic circuit of the process.

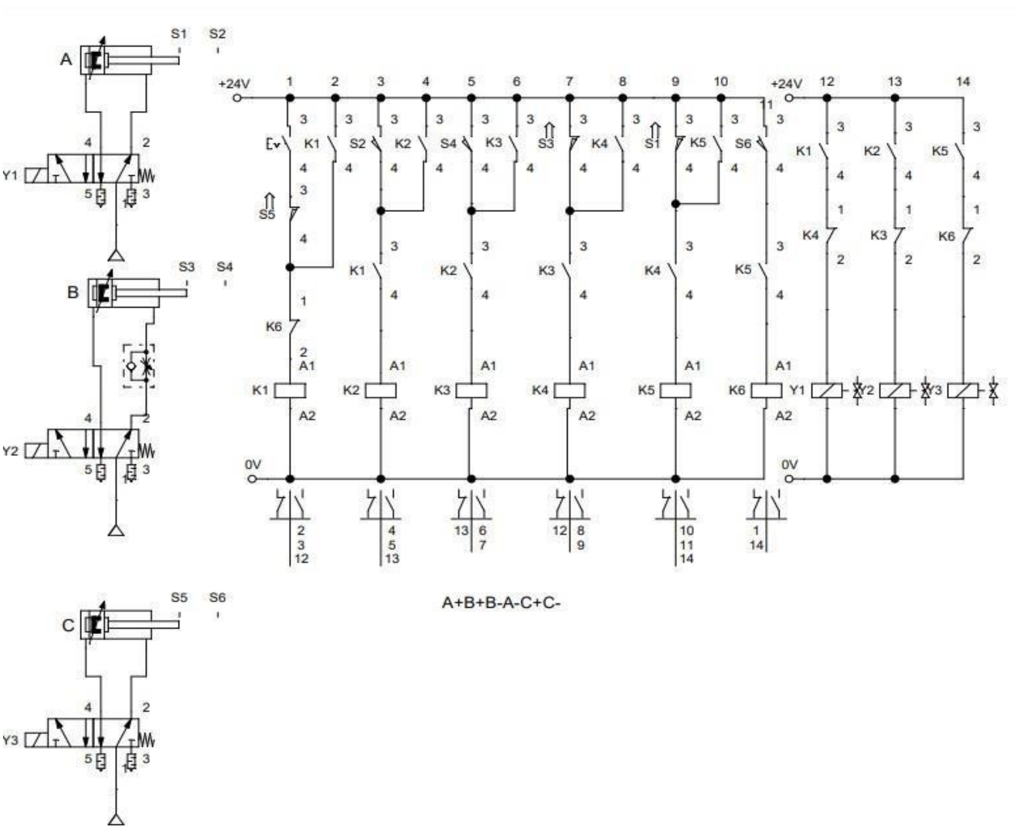

Fig. 17. Electro-pneumatic circuit of the process.

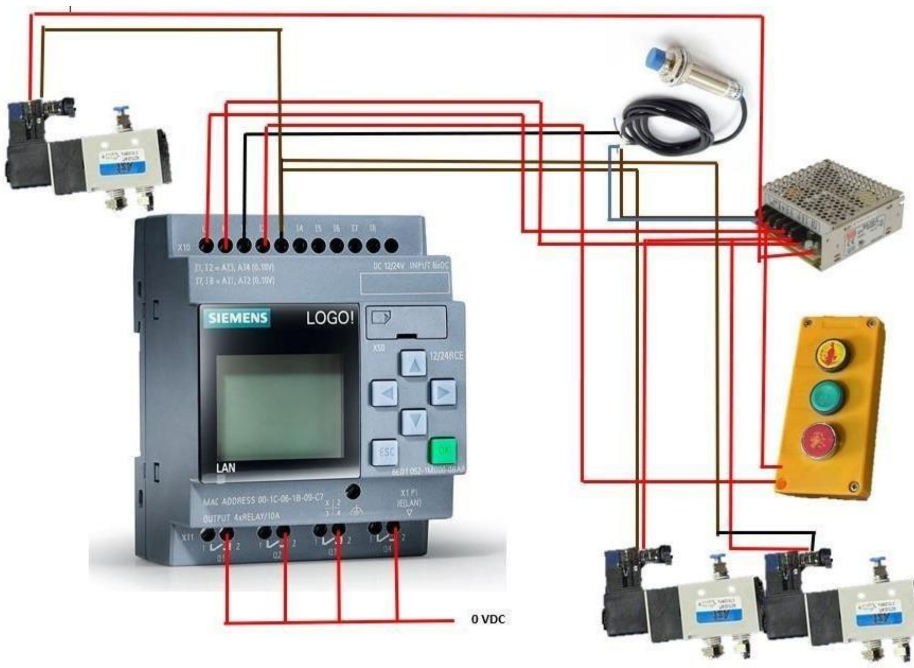

Fig. 18. PLC wiring.

4.8 Ladder programming of the process (comment each of the segments used in your Ladder programming).

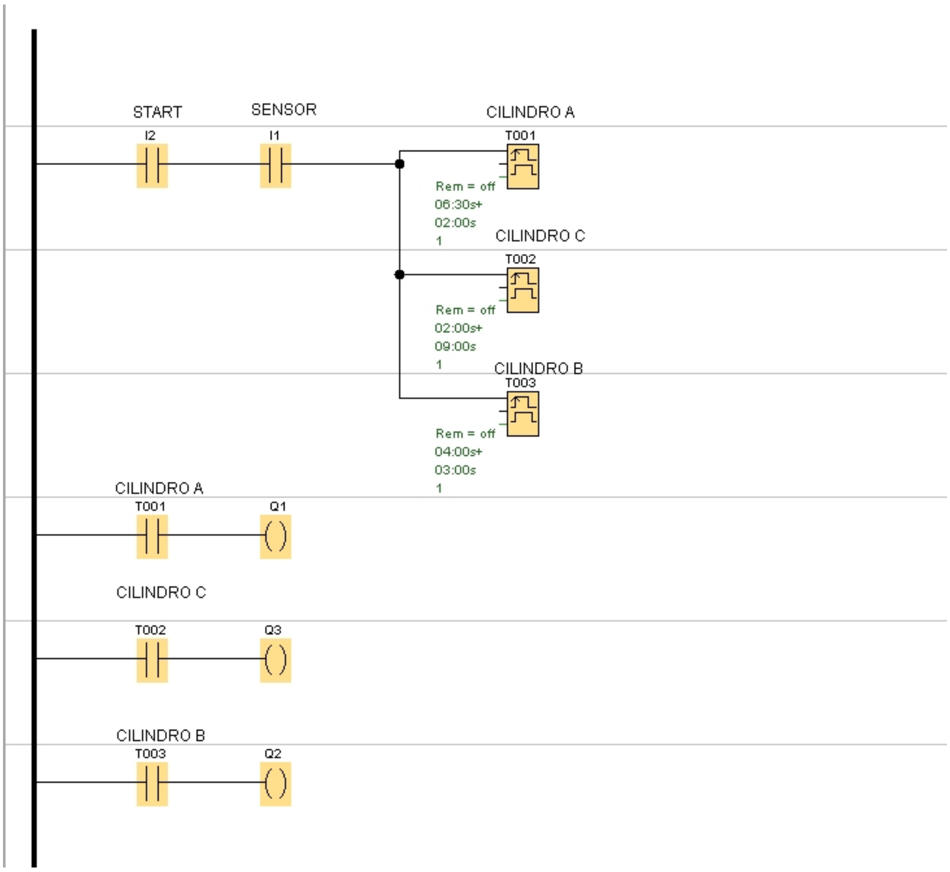

Fig. 19. Programming in Ladder language.

Open contact corresponding to the control panel "I2" (START) was inserted, then open contact was connected to enable the sensor that will enable the three relays of sweep triggered by flanks (Timers). Each timer closes the open contact that has the same name (T001, T002 and T003) activating the coil that in our case are the solenoid valves, thus extending our pneumatic cylinders.

4.9 Ladder programming of the improved process (comment on each of the segments used in your Ladder programming).

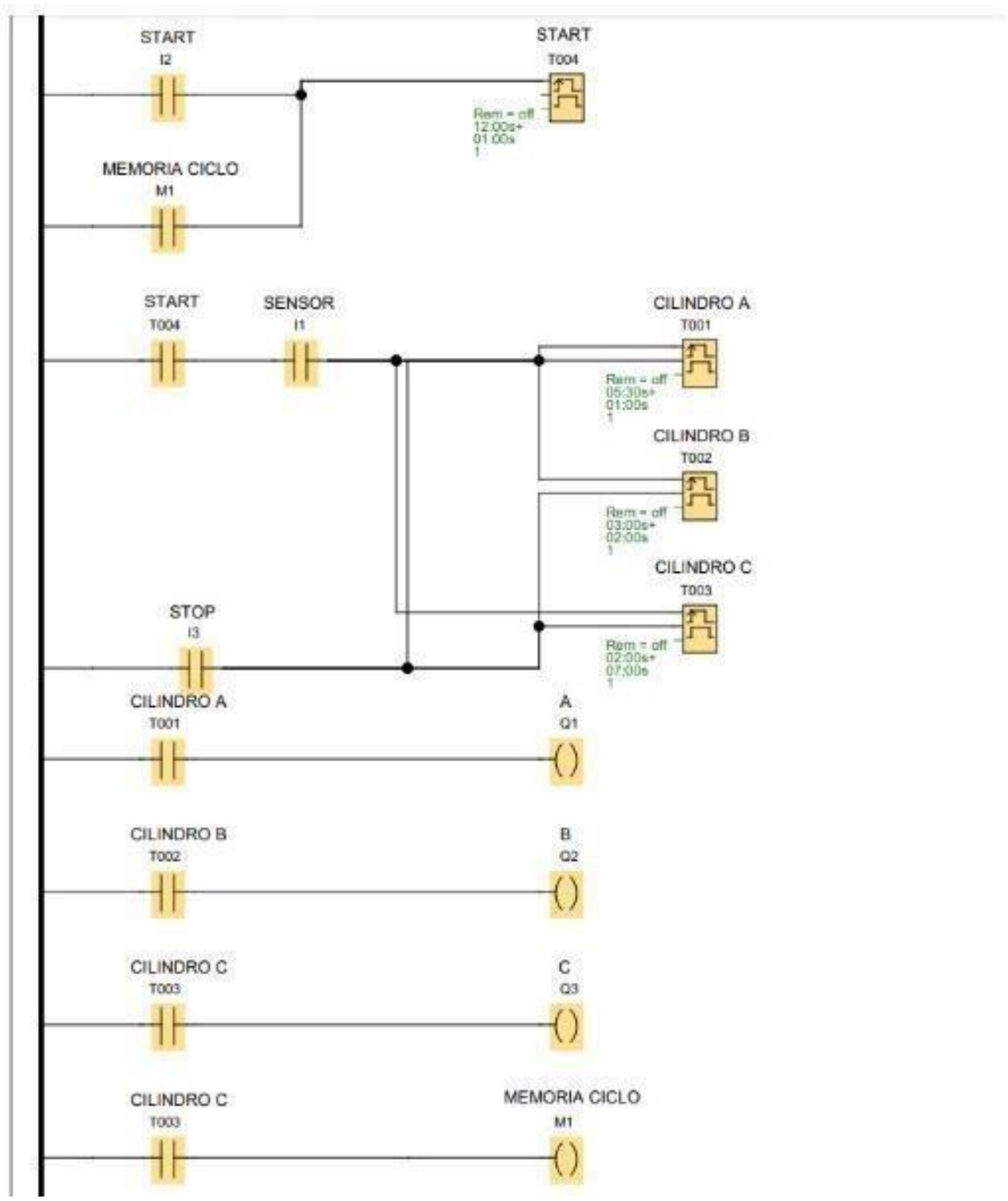

Fig. 20. Programming in improved Ladder language.

An open contact corresponding to the control panel "I2" (START) was inserted, then an edge-triggered relay (Timers) was connected, also adding a new open contact that energizes the system when the whole circuit is finished thus making the whole system cyclic. The open contact to enable the sensor has input I1 of the PLC which will enable the three edge-triggered sweep relays (Timers) each time it detects metal at a distance of 6-9 ms. Each timer closes the open contact that carries its

We also added to the timer of cylinder C a cycle memory, in this way each time you finish executing the actuation of cylinder C a memory will be activated, which energizes the system again. We also added an emergency stop button or STOP, the latter connected to input I3 of the PLC, which will serve to stop the entire process in case of error in the positioning of the boxes or any unexpected situation.

4.10 Description and detail of production indicators after automation.

Production cycle time indicator: this indicator measures the time it takes to manufacture the required production, from the moment the order is released until the finished products are delivered. According to our automated project, due to the valves and their respective automatic cylinders, and with a sophisticated PLC, the production efficiency is very high, with the capacity that can reach almost twice as many times of sealing in the same time as a manual one.

Competitiveness indicator: this indicator relates the manual machine to the already automated one. Thanks to the PLC incorporated in our automated project, it achieves a programmable logic controller with numerous high-performance functions.

On-time delivery indicator: this indicator aims to achieve the production target of products produced by the machine and provides an important way to establish performance benchmarks. According to our automated project we can visualize that the sealing machine thanks to its high proactivity performance, service delivery is achieved before the agreed time.

Yield indicator: this production indicator is the rate of how many units on average a machine, cell or line is producing over time. According to our automated project, we can see reflected the great difference in the amount of production that is achieved with the automated sealing machine, since, with PLC control, convenient and practical operation can be performed without the use of a person.

4.11 Industrial safety aspects after the implementation of the proposal.

Establish official project policies and procedures.

Create a manual that describes the steps to be taken to prevent accidents in the workplace. Include in a simple and brief manner a description of the personal protective equipment required to perform an activity or task, the handling and storage of materials and supplies required to perform each activity or task, and the procedures developed to ensure that an activity or task is performed safely.

Appoint the Safety Coordinator for the project and assign roles, responsibilities and authority.

Review current security policies with security coordinators and develop plans to ensure implementation and compliance with each standard. Verify that the person understands all safety-related responsibilities. Show your support for this person and hold regular meetings to discuss progress, results and accident prevention solutions.

Ensure that the tools are available so that you don't have to improvise.

If a group of people have to improvise to get the job done, it means your project is not taking safety seriously.

- For example, if you don't have a workspace that contains a large desk, make sure you have a box available so team members don't waste time searching for tools while creating automation projects.

CHAPTER 5: INVESTMENT AND OPERATING COSTS

5.1 cash flow

	MES 1	MES 2	MES 3	MES 4	MES 5	MES 6	MES 7	MES 8	MES 9	MES 10	MES 11	MES 12
INGRESOS	8400	11500	13800	16560	19872	23846.4	28615.68	25300	20700	25300	27600	23000
ventas	6900	11500	13800	16560	19872	23846.4	28615.68	25300	20700	25300	27600	23000
cantidad	3	5	6	7	9	10	12	11	9	11	12	10
precio	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300
aporte a capital	1500											
EGRESOS DE CAJA	**8210**	**9610**	**9610**	**13810**	**15210**	**16610**	**18150**	**19844**	**20810**	**20810**	**20810**	**12410**
COMPRAS	7000	8400	8400	12600	14000	15400	16940	18634	19600	19600	19600	11200
CANTIDAD	5	6	6	9	10	11	12	13	14	14	14	8
PRECIO	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400
TRANSPORTE	10	10	10	10	10	10	10	10	10	10	10	10
COSTOS FIJOS	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200
ARRIENDO	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
LUZ	70	70	70	70	70	70	70	70	70	70	70	70
AGUA	30	30	30	30	30	30	30	30	30	30	30	30
INTERNET	100	100	100	100	100	100	100	100	100	100	100	100
FLUJO DEL MES	190	1890	4190	2750	4662	7236.4	10465.68	5456	-110	4490	6790	10590
FLUJO ACUMULADO	190	2080	6270	9020	13682	20918.4	31384.08	36840.08	36730.08	41220.08	48010.08	58600.08

Table 5: Cash flow

5.2 Feasibility economic feasibility

With respect to our cash flow, we can see that in the first month we had a deficit since it was negative. However, a capital of 1500 soles was injected to sustain the company. At the end of our cash flow we can see that it is profitable.

CONCLUSIONS

- PLCs are devices that allow the development and control of processes through programming, allowing for greater control and flexibility in terms of process change.
- Automated machines have a higher accuracy compared to conventional systems, and even these machines save time, which, in a complex production system, is very valuable.
- The PLC programming is important because it allows the execution of the process, that is to say, this programming allows the PLC to order the functions that each part of the project has.

RECOMMENDATIONS

- For the wiring of the project, it is necessary to verify if the specifications of the parts are correct, also the type of current and voltage must be uniform to avoid inconveniences at the moment of the operation of the machine.
- It is necessary to keep a project schedule in order to optimize the creation and execution time of the desired production plan.
- At the time of programming, it must be taken into account that the programming must be sequential, since this way the order in which the tasks of the process will be developed can be correctly defined.
- It is important to maintain the working space of the machine in adequate conditions, so that there is a better flow in the process to be carried out, avoiding inconveniences or accidents.

BIBLIOGRAPHY .

E. V. Terzi, H. Regber, C. Löffler, F. "Programmable Logic Controls. Basic Level". Festo Didactic. 2000

Salas, G. E. (2017, August). *HISTORY OF THE BEGINNINGS OF PLC* (No. E12020311). Institute Tecnológico de Veracruz. https://www.academia.edu/34381291/historia_del_plc.

Rojas Lazo, O. (2014). Computer Aided Design in Industrial Engineering at UNMSM. Industrial Data, 3(2), 06. https://doi.org/10.15381/idata.v3i2.6618

Rojas Lazo, O. (2014a). COMPUTER AIDED DRAFTING IN THE FACULTY OF INDUSTRIAL ENGINEERING - UNMSM. Industrial Data, 8(1), 018. https://doi.org/10.15381/idata.v8i1.6150

ElectroIndustry Magazine - PLC: The evolution of a small giant (2018, June 10). EMB. Retrieved 2 from June from 2022,

from http://www.emb.cl/electroindustria/articulo.mvc?xid=1131&ni=plc-la-evolucion-de- un-pequeno-gigante#:%7E:text=La%20historia%20del%20PLC%20

Monitoring-Delta (2002, July 25). UNINTERRUPTIBLE POWER SUPPLY
AD-155A - Uninterruptible Power Supply Modules - Delta. DELTA. Retrieved June 18, 2022, from https://shopdelta.eu/fuente-de-alimentacion- uninterruptible-ad-155a_l6_p3374.html.

Navas, M. Á. (2018, July 27.) What is a power supply, and how does it work? Professional Review.https://www.profesionalreview.com/2017/11/19/una-fuente-power-supply-works/#%C2%BFWhat_is_a_power_supply?

Siemens PLC LOGO Theory and Practices (2020, May 10). AREATECNOLOGIA. Retrieved June 18, 2022, from https://www.areatecnologia.com/electricidad/plc-logo.html.

Capacitive sensor. (2018, November 27). Rechner Sensors. https://www.rechner-sensors.com/en/documentation/knowledge/capacitive-sensor.

Moreno, E. G. (2001). Automation of industrial processes. Valencia: Alfaomega. Budynas, Richard, Shigley's Mechanical Engineering Design, Eighth Edition, McGraw-Hill, Mexico.

Rondón Matheus, Oscar, 2002. Machine Engineering Design and its evolution in history.
2002.

La Cruz, Jorge, (2018). Evolution in construction management from the '80s to 2017 - LeanConstruction philosophy.http://repositorio.urp.edu.pe/bitstream/handle/URP/1634/T030_09371579_T%20Thesis%20FERNANDEZ%20REYNAGA.pdf?sequence=1.

Online Thesis: Gantt Chart. (2019, 09 August). Retrieved August 9, 2022, from https://online-tesis.com/diagrama-de-gantt/.

Gastelo Arnales (2017, Lima) "IMPROVEMENT OF PRODUCTIVITY THROUGH THE EFFICIENT USE OF DIRECT LABOR IN THE PLASTICS INJECTION PROCESS AT CIPLAST PERÚ S.A.C.".

Anonimo (2014, Arequipa) Process operations diagram - DOP https://hernanincafrs.blogspot.com/2014/04/diagrama-de-operaciones-de-proceso-dop.html

ANNEX

Project summary

TURNITIN RESULT