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ICAI

# GRADO EN INGENIERÍA EN TECNOLOGÍAS INDUSTRIALES

TRABAJO FIN DE GRADO

DISEÑO DE CAJETILLA DE TABACO  
INTELIGENTE Y ESTUDIO DE VIABILIDAD

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Madrid

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# **DISEÑO DE CAJETILLA DE TABACO INTELIGENTE Y ESTUDIO DE VIABILIDAD**

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## **ABSTRACT**

Tobacco generates more than 60,000 deaths a year in Spain. To help reduce this, a solution has been proposed that consists of an intelligent tobacco pack that helps smokers progressively reduce consumption and allows it to be combined with other treatments to increase the success rate.

The tobacco pack has been designed to automatically dose the cigarettes when the necessary time has elapsed concerning the previous cigarette. An electronic system has been designed to control the dosage of cigarettes, to refill the pack with more cigarettes when it is empty, and to exchange information with the app through which it will be controlled.

In addition, a business plan has been designed. This business plan includes an analysis of the costs and revenues to produce and market the product and a sales forecast.

## **RESUMEN**

El tabaco genera en España más de 60.000 muertes al año. Para ayudar a reducir esto se plantea una solución que consiste en una cajetilla de tabaco inteligente que ayude a los fumadores a ir reduciendo de manera progresiva el consumo y permite combinarlo con otros tratamientos para aumentar la tasa de éxito.

Se ha diseñado la cajetilla de tabaco que permite dosificar de forma automática los cigarrillos cuando haya pasado el tiempo necesario con respecto al anterior cigarrillo. Se ha diseñado un sistema electrónico para controlar la dosificación de los cigarrillos, poder rellenar la cajetilla con más cigarrillos cuando esta esté vacía e intercambiar información con la app a través de la cual se controlará.

Por otra parte, se ha diseñado un plan de negocio. En este plan de negocio se incluye un análisis de los gastos e ingresos para producir y comercializar el producto y una previsión de las ventas.



## Index

1.	Introduction .....	4
2.	Objectives .....	7
3.	General idea .....	8
4.	Prototype.....	10
4.1.	Mechanical design .....	10
4.2.	Hardware .....	16
4.3.	Firmware.....	22
4.4.	IoT platform algorithms .....	25
5.	Market research .....	27
6.	Business model.....	31
6.1.	B2B.....	31
6.2.	B2C.....	32
6.3.	Conclusion of the business model .....	32
6.4.	Lean Canvas .....	33
6.5.	4 P's .....	35
6.6.	Market sizing .....	40
6.7.	Sales forecast .....	44
6.8.	Cost analysis .....	46
6.9.	Estimated net income.....	52
6.10.	Net present value .....	54
7.	Bibliography .....	55
8.	Annex .....	58
8.1.	Arduino code .....	58
8.2.	SmartWorks code .....	63
8.2.	Sustainable development goals.....	65
8.3.	Blueprints .....	66

## Figure index

Figure 1: Perception of the relationship between tobacco and e-cigarette use and COVID disease, total (percentages). Spain, 2020 [1].	4
Figure 2: Products consumed before and during confinement by COVID, (percentages). Spain, 2020 [1].	6
Figure 3: Focus Cigarette Case B10R [2].	10
Figure 4: Focus Cigarette Case B10R mechanism [3].	11
Figure 5: Pinion.	12
Figure 6: Rack.	12
Figure 7: Support.	12
Figure 8: Pushbutton extension	13
Figure 9: Electronic components support.	14
Figure 11: Case part 1.	14
Figure 12: Case part 2.	15
Figure 13: Arduino Nano 33 IoT [4].	16
Figure 14: Micro servo SG90 9g [5].	17
Figure 15: SG90 9g micro servo wiring diagram [6].	17
Figure 16: Servo SG90 PWM signals and corresponding positions [7].	18
Figure 17: Button [8].	18
Figure 18: EVARY PowerBank 5000mAh [9].	19
Figure 19: Circuit diagram.	20
Figure 20: PCB.	21
Figure 21: FitSmoke [10].	29
Figure 22: Nicotrax [11].	30
Figure 23: Tobacco consumption in Spain (percentages) [13].	40
Figure 24: Attitude towards smoking cessation during confinement, according to consumption pattern (daily or non-daily) (percentages). Spain, 2020 [1].	42

## Table index

Table 1: Tobacco consumption by age group in thousands of people in Spain in 2020 [14]. .....	41
Table 2: Units sold in the optimistic scenario. ....	45
Table 3: Units sold in the pessimistic scenario. ....	45
Table 4: Cost of materials and processes. ....	47
Table 5: Distribution costs in the optimistic scenario. ....	47
Table 6: Distribution costs in the pessimistic scenario.....	47
Table 7: Marketing costs. ....	48
Table 8: Hours worked per year to assembly taking into account expected units sold in each year. ....	48
Table 9: Staff costs. ....	49
Table 10: Social Security incentives for initial indefinite-term contracts [15]. ....	49
Table 11: Rent costs. ....	50
Table 12: Summary of Social Housing Agency's Local Plans for entrepreneurs [16]...	50
Table 13: Web costs. ....	51
Table 14: App costs.....	51
Table 15: Taxes in the optimistic scenario. ....	52
Table 16: Taxes in the pessimistic scenario. ....	52
Table 17: Net income in the optimistic scenario. ....	53
Table 18: Net income in the pessimistic scenario. ....	53

# 1. Introduction

In Spain, smoking is related to around 60,000 deaths per year, which is about 200 deaths per day. In addition, exposure to environmental tobacco smoke accounts for approximately 2,200 deaths in the non-smoking population. Tobacco consumption in the country has been reduced in recent years, but 20% of the population smokes daily.

The COVID-19 pandemic has highlighted the increased vulnerability of smokers. According to some studies, smokers have a 1.45 times higher risk of having more severe symptoms than non-smoker. According to the survey "Tabaco, otras formas de consumo y confinamiento" carried out by the Ministry of Health, the National Committee for the Prevention of Smoking, and the autonomous communities of La Rioja and Murcia, 81.52% of those surveyed are aware of this higher risk, as can be seen in the image below. Consequently, some smokers have tried to quit smoking; according to the same survey, 13.56% have tried to quit smoking during the confinement stage.

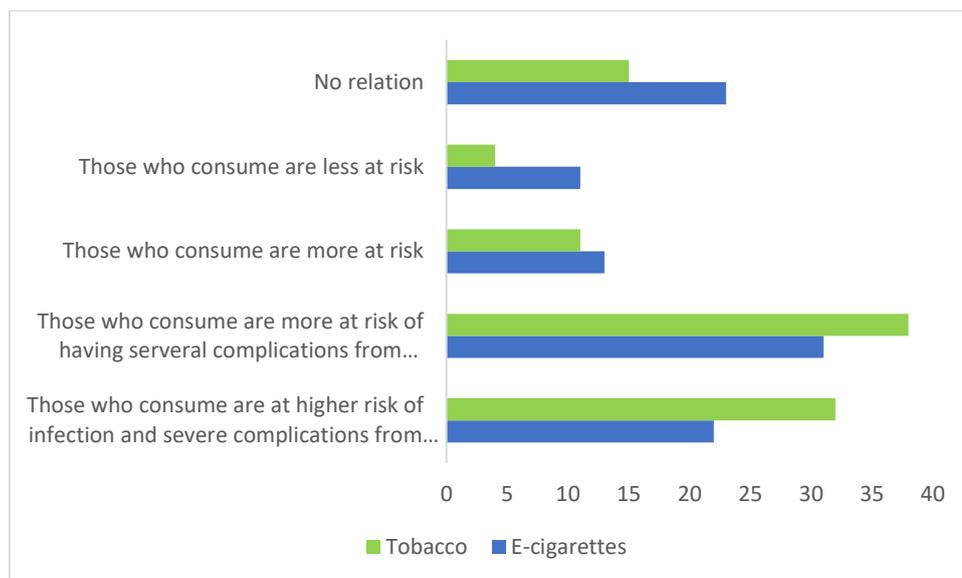


Figure 1: Perception of the relationship between tobacco and e-cigarette use and COVID disease, total (percentages). Spain, 2020 [1].

The goal is clear, smokers must quit smoking. The decision to quit smoking not only improves personal health and quality of life but also that of the people around the smoker. Currently, different methods and medications allow overcoming the powerful nicotine addiction, but in many cases, it is not enough.

Some people quit smoking suddenly and completely without medication or other aids, but others after several attempts to quit smoking abruptly fail. It is at this point that they often stop trying to quit smoking, but the solution is to find a method to quit smoking gradually. Quitting smoking gradually by reducing the number of cigarettes smoked per day can be a complicated process, so the smoker must be supported by a method. During this process, the amount of nicotine in the body slowly decreases, which reduces withdrawal symptoms. The need to smoke arises when nicotine levels, which the regular smoker tends to keep constant, decrease. If this need is not satisfied, irritability, nervousness, lack of concentration... all of which are symptoms of withdrawal. Therefore, in addition to following a strict reduction program, it is advisable to combine it with medications such as varenicline, which simulates the effects of nicotine on the brain and helps to reduce the symptoms, and makes it easier to achieve the goal of quitting smoking for life.

From all the above, the idea arises to try to provide a new solution to increase the chances of success and that can be combined with other methods such as the use of medications, with a doctor's prescription such as varenicline, or any other smoking cessation method that helps reduce nicotine withdrawal symptoms. It seeks to combine this idea with a technology that is currently growing which is the IoT (Internet of Things), which allows connecting devices through the internet and exchanging data. This data can be used to help users quit smoking more efficiently by following a reduction plan and curbing the urge to smoke to gradually reduce consumption. In addition, being able to have the data in real-time allows to offer instant help to the user and that the user can see his progress and thus get more motivation, which is in many cases what is necessary to cope with all the impediments that arise during the process of quitting smoking. In addition, as cigarettes are the most consumed tobacco, as shown in the image below, it will focus on helping mainly this segment.

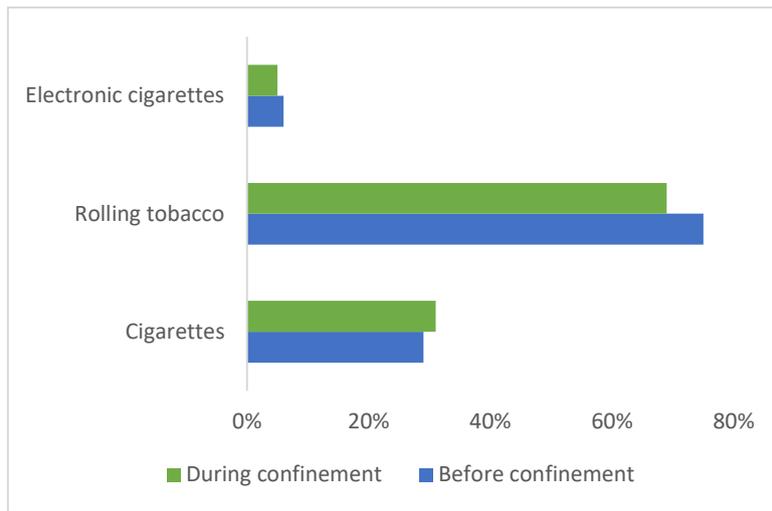


Figure 2: Products consumed before and during confinement by COVID, (percentages). Spain, 2020 [1].

## **2. Objectives**

The three main objectives of this project are the design of the connected product, prototyping, and the development of a business plan.

One of the objectives of this project is to design an intelligent tobacco pack that allows blocking access to cigarettes to allow the user to gradually reduce tobacco consumption. The aim is to achieve a device that allows interaction with the user and offers him all the necessary data so that he can see that there is progress and that he can stop smoking. The aim is that these times are adapted to each user to allow him to adapt as quickly as possible and facilitate the achievement of the objectives.

Prototyping is another objective of this project. The goal is to get a fully functional device to validate the design. To verify that the design works as desired, fulfilling the established criteria and functions.

Finally, the objective is to develop a realistic business plan. This will allow to know the size of the company necessary to reach the target audience and an adequate level of sales to meet the established objectives. In addition to sales, it will also be necessary to analyze the income and expenses needed to reach the established sales level. The business plan will make it possible to analyze whether it is viable to manufacture and market the product. Both from the economic point of view, that the income exceeds the expenses soon, and from the commercial point of view, that the product is attractive to the consumer to reach the desired level of sales.

### 3. General idea

The basic idea of the project is to achieve a pack of cigarettes that allows automatic dosing of cigarettes one by one when the time to the previous cigarette is indicated and that does not allow access to the cigarettes inside the pack.

The average consumption of cigarettes is around 13 cigarettes. What it has been looked for is a pack that allows to store of an adequate number of cigarettes, which according to the data mentioned above would be around 20 to cover both those who smoke little and those who smoke a lot.

As for the electronics, the functions that the device will have to perform are:

- Exchange information with the platform to be able to control the times between each cigarette and collect all the data to be able to track the user.
- Move two servomotors, one in charge of dosing the cigarettes and the other in charge of blocking access to the inside of the pack and unblocking it when the pack is empty. The position of the servomotors can be modified using two different ways: two buttons located on the pack itself and by sending a message from the app.

The following electronic components are required for this:

- Microcontroller: in charge of the communication between all the components present in the pack.
- Servomotors: they will perform the functions mentioned above and will receive the information from the microcontroller to move to the corresponding position and at the corresponding speed.
- Bluetooth module: responsible for sending and receiving information from the app to allow the user to have all the data and can interact with the device.
- Buttons: will allow moving the servomotors if possible, according to the function performed by each servomotor and the constraints set for each function.
- Power supply: it will be necessary to power all the electronic components according to the requirements of each component.
- LEDs: they will be used as indicators of the battery level.

In addition, to control the time between each cigarette, an algorithm to be established in the platform will be necessary.

## 4. Prototype

### 4.1. Mechanical design

To start with the mechanical design, there are two possibilities: to make the design from scratch or to take an existing tobacco box and adapt it to the needs of the project. The possibility of starting from an existing cigarette pack would facilitate the design. If the model with the right design and function is found, it would only be necessary to adapt it by adding new elements or modifying the existing ones. It was therefore decided to look for a model that could meet the desired criteria.

The most complex part of the design is to be able to dispense cigarettes one by one, so when looking for a model to use as a base this is the most important part. A model has been found that meets these characteristics and in which a maximum of 10 cigarettes can be stored, which is not the desired amount, but it is considered sufficient as it is a prototype. This model is shown in the following image:



Figure 3: Focus Cigarette Case B10R [2].

The mechanism used to remove the cigarettes one by one is mainly based on the use of torsion springs. Two torsion springs are used in the two moving parts in charge of pushing the cigarettes towards the part in charge of lifting them out of the pack. Another torsion

spring is used in the lid that opens when a cigarette is removed from the pack by raising a part located on the side of the pack for this function.



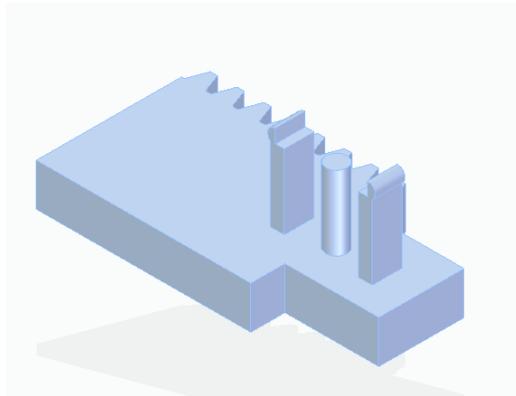
*Figure 4: Focus Cigarette Case B10R mechanism [3].*

To be able to use this pack in the project it is necessary to make some modifications and add new parts so that it has all the necessary elements.

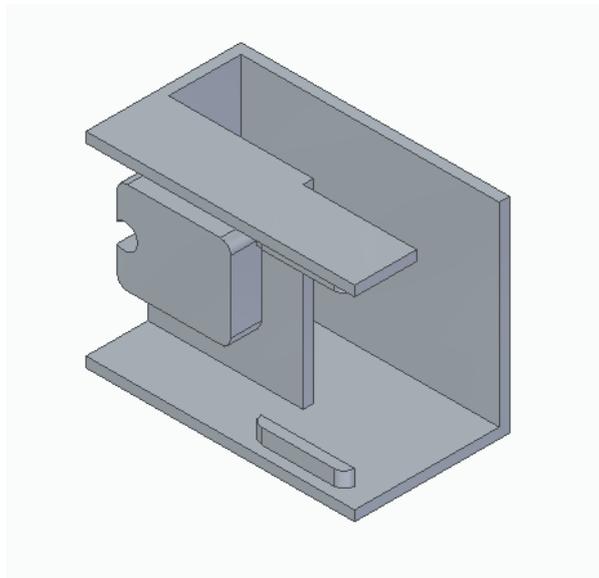
The main modification that has to be made is the necessary one so that a servomotor can take the cigarettes out of the pack. This servomotor must perform a linear movement to lift the cigarette out of the pack. Therefore, it has been decided that the best mechanism to perform this function is a rack and pinion mechanism. The purpose of this mechanism is to transform the circular motion of the servomotor into a linear motion and for this motion to be reproducible. The motion must always be the same in both distance and speed and with this mechanism, these two variables are easily controllable. It will be necessary to control the speed of rotation of the servomotor and the degrees it rotates. The distance of the rack has been designed considering the distance the mechanism climbs the box, which is designed to climb by hand. The rack has been designed with brackets to be able to replace the original package part and have better performance. In addition, another bracket, which is coupled to the pack, has been designed to guide the linear movement of the rack and facilitate the contact between the pinion and the rack. In addition, whenever there are cigarettes inside the pack, the servomotor will be able to remove them thanks to the torsion spring mechanism mentioned above.



*Figure 5: Pinion.*



*Figure 6: Rack.*



*Figure 7: Support.*

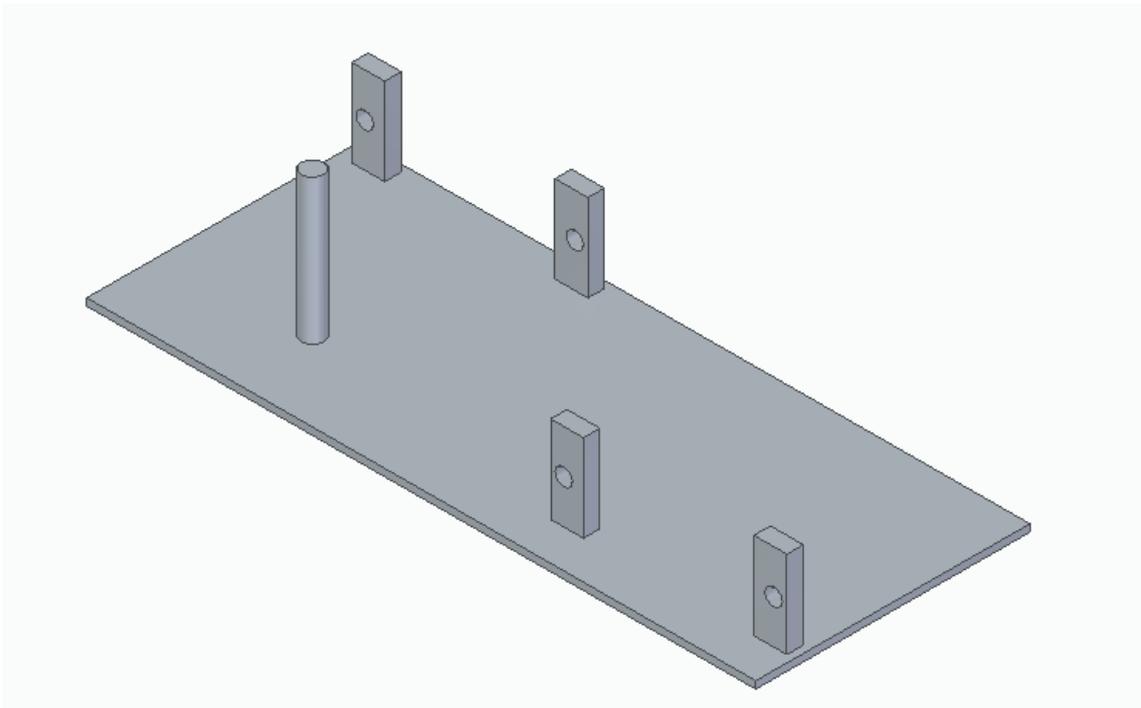
This will not be the final product design that will be marketed, it is an initial prototype to check if it is possible to realize the idea that has been proposed. This design and all the ideas included in it will be revised and perfected to launch the product to the market and that it will have a better finish and adapted for a larger production.

As for the servomotor in charge of preventing access to the cigarettes inside, it will only be necessary to make the support to keep it in a suitable position so that with a 90° movement of the servomotor the opening of the pack can be locked or unlocked to be able to refill it. This is a simple mechanism. When the servomotor is in the 0° position, it is in contact with the pack on the outside to prevent the inner compartment from opening, while when the servomotor is in the 90° position, it is no longer in contact with the pack and can open freely and thus fill the inside of the pack with more cigarettes.

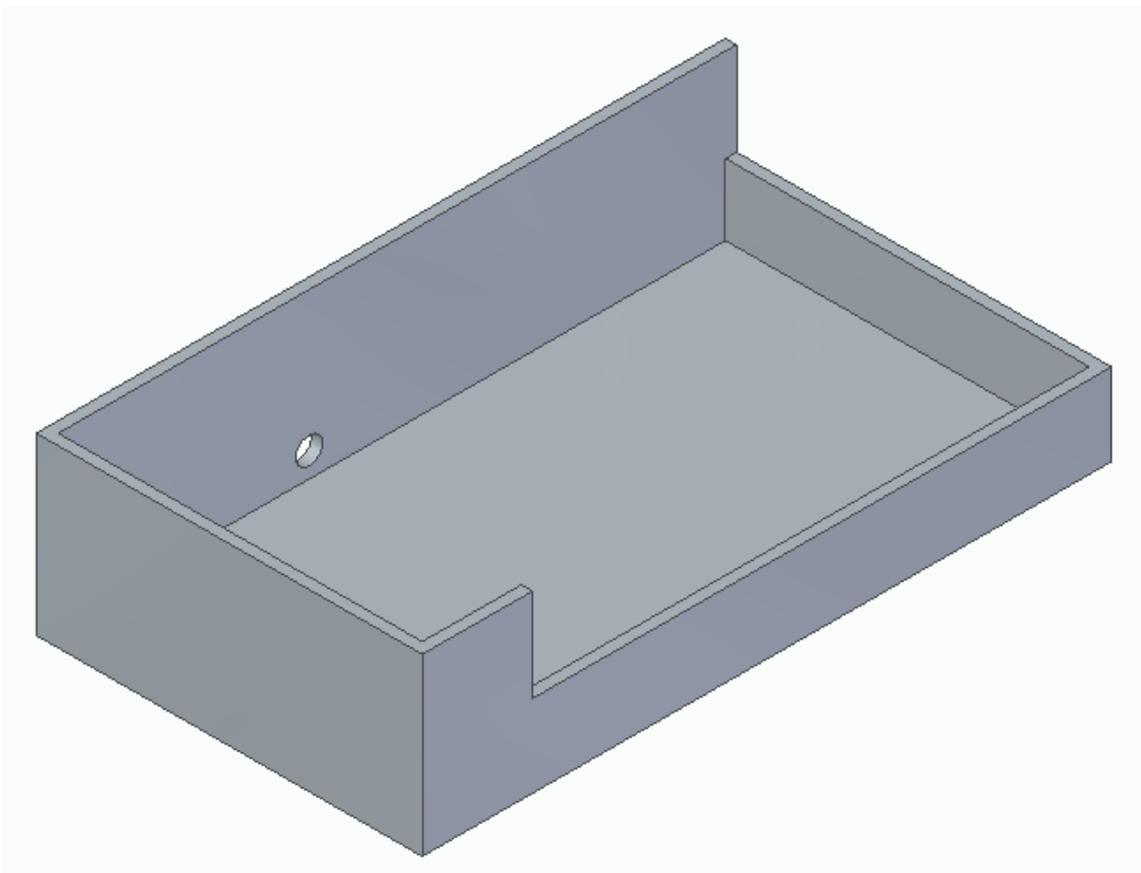
In addition, it is also necessary to make supports for the rest of the electronic components since it is a device that is going to have a lot of movement as it usually goes in the users' pockets for daily use. One side of the case will be used to house all the electronics and the other side will house the battery. The supports will be made on a flat surface so that they can be glued to the pack. The larger the contact surface, the greater the strength of the glue. Therefore, this piece occupies the largest flat surface that exists in the pack. The brackets are designed so that the parts can be attached to them with screws.



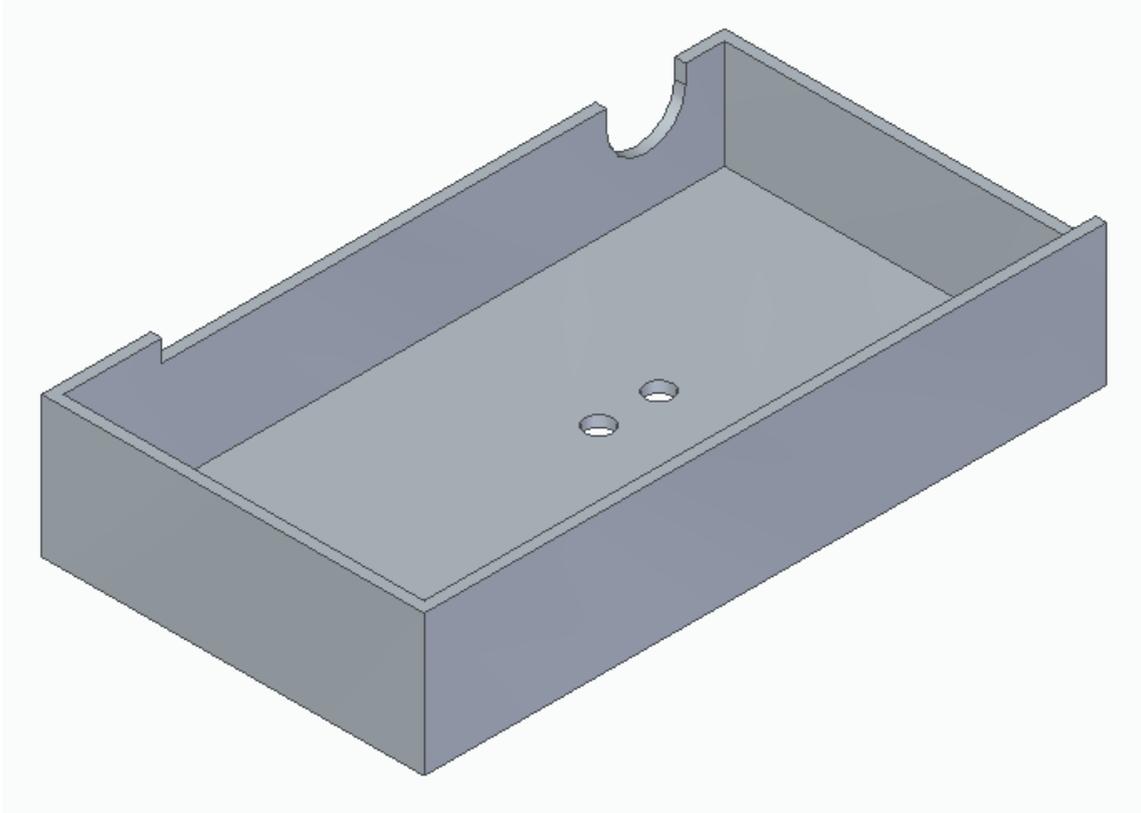
*Figure 8: Pushbutton extension*



*Figure 9: Electronic components support.*



*Figure 10: Case part 1.*

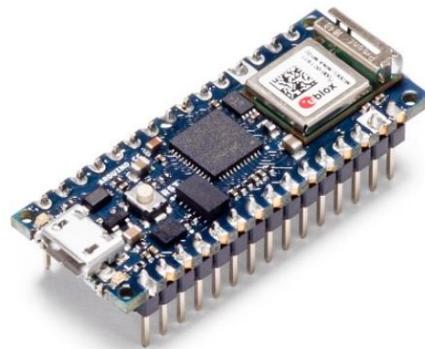


*Figure 11: Case part 2.*

## 4.2. Hardware

### Arduino Nano 33 IoT

Using an Arduino board facilitates the realization of the project since it is a company that designs open-source hardware and software. Specifically, this board has been chosen for its small size (45 x 18 mm) and weight (5 g) and because it is specially designed to be incorporated in IoT devices such as the one that is intended to be obtained with this project. These features facilitate the design of the device since it is a device that the user will use in their daily life. It contains 11 digital pins, which are enough to incorporate all the devices, both servo motors and push buttons, that are intended to be included in the design. In addition, it contains a module, the NINA-W10, which allows Wi-Fi and Bluetooth connectivity. The Wi-Fi connectivity or Bluetooth will allow the use of the MQTT protocol to exchange information between the device and the cloud.



*Figure 12: Arduino Nano 33 IoT [4].*

### Micro servo SG90 9g

This servomotor model has been chosen because of its small dimensions (22.2 x 11.8 x 31 mm) and weight (9 g), which is important to be able to make a prototype of adequate dimensions and weight. This servomotor model only performs a 180° turn, but this is enough for the prototype to be designed. The servomotor in charge of allowing access to the interior compartment does not have any external resistance so it is only necessary that they can perform the circular motion. On the other hand, the servomotor in charge of dispensing the cigarettes does have external resistance as it has to move the rack upwards,

but the weight and dimensions of this part are small, so the torque offered by this model of the servomotor is enough for it to perform its function.



Figure 13: Micro servo SG90 9g [5].

The operation of the servomotors is based on receiving a signal that indicates the position in which it has to be, and the servomotor moves to this position. In this case, this model of servomotor can rotate a maximum of  $180^\circ$ , it has defined the central position as  $90^\circ$  and from this, it can rotate  $90^\circ$  clockwise and the same degrees counterclockwise. This servomotor has three wires, the power cable is the red wire, the ground wire is the brown wire, and the yellow wire is through which receives the coded signal.

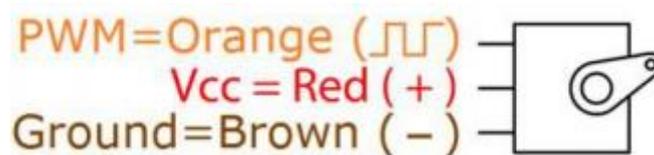


Figure 14: SG90 9g micro servo wiring diagram [6].

The signal received is a pulse width modulated signal, also known as PWM for its acronym. This system of transmitting the signal is based on receiving square waves of 5 V with a constant period of 20 ms, which is the same with a frequency of 50 Hz, and what varies is the duration of the pulse. The  $90^\circ$  position is the central position and is equivalent to a signal with a 1.5 ms pulse. The  $180^\circ$  position is the position to the right of the whole and is equivalent to a pulse of 2 ms. The  $0^\circ$  position is the leftmost position of the whole and is equivalent to a 1 ms pulse.

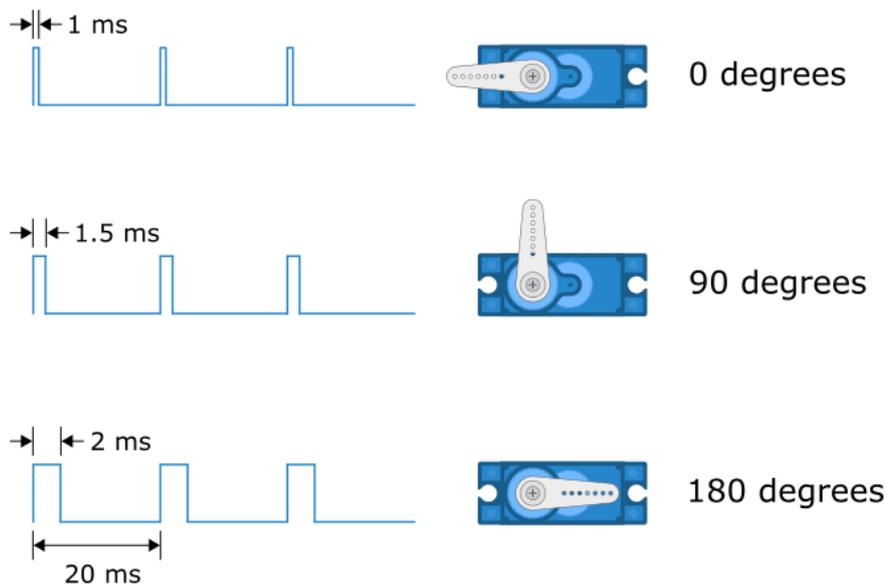


Figure 15: Servo SG90 PWM signals and corresponding positions [7].

The servomotor's internal controller receives this signal and decodes it to know the position in which the servomotor has to be. If the position is different from the current one, the motor part is activated and the movement to the desired position takes place. Once the desired position is reached, the motor part stops, unlike the internal controller part that continues to check the signal it receives to verify that the servomotor remains in the desired position, so that in case there has been any small variation in the position to correct it or to reactivate the motor part to move it to a new position.

### Buttons

Two buttons have been used in the design. One of the buttons will be used to dispense cigarettes and the other will be used to unlock the pack and allow refilling inside.



Figure 16: Button [8].

## Battery

The battery shown in the image below has been selected to provide proper power to all components. The output voltage is 5 V, which is necessary for both servo motors, and the Arduino Nano 33 IoT will be powered by USB, which regulates the voltage and current, avoiding any problems that may be caused to the board by over voltages or similar problems. In addition, its dimensions are ideal for the project, as it has the same dimensions as the box.



Figure 17: EVARY PowerBank 5000mAh [9].

## Circuit

A schematic of the connections of all the elements explained above is shown below. The Arduino Nano 33 IoT is connected via a USB cable directly to the battery. This image shows clearly how the connections have been made, but they have not been made exactly like this. To build the prototype a prototyping board has been used and the connections have been made with tin solder. Due to space problems in the prototype, the components had to be positioned in such a way that the cable lengths were as short as possible.

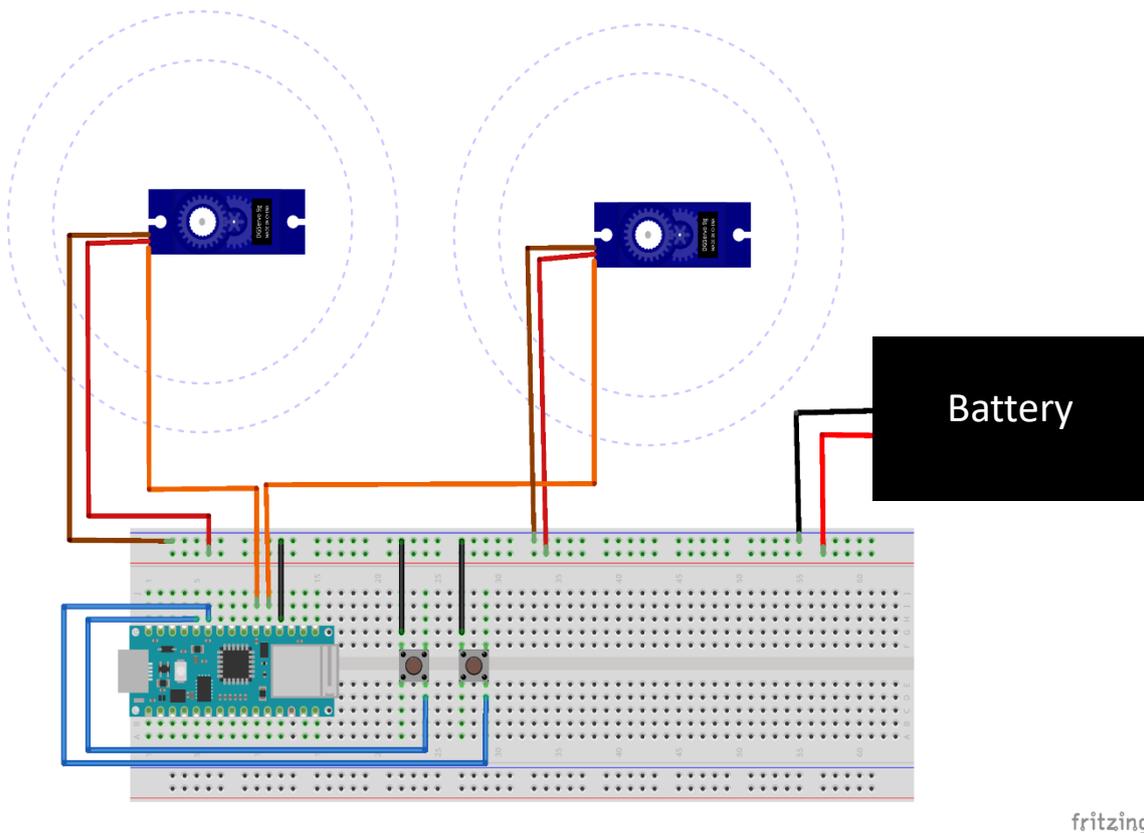


Figure 18: Circuit diagram.

The next step to improve the prototype would be to build a PCB to optimize the space and position of the components so that there are no space problems due to cables as has happened with the prototype that has been built. This one has not been built, but it has been designed.

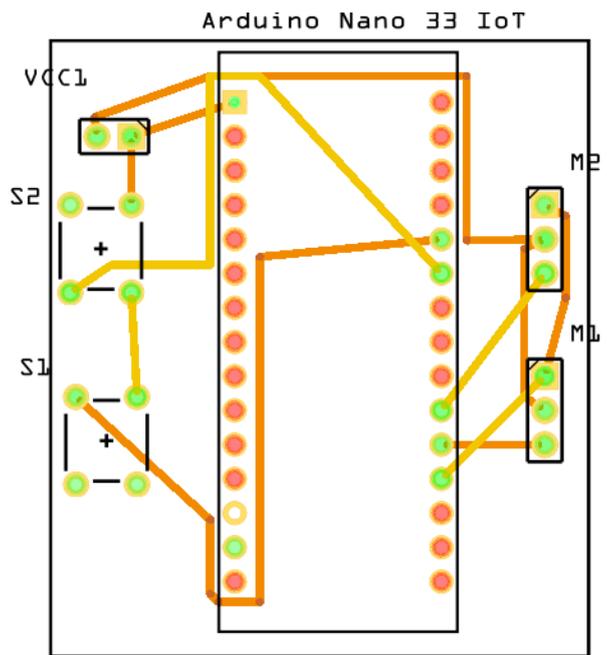


Figure 19: PCB.

### 4.3. Firmware

The circuit works as follows: there are two pushbuttons, one to dispense cigarettes and the other to unlock the pack for refilling. When the button is pressed to dispense the cigarette, the servomotor turns, and the cigarette comes out. The button must be pressed again to return the servomotor to its initial position and close the pack. When the pack is empty, which means that there are no cigarettes in it, the opening can be unlocked by pressing the other button, which turns the other servomotor, so that the pack can be refilled. Once the pack has been filled, the button must be pressed again to relock the opening.

The code that has been uploaded to the Arduino Nano 33 IoT is complete in the appendix and each part of it will be explained below:

- void setup\_wifi(): this function connects the Arduino to the Wi-Fi network that is declared in the variables.
- void reconnect(): this function is in charge of establishing the MQTT connection and reconnecting in case it is lost.
- void loop(): this function is in charge of receiving the pushbutton status information, sending the signal to the servos so that they change position when necessary, and sending all the information to the platform.

The code of the void loop() function is explained in more detail below.

```
if (!client.connected())
{
    reconnect();
}
client.loop();
```

In this part of the code, the MQTT connection is established.

```
if (count == months_quit*30/actualn*nnow){
    nnow--;
    count=0;
}
long now = millis();
if (now - last_cigarette < 16/nnow*3600000){
    unlocked = false;
}else{
    unlocked = true;
```

```
}
```

This part of the code controls the time between each cigarette.

```
buttonState_dispense = digitalRead(buttonPIN_dispense);
if ((buttonState_dispense == HIGH)&&(old_buttonState_dispense ==
LOW)&&(unlocked == true)){
    pos_dispense=150-pos_dispense;
    if(pos_dispense == 0){
        for (pos = 150; pos >= pos_dispense; pos -= 1){
            servoMotordispense.write(pos);
            delay(5);
        }
    }else{
        for (pos = 0; pos <= pos_dispense; pos += 1){
            servoMotordispense.write(pos);
            delay(5);
        }
    }
    if(pos_dispense == 150){
        if (number > 0){
            number--;
            count++;
            total_number++;
            last_cigarette = now;
            String cigarette_str = "\"cigarette\": ";
            json_string_cigarette = opening + cigarette_str + String(1) + closing;
            json_string_cigarette.toCharArray(json_char_cigarette, 200);
            client.publish(cigaretteTopic, json_char_cigarette);
            Serial.println("New property upadted:");
            Serial.println(json_string_cigarette);
            String cigarette = "\"cigarette\": ";
            String id = "\"ID\": cajetilla";
            json_string_data = opening + cigarette + String(1) + comma + id +
closing;
            json_string_data.toCharArray(json_char_data, 200);
            client.publish(dataTopic, json_char_data);
            Serial.println("New message sent:");
            Serial.println(json_string_data);
        }
    }
}
old_buttonState_dispense = buttonState_dispense;
```

This part is in charge of moving the servomotor in charge of dispensing the cigarettes when the button is pressed, and enough time has passed with respect to the previous cigarette. For loops have been used to control the speed of the servomotor because with the default speed it was moving too fast. When the servomotor returns to its initial position a message is sent to the platform indicating that a cigarette has been dispensed and the platform properties are updated. One is added to the property indicating the total

number of cigarettes and one is subtracted from the property indicating the number of cigarettes inside the pack.

```
if (number == 0){
  buttonState_load = digitalRead(buttonPIN_load);
  if ((buttonState_load == HIGH)&&(old_buttonState_load == LOW)){
    Serial.println(buttonState_load);
    pos_load=90-pos_load;
    servoMotorload.write(pos_load);
    if(pos_load == 90){
      number = 10;

      sprintf(json_char_load,
"{\r\n\t\"loaded\":{\r\n\t\t\"data\":{\r\n\t\t\t\t\"ncase\":
%d\r\n\t\t}\r\n\t}\r\n}", number);
      client.publish(loadTopic, json_char_load);
      Serial.println("New event sent:");
      Serial.println(json_char_load);
    }
  }
}
old_buttonState_load = buttonState_load;
```

This last part of the code is responsible for moving the servomotor in charge of unlocking the pack so that it can be refilled when it is empty, and the button is pressed. When the servomotor returns to its initial position, an event is sent to the platform indicating that it has been refilled.

#### **4.4. IoT platform algorithms**

The device connects via Wi-Fi to the Altair SmartWorks platform. It is a platform oriented to the development of IoT applications using the minimum possible code, i.e., it orients the developer to spend his time creating value for his product and not spending that time on programming common to all devices with these characteristics and that does not add any value to his product.

The communication is going to be done using the MQTT protocol. This is one of the most widely used protocols in IoT devices due to its lightness and simplicity. It is a client-server message transport protocol based on publications and subscriptions to the so-called topics. The device that publishes the messages and the one that receives them do not contact each other directly, the connection is carried out by a third component called a broker. The device that sends the information publishes it in a topic and the different devices that are subscribed to that topic receive the information. The information is sent in JSON format, which is a simple and standard text format used to exchange data. The different topics are ordered hierarchically. Within the topic, the name of the space, the name of the collection, and the identifier of the thing are included first, in that order. Then, there are four different sections, on the one hand, there is the data that is sent from the device and that accumulates and records the date and time it arrives. On the other hand, there are the properties where you can see the current status of the device. Also, there are the actions that are executed when something happens and with them, you can modify properties, send changes to the device, or set a time to perform some activity. Finally, there are the events that monitor the changes in the properties.

##### Properties

In this section it will be explained all the properties that have been created:

- Money: indicates how much money the user has spent on cigarettes since using the smart pack.
- Number of cigarettes in the case: indicates the number of cigarettes currently inside the case.
- Total number of cigarettes smoked: indicates the total number of cigarettes the user has smoked since he/she started using the smart box.
- Owner: displays the name of the owner of the pack.

- Unlocked: indicates whether or not the pack is unlocked to be able to dispense a cigarette.

### Events

This section explains all the events that have been created:

- Cigarette consumption: an event is created each time a cigarette is dispensed.
- Loaded: an event is created each time the pack is refilled. In addition, the event receives information on the number of cigarettes that have been inserted into the pack.

### Actions

This section explains all the actions that have been created:

- Dispense: this action sends a message to the pack to remove a cigarette from the pack.
- Load: this action sends a message to the pack to allow the pack to be refilled when it is empty.

Within the platform, it is also possible to create functions. These functions are used to reduce the amount of code in the device. The functions are separated into workers and triggers. The workers have the function code and the triggers act as a listener of the properties so that every time a property is modified the function is executed.

### Functions

This section will explain all the functions that have been used:

- Properties-update: this function is executed every time a cigarette is taken out of the pack. This function updates money spent by adding €0.25 for each cigarette, updates the total number of cigarettes smoked by adding one each time a cigarette is taken out of the pack, and updates the number of cigarettes inside the pack by subtracting one each time a cigarette is taken out of the pack.

## 5. Market research

Currently, the most widespread smoking cessation products are nicotine replacement products and medications. Nicotine replacement products include nicotine patches, nicotine gum, nicotine lozenges, nicotine inhalers, and nicotine nasal sprays. The treatment followed with nicotine patches consists of sticking a nicotine patch on the skin all day long and even during the night if the patch is of longer duration. The patch constantly delivers nicotine to mitigate withdrawal symptoms. The treatment followed with nicotine gum is different, it is a fast-acting treatment for when a craving arises, or withdrawal symptoms appear. Nicotine gum can be used following a program of progressive reduction of the number of cigarettes smoked per day. Nicotine lozenges, nicotine inhalers, and nasal sprays follow a similar treatment, starting at the beginning of treatment with the highest dose to reduce withdrawal symptoms and progressively reducing the dose over time. As can be seen, the only nicotine replacement treatment with which the possibility of progressively reducing the number of cigarettes smoked per day can be considered is nicotine gum, with the rest of the treatments the consumption of cigarettes is drastically suppressed.

As for smoking cessation medications, the most used are varenicline and bupropion. Varenicline is a pill that helps to reduce withdrawal symptoms like all the above-mentioned products, but in this case, it does not use nicotine. They can be used following three different strategies. The first one is when you want to quit smoking drastically, the treatment consists of starting to take varenicline one week before the established quit date. The second strategy would be to increase the period in which you start taking varenicline before quitting smoking to a maximum of about 30 days. Lastly, there would be the strategy of smoking cessation progressively over a 12-week course of treatment. Bupropion is an antidepressant medication that has the same objective as all the previous products, which is to reduce withdrawal symptoms and the desire to smoke.

In addition to these products, attempts have also been made to launch products that help you to progressively reduce cigarette consumption by setting challenges and providing information that allows you to track your progress.

On the one hand, there is FitSmoke, which is currently not on the market because it has not achieved sufficient funding in a crowdfunding campaign. Despite this, it is interesting to be able to analyze the reasons why the project has not been successful to take them into account when developing this project. First, it is going to be analyze what is offered by this pack created by the company Revool Srl. It is a smart cigarette pack whose operation is based on blocking access to the user to help him quit smoking. Through the application, also created by the company, the user specifies the number of cigarettes he smokes per day before starting to use the pack and what is the objective he has: to quit smoking, reduce consumption or simply control consumption. From this, the application calculates how much time must pass between the consumption of each cigarette to achieve the goal. The times you set are constant, they do not change throughout the day. Also, you can press an emergency button in the application to be able to have a cigarette when the time that has to be closed has not yet been fulfilled. One of the possible reasons that may have led to the failure of the project in the first place is an unattractive product that may confuse the potential consumer and not see a clear difference from a traditional cigarette pack. The price of this pack is €80, so if the consumer does not see a clear difference with the pack containing cigarettes when he buys it, he will not choose to buy it. On the other hand, it may also be the lack of adaptation to the customer as it offers constant times between each cigarette that can make it very difficult for the user to meet the objectives. The development of the day can lead to having quiet moments of the day, such as at the beginning or end of the day, and more stressful moments, such as when you are at work. Tobacco consumption is often associated with stressful situations, so it would be best to let the user consume more cigarettes at the most stressful times of the day and, conversely, reduce consumption at less stressful times. In short, adapting cigarette consumption to the user's schedule and life facilitates the achievement of the objectives. Another problem with this product may be that the pack is transparent and therefore the user can see the cigarettes inside, which may make the user feel the need to smoke or increase the desire to smoke. If the pack were not transparent, there would be no possibility of the temptation to smoke.



Figure 20: FitSmoke [10].

On the other hand, there is the company Nicotrax, which has developed a smart cigarette pack, but it is not on the market either. It also conducted a crowdfunding campaign that did not get the necessary financial support. This pack does not limit your access, its function is to collect all the information when a cigarette is taken out of the pack. This information is the location, the time, and the people you are with while smoking. With all this information Nicotrax helps you set goals and track your progress. One of the possible reasons that have led to this product not being so attractive is that the only difference with a normal cigarette pack is that it collects a lot of information, which is very important for the user to be able to motivate him to meet the goals, but sometimes this is not enough. The vast majority of smokers know approximately how many cigarettes they consume because they have to go and buy them, so the only advantage offered by this pack is to set more specific goals. For the user, knowing the exact number of cigarettes he smokes does not offer any motivation; what motivates him is knowing the number of cigarettes he has smoked less compared to the previous period, whether it be days or weeks. The great disadvantage of this model is that if the user is tempted to want to smoke, there is nothing to stop him, only his willpower can stop him, which sometimes is not enough. Willpower must be built through motivation and is what will help the user to quit smoking, but the process is very complex because many effects arise when you start to reduce smoking that are often uncontrollable. In most cases what prevents smokers from quitting smoking is the lack of willpower, so in this type of product, they are looking for more than just motivation. The positive points are that besides following your progress

and being able to set goals, there is a community with which you can motivate yourself by observing the progress of other people in the same situation. This product has a price of €74.

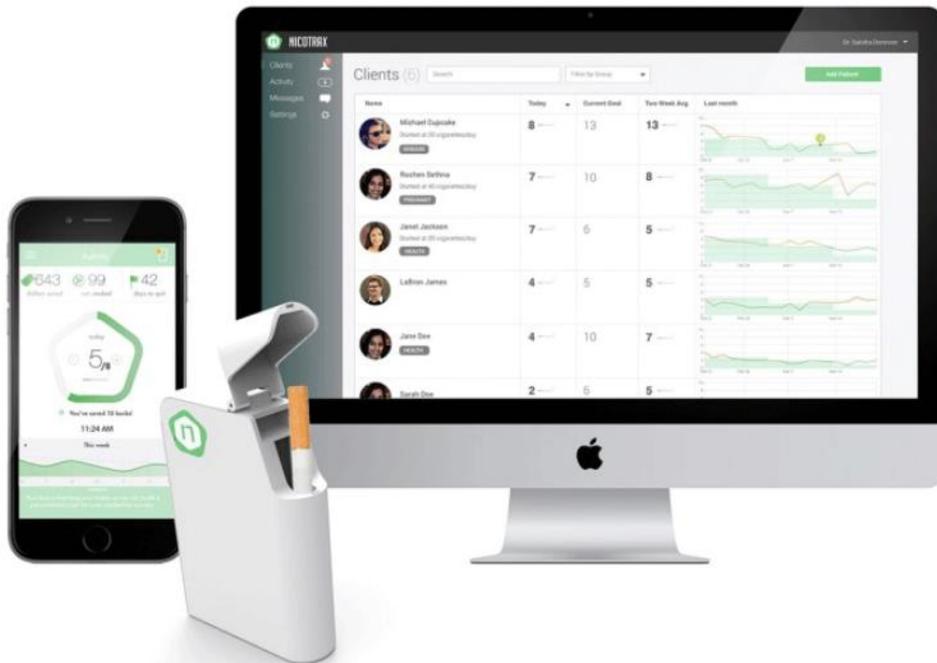


Figure 21: Nicotrax [11].

## **6. Business model**

The first step is to choose the business model to know who is targeted and who is going to buy the product. Buyers are the key to the business since they are the main sources of business income and therefore the key to the success or failure of the business. There are two types of business models: B2B or B2C.

### **6.1. B2B**

The B2B business model, which stands for "business to business", is a model based on the sale of the product to other companies.

One of the advantages of this business model is the aggregation of demand. It is not sold directly to the final consumer, there is an intermediate company. It is this company that aggregates the demand, as it would place large orders to have enough inventory to accommodate the demand. Demand aggregation makes demand easier to predict as it is less volatile. This also reduces inventory costs, since it is not necessary to have a lot of inventory reserved for possible changes in demand since these changes would not be very large. From this advantage derive other advantages such as cost reduction. By receiving large orders, the transportation costs per unit would be lower, since they would be transported in large quantities. Also, production costs per unit could be reduced thanks to economies of scale.

On the other hand, one of the disadvantages is that margins are lower. Selling in large quantities makes the selling price lower. The buying company demands in exchange for buying those large quantities, which means a higher risk for them, and reduces the risk of the selling company. This risk has to do with the aggregate demand mentioned above.

In this case, it could be sold to companies that help smokers to quit smoking. But the products that currently exist for smoking cessation are all medical products, such as nicotine treatments, obtained from pharmacies. The other option is to assist in the follow-up of patients who are trying to quit smoking.

## **6.2. B2C**

The B2C business model, which stands for "business to customer", is a model based on direct sales to the end consumer.

One of the disadvantages of this model is that the investment required is higher. It is higher because the product has to reach the final consumer but also at a marketing level. After all, it is necessary to capture the attention of a larger number of customers. Also, the investment is greater since it is necessary to create points of sale where the consumer can purchase the product, these can be both online and in establishments where the product can be purchased in person. Concerning the previous model, demand is more volatile and less predictable, therefore, inventory costs are higher since it is necessary to be more prepared for changes in demand. Also, transportation costs per unit are higher since, as mentioned above, the product has to reach the final consumer, therefore, it has to reach more customers located in different places.

On the other hand, unlike the previous model, margins are higher since there is no intermediary to reduce the risk associated with the uncertainty of demand. A higher price is necessary to reduce the risk and cover the costs incurred in bringing the product to the final consumer.

## **6.3. Conclusion of the business model**

With the characteristics mentioned above, the best option is a B2C model, because although it is the riskiest option and requires the highest investment, it is the one you can obtain the highest profit. In addition, with the B2B option, there is no type of company to which owning the smart pack provides a clear benefit and therefore it would be difficult to attract customers.

The B2C option allows the end consumer, in addition to using it as the only method to quit smoking, to combine it with other methods. Therefore, it offers a very wide range of options and allows you to use the product whenever you want to quit smoking and whichever method you use.

## 6.4. Lean Canvas

Lean Canvas is a tool specially oriented to entrepreneurs focused on defining a strategy. This tool is designed to help design and conceptualize the business model for innovation-oriented projects, i.e., with novel ideas that want to introduce in the market because its characteristics have great uncertainty. This project has these characteristics so this tool is ideal because there is no similar product on the market and will be used in the most important features. It allows focusing on both the product to be launched and the market, both essential for the product to be successful and related to each other.

As mentioned above, this tool is divided into two parts. The part on the left is product-oriented and the part on the right is market-oriented. Each part contains several blocks which are:

- Customer segments: this block defines the target customers at whom the product is aimed. It also includes the early adopters' section, which defines the users who have the problem that the product is trying to solve and are looking for a solution.
- Problem: this block defines the problem that the customer is experiencing and that the product is intended to solve.
- Unique value proposition: this is a simple, clear, and straightforward statement that defines what makes the product different from the rest that exist and what will make customers pay for it.
- Solution: this block defines the most important features that will solve the customer's problems.
- Channel: this block defines how the consumer will get to know the product and how the product will reach him.
- Revenues stream: in this block, you define how the money will be paid in.
- Cost structure: this block defines the approximate costs to be incurred.
- Key metrics: in this block, a reduced set of key indicators will be defined to enable strategic decisions to be made.
- Unfair advantage: this block will generally be easier to define over time. In many cases, until the product is not on the market, it is not easy to specify what the advantage over competitors is that makes you different from them and that is difficult to copy.

<p><b>PROBLEM</b></p> <p>Not having enough willpower to quit smoking.          Not having concrete goals which can affect motivation.          Not having a follow-up which can cause you to go off plan.</p>	<p><b>SOLUTION</b></p> <p>Control the desire to smoke.          Motivate yourself by setting goals.          Track your progress.</p>	<p><b>UNIQUE VALUE PROPOSITION</b></p> <p>Smoke when the device lets you and not when you want, without being tempted to smoke because you can neither see nor take out the cigarettes.</p>	<p><b>UNFAIR ADVANTAGE</b></p> <p>There is currently no similar product on the market, a smoking cessation plan customized to each customer's smoking habits.</p>	<p><b>CUSTOMER SEGMENTS</b></p> <p>Smokers who want to quit smoking.          This is a group of people who are continually looking for new methods to quit smoking because they have already tried or are trying with others.          The success rate of the products is at most 30% so the chances of failing in the attempt are high and they will look for new ways.</p>
	<p><b>KEY METRICS</b></p> <p>Website traffic          Increase of new customers          Number of downloads of the app downloads</p>		<p><b>CHANNELS</b></p> <p>Through a web page and direct shipment to the consumer</p>	
<p><b>COST STRUCTURE</b></p> <p>Production costs          Distribution costs          Employee salaries          Rent          Marketing expenses for product positioning          Web and app design and maintenance expenses          Cost of raw materials          Taxes.</p>			<p><b>REVENUE STREAM(S)</b></p> <p>Sale of the product in the online store</p>	

## 6.5. 4 P's

The 4 Ps are the components of the marketing mix. The term marketing mix was introduced in 1953 by Neil Borden and in 1964 Jerome McCarthy defined the 4 Ps. The marketing mix is the combination of the 4 P's that the company chooses as the most appropriate to achieve its objectives [12].

### Product

The product is the good offered to consumers to meet a specific need [12].

The product to be sold is a smart cigarette case that is connected to an app. This product aims to help people who smoke quit progressively so that the effects of abstinence are gradually reduced until they quit for life.

The product has the following characteristics:

- It doses cigarettes one by one with the push of a button, either a physical one that exists on the pack or one on the app.
- Prevents access to the cigarettes inside, unlocking only when there are no cigarettes left inside.
- Sends all information to the app.
- Cigarettes inside cannot be seen.
- Controls the time between each cigarette to gradually reduce consumption with a personalized plan for each person.

What makes this product more attractive compared to other similar products is that it allows greater interaction, that to dose the cigarette you have to press a button and when you press it the cigarette comes out.

The other important feature is that you cannot see the cigarettes inside to reduce the user's temptation to smoke. One of the biggest problems when it comes to quitting smoking is to have enough willpower to do it, so you have to reduce as much as possible the temptations that the user may have to skip the plan to quit smoking.

## Price

Price is the effort consumers are willing to make to buy the product [12].

To set an appropriate price for the product will be first examined the prices of the different smoking cessation treatments available to understand how much consumers are willing to pay to quit smoking.

Starting with nicotine patches and taking an example such as the Nicorette Clear patches which are used every 16 hours. A box of these patches contains 14 patches and has a retail price of €60. The technical data sheet issued by the Spanish Agency for Medicines and Medical Devices indicates that the treatment is 12 weeks. Therefore, the treatment has the following price:

$$\text{Number of patches spent} = \frac{12 \text{ weeks} * 7 \text{ days} * 24 \text{ h}}{16 \text{ h}} = 126 \text{ patches}$$

$$\text{Total money spent} = \frac{126 \text{ patches}}{14 \text{ patches}} * 60 \text{ €} = 540 \text{ €}$$

$$\text{Total time spent} = 12 \text{ weeks} * 7 \text{ days} = 84 \text{ days}$$

$$\text{Treatment cost per day} = \frac{540 \text{ €}}{84 \text{ day}} = 6,4 \text{ €/day}$$

On the other hand, there is nicotine gum. Nicorette nicotine gum will be used as a reference. The average number of cigarettes smoked in Spain is around 10 cigarettes per day, so this number will be used as the basis for the treatment. The brand indicates that for less than 20 cigarettes, which would be the case under analysis, 2 mg chewing gum should be used. During the first 6 weeks, you would have to combine 5 cigarettes with 5 nicotine gums, which means that the average of the 6 weeks would be to smoke 7.5 cigarettes and 2.5 nicotine gums per day. The price of a box of 30 of the above-mentioned gums is €14.10, which means a price of €0.47 for each gum.

$$\begin{aligned} \text{Money spent in the first 6 weeks} &= 0.47 \text{ €} * 2.5 \text{ gums} * 7 \text{ days} * 6 \text{ weeks} \\ &= 49.35 \text{ €} \end{aligned}$$

The treatment would continue with the progressive reduction of cigarettes and the progressive increase of chewing gum until reaching 10 chewing gums per day and no cigarettes after 4 months from the beginning of the treatment. This means that for 10 weeks the average number of chewing gums is 7.5 per day.

*Money spent in the following 10 weeks*

$$= 0.47 \text{ €} * 7.5 \text{ gums} * 7 \text{ days} * 10 \text{ weeks} = 246.75 \text{ €}$$

The last step of the treatment would be to reduce 1 nicotine gum every 5 days. Therefore, to reduce 10 gums would take 50 days. During these 50 days, the average number of cigarettes consumed is 5 gum per day.

$$\begin{aligned} \text{Money spent in the last step of the treatment} &= 0.47 \text{ €} * 5 \text{ gums} * 50 \text{ days} \\ &= 117.5 \text{ €} \end{aligned}$$

$$\text{Total money spent} = 49.35 + 246.75 + 117.5 = 413.6 \text{ €}$$

$$\text{Total time spent} = 16 \text{ weeks} * 7 \text{ days} + 50 \text{ days} = 162 \text{ days}$$

$$\text{Cost of the treatment per day} = \frac{413.6 \text{ €}}{162 \text{ días}} = 2.5 \text{ €/day}$$

These two treatments have been given as examples because they are the easiest to quantify the total cost, since when other treatments are used, such as asking for help from a psychologist, it is more difficult to quantify the total amount of money that can be spent on the treatment.

The treatment with nicotine gum is the one that can be most similar to the method used with the smart pack since it progressively reduces tobacco consumption. It could be combined with this treatment to increase its effectiveness and have greater control of progress. Therefore, to increase the number of potential consumers, it is interesting to establish a price that can be combined with treatments like this one.

On the other hand, there are similar products like the FitSmoke and Nicotrax packs that had a selling price of about €80 and did not get the necessary funding.

Therefore, a suitable price would be €60 for the smart pack. With this price, it can be used with the treatment of for example nicotine gum and still be cheaper than the treatment of

nicotine patches. In return, the treatment is longer. Also, a lower price than FitSmoke and Nicotrax packs may attract more consumers as it includes features that may make it more attractive.

### Place

The place is the method used by the company for the product to reach the consumer, this can be before buying the product so that the consumer buys it or after buying it so that the product, he has bought reaches him/her.

During the early stages of the product life cycle, timing and product availability are very important. During these stages demand is uncertain, and procurement is unpredictable. With this in mind, it is important to have high inventory levels. This is not a great expense since the dimensions of the product are reduced, which facilitates its storage and allows to have a great number of products in little space. This will allow having a single warehouse in the early stages of the product life cycle located in Madrid. The reasons for choosing Madrid are because it is the Spanish province with the most smokers and because of its location within the Iberian Peninsula. From Madrid, the product can be shipped to all the Spanish areas of the Iberian Peninsula without great differences in time and cost.

The sales channel to be used will be online sales. The reasons for using this type of channel are first to reduce costs, which is especially necessary for the initial stages of product launch. On the other hand, greater visibility of the product compared to the sale in a physical store. It offers the possibility of reaching all parts of Spain with inventory only in Madrid and facilitates international expansion.

Shipments will be made through specialized companies. The reduced dimensions of the product allow obtaining a low cost per shipment that facilitates the control of the costs to obtain the desired selling price.

## Promotion

Promotion is all the information about the product that the company conveys to the consumer [12].

Since it is an innovative product related to technology, and to use the product it is necessary to use the app, it would be more appropriate to carry out online marketing campaigns. The advantages of advertising campaigns are that they can be customized for each user according to their tastes. This makes it possible to reach the target audience more precisely with the least possible resources. In addition, as it is possible to combine it with other medications, it would also be possible to place ads in pharmacies, since these are the places where smoking cessation medications are sold.

## 6.6. Market sizing

The first step in launching a product on the market is to know the target audience for the product to be launched. The target market is the set of individuals with specific characteristics to which the product is directed. Knowing these characteristics makes it possible to quantify the potential customers that the product would have and from this point to establish hypotheses of how many individuals would purchase the product.

To quantify the target market, the Spanish smoking population will be analyzed. Not the entire smoking population is the target audience for this product; it will be primarily those who want to or are trying to quit smoking.

Spain has a population of approximately 47 million inhabitants, of which approximately 40 million are over 15 years of age. Of these, 19.8% are daily smokers, which means that in Spain there are around 7.9 million smokers who smoke daily 2.3% are occasional smokers, which means that there are around 900,000 occasional smokers.

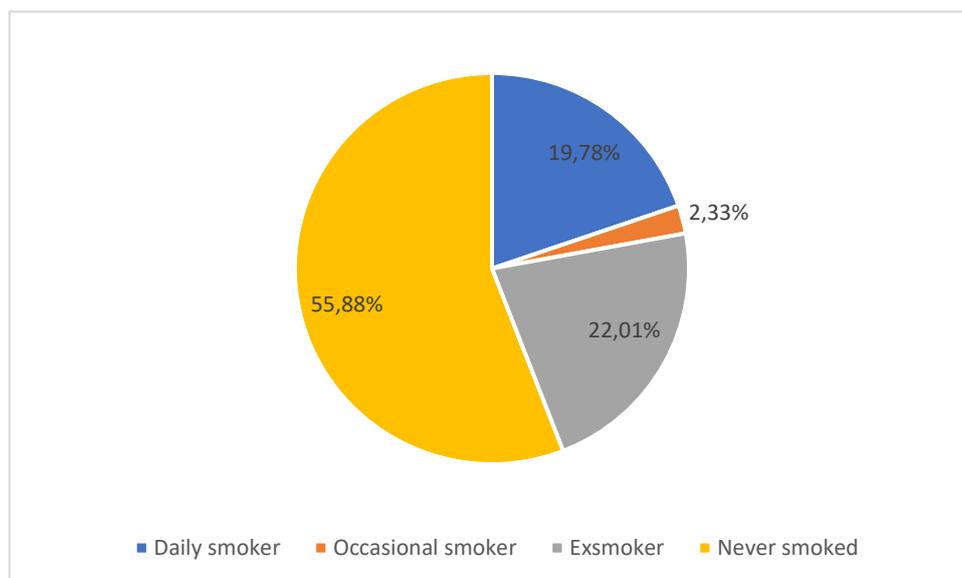


Figure 22: Tobacco consumption in Spain (percentages) [13].

Focusing on the resources used by smokers to quit smoking, the following table summarizes these data:

	16-24 years old	25-34 years old	35-44 years old	45-54 years old	55 years or older	Total
Alone, without help	96.8	92.1	82.0	78.7	73.7	83.9
With the help of health professionals from the health center	0.6	4.9	8.8	11.7	16.7	8.9
With the help of the pharmacist	0.6	0.1	2.2	1.4	0.8	1.4
Drugs	0.6	3.9	10.2	15.3	15.1	9.6
With the help of a psychologist	2.5	0.7	1.0	1.4	2.8	1.4
Webs or apps	0.6	3.7	6.0	2.5	2.4	3.6

*Tabla 1: Resources used to quit smoking, total and by age group (percentages). Spain, 2020 [1].*

It is observed that the age range in which they least ask for or seek help to quit smoking is 16 to 24 years of age. This group of smokers would not be the main target of the smart pack as most of them are smokers who have just started smoking and do not plan to quit. In addition, this is the smallest group of smokers as shown in the table below, which shows the number of daily and occasional smokers by age group in thousands of people:

	Daily smoker	Occasional smoker
TOTAL	7,892.9	929.5
From 15 to 24 years old	718.7	165.7
From 25 to 34 years old	1,386.6	179.9
From 35 to 44 years old	1,743.7	194.9
From 45 to 54 years old	1,875.7	184.7
From 55 to 64 years old	1,474.9	121.9
From 65 to 74 years old	508.0	51.3
From 75 to 84 years old	166.3	24.4
85 and over	19.0	6.7

*Table 1: Tobacco consumption by age group in thousands of people in Spain in 2020 [14].*

It is observed that the groups between 25 and 64 years are distributed similarly, and this will be the target audience of the smart pack of tobacco. These age groups meet the age

characteristics to be opened to try a product as innovative as the one proposed in this project and are very numerous groups in which it is more likely that more people want to quit smoking. Smokers over 65 years of age are discarded, since it is a novel product that requires the use of new technologies, and it is less likely that they will be willing to use it. In the first few years, it will be adopted mainly by the younger public, but if the product works it will be adopted by older people. The success rate of the various forms of smoking cessation is never more than 30% with the different products and medications and quitting smoking without assistance the success rate drops to less than 10%. The low success rates mean that smokers who want to quit have to try several times before quitting and try different methods. If a product is successful and helps to increase these success rates many people will likely want to try it. The total number of daily smokers between 25 and 64 years of age is 6,480,900 people and the number of occasional smokers in the same age range is 681,400 people. Therefore, smokers between these ages total 7,162,300 people.

To analyze the number of smokers who are willing to quit smoking each year, the following graph is shown:

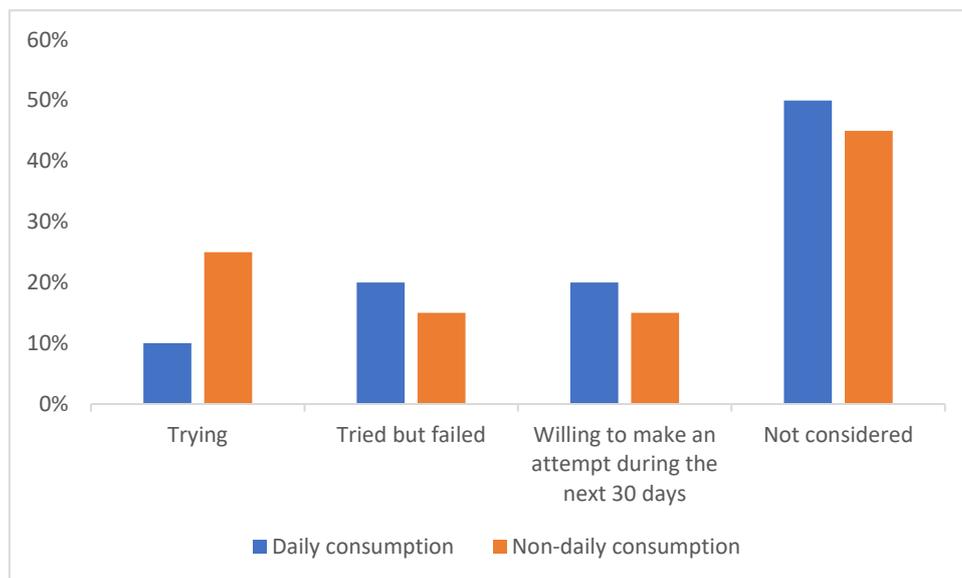


Figure 23: Attitude towards smoking cessation during confinement, according to consumption pattern (daily or non-daily) (percentages). Spain, 2020 [1].

From the above graph, it can be concluded that of the total number of daily smokers approximately:

- 10% are trying to quit smoking.

- 20% have tried but have not succeeded.
- Another 20% would be willing to attempt during the next 30 days.

As for occasional smokers, it can be concluded that of the total of these approximately:

- 25% are trying to quit smoking.
- About 15% have tried but have not succeeded.
- Another 15% would be willing to attempt during the next 30 days.

In summary, 50% of daily smokers and 55% of occasional smokers make up the product's target audience. This means that a total of 3,240,450 daily smokers and 374,770 occasional smokers try to quit smoking over a year. The group of people who have tried less than a year ago has been included, as it is included in the group of smokers who try to quit smoking within a year. Also, likely, the reasons that led them to try are still present and if they find a method such as the smart pack that is attractive to them, they may try again. Therefore, it can be concluded that a total of 3,615,220 smokers try to quit smoking over a year.

According to the data shown in the table on the different ways smokers use to quit smoking, in the 25-64 age bracket approximately 20% resort to different ways to quit smoking. This means that approximately 723,044 people between 25 and 64 years of age seek help to quit smoking over a year. All smokers who are trying to quit smoking are taken into account, as the smart pack can be used as the only method to try to quit smoking; combined with other methods that require a progressive reduction, such as varenicline or nicotine gum; or even the different professionals to whom smokers turn to follow up their patients so that they can have better control of the data.

To make the target public more specific, only smokers who smoke cigarettes will be taken into account, as they are the only ones who will be able to use the product. Bearing in mind that approximately 70% of smokers consume cigarettes, the target public is made up of a total of approximately 500,000 people.

## **6.7. Sales forecast**

In this section, a forecast of sales over the next 5 years will be made. Two scenarios will be presented, one optimistic and the other pessimistic, to see what sales would be like if the product is successful and if the product is unsuccessful. To do this, the data of the number of Spanish smokers who smoke cigarettes and who want to quit smoking between 25 and 64 years of age analyzed above is used, as well as the number of sales of similar products.

### Optimistic scenario

This scenario establishes that the product is successful and that most of the customers who buy it are satisfied with the result. In addition to the investment that can be made in marketing to increase sales, an important part of the long-term success of the product is that customers are satisfied with it. If customers are satisfied with the product, they act as prescribers of the product and increase sales without having to increase the marketing investment. It has been estimated sales of 1000 units in the first year, taking into account the sales of similar products previously analyzed in the market research, the price established in comparison to the other options available on the market for smoking cessation and the investment to be made in marketing.

To establish the sales in each of the five years, the growth rates in each year are based on the research conducted by Rogers on the adoption of a disruptive idea, since not all people accept these ideas, even if they have obvious benefits [15]. The first users of the product would be young people with enough purchasing power to risk buying the product, even if there is a chance that it might not work for them. According to the data presented above, this segment could be between 25 and 44 years old. In addition, this segment of smokers is the one that most uses websites or apps to quit smoking, therefore, they are easily accessible. From the adoption of the product in this segment, it would be extended to the rest of the segments and the use of the product would increase to combine it with drugs or in case a professional is asked for help, he can follow the progress of his patient. Such high growth rates are established because this is a sector where smokers are in some cases desperately looking for a formula to quit smoking for life.

According to this theory, the following sales figures have been established:

Optimistic scenario	2022	2023	2024	2025	2026
Growth		100%	100%	70%	50%
Units sold	1000	2000	4000	6800	10200

*Table 2: Units sold in the optimistic scenario.*

### Pessimistic scenario

In the pessimistic scenario, it is hypothesized that the product will not be effective for customers and will produce the opposite effect to that produced in the optimistic scenario. If customers are not satisfied with the product and despite the marketing efforts, these have a negative influence on the opinion of potential customers and the latter do not buy the product. Sales growth has been established for the first three years because marketing investment is high and the number of units sold is not very high, which means that few people can influence the behavior of potential consumers.

The sales figures for this scenario are:

Pessimistic scenario	2022	2023	2024	2025	2026
Growth		100%	75%	-14%	-17%
Units sold	1000	2000	3500	3000	2500

*Table 3: Units sold in the pessimistic scenario.*

## 6.8. Cost analysis

In this section, all the costs necessary to produce the product and get it to the consumer are going to be analyzed. The costs of the materials and processes needed to produce the product, the shipping costs to get the product to the consumer, the salaries of the employees, the costs of the facilities needed to perform all the activities necessary to sell the product, and the costs of the website and the app needed for the user to use the product are going to be analyzed.

### Cost of materials and processes

First, the costs of the materials and processes required to produce the product will be analyzed. It can be divided into two parts: the electronics and the case. In the electronics part, the basis of everything is the PCB, which has an approximate cost of €0.5 per unit, this price must include all the electronic components. The cost of the microcontroller is approximately €1 per unit. The cost of the servomotors is €1.5 per unit and taking into account that each pack has two, the cost per product is €3. Also, a Bluetooth module is needed to allow the tobacco pack to send and receive all the necessary data for its correct operation, which costs €4.5 per unit. In addition, the cost of the rest of the components must be included such as resistors, LEDs, and pushbuttons that make a total of €1.3 per unit. The cost of assembling the components to the PCB must be included, which represents an expense of €1 per unit. Therefore, the cost of the electronics per unit sold would be €11.3. On the other hand, the manufacturing of the box has been estimated to cost €4. These two activities would be carried out by two external companies. It was decided to subcontract both the PCB manufacturing process and the assembly of all the components to it and the manufacture of the box because it requires very specialized machinery for both. This very specialized machinery requires a large investment that is not considered necessary, although it is important to carry out demanding quality tests on both products to ensure that they meet the minimum requirements because between them they make up the final product that will be sent to the customer. All costs have been estimated taking into account that the activities that are subcontracted are carried out by external Spanish companies. It is important that the companies that carry out these activities in Spain because this will allow a quick response to changes in demand. Since

this is a new product, estimates may have high errors due to the lack of historical data and demand will be highly volatile, especially in the first few years.

The table below shows a summary of the costs of the materials and processes required to produce the smart pack:

<b>MATERIALS AND PROCESSES</b>	
Microcontroller	€1.00
Resistors (5 units)	€0.50
Servomotors (2 units)	€3.00
Buttons (2 units)	€0.20
LEDs (3 units)	€0.60
Bluetooth module	€4.5
PCB	€0.50
PCB assembly	€1.00
Case fabrication	€4.00
<b>Total</b>	<b>€15.30</b>

*Table 4: Cost of materials and processes.*

### Distribution

Regarding distribution costs, for all purchases made through the website, shipping costs are estimated at €1 per unit. This price has been estimated taking into account the weight and dimensions of the product.

In the optimistic scenario the costs are as follows:

Year	2022	2023	2024	2025	2026
Distribution costs	€1,000	€2,000	€4,000	€6,800	€10,200

*Table 5: Distribution costs in the optimistic scenario.*

And in the pessimistic scenario the costs are:

Year	2022	2023	2024	2025	2026
Distribution costs	€1,000	€2,000	€3,500	€3,000	€2,500

*Table 6: Distribution costs in the pessimistic scenario.*

### Marketing

About marketing costs, it is necessary to make a large investment to publicize the product and all its benefits. The consumer must understand for whom the product is intended and

the different uses that can be given by combining it with different treatments or using it as the main treatment. Aggressive marketing is going to be carried out, therefore a large investment is required each year, which will remain constant for the first 5 years and will amount to €50,000 per year.

Therefore, the summary of these costs is the same for both scenarios and is as shown below:

Year	2022	2023	2024	2025	2026
Marketing costs	€50,000	€50,000	€50,000	€50,000	€50,000

*Table 7: Marketing costs.*

### Staff costs

As for personnel costs, these include both the gross salary paid to the worker and the cost of social security payable by the company. It is necessary to have an employee in charge of assembling all the components of the product and packaging it for sale, whose gross salary is fixed at €18,000, to this amount the cost of social security payable by the company must be added, which is approximately 31%.

In the following years, a 1% increase will be applied to the gross salary. The working hours required for the sales levels established for the next 5 years in the optimistic scenario are shown below:

Year	Hours
2022	83.3
2023	166.7
2024	333.3
2025	566.7
2026	850.0

*Table 8: Hours worked per year to assembly taking into account expected units sold in each year.*

The total hours worked over a year by a worker are around 1800 hours. It is estimated that the worker can take approximately 5 minutes to assemble all the components of the product and match it, therefore, taking into account the sales estimate, it is not necessary to hire another employee. The costs are the same in both years and are summarized in the following table:

Year	2022	2023	2024	2025	2026
Staff costs	€23,580	€23,815.80	€24,053.96	€24,294.50	€24,537.44

Table 9: Staff costs.

If necessary, a cost reduction could be sought by seeking bonuses by making permanent contracts to people whose hiring is incentivized. Below are all the cases in which incentives can be received:

Conditions		Bonus €/month	Bonus €/year	Duration	
<b>People with disability</b>  -Degree of disability ≥ 33% or or declared incapacitated permanent-	Cerebral Palsy Mental Illness people with disability Intellectual, physical or sensory disability ≥ 65%	Older than or equal to 45 years old	525.00	6,300	The entire contract
		Women under 45 years of age	495.83	5,950	
		Man under 45 years of age	425.00	5,100	
	Other people with disabilities	Older than or equal to 45 years old	475.00	5,700	The entire contract
		Women under 45 years of age	445.83	5,350	
		Man under 45 years of age	375.00	4,500	
Special Labor Relations of people with disabilities in Special Employment Centers		100% bonus on company contribution to S.S.		The entire contract	
<b>Permanently disabled readmitted</b>		50% reduction in corporate contribution C.C.		2 years	
<b>Family members hired by the self-employed worker</b>	Spouse, ascendants, descendants descendants and other relatives by consanguinity or affinity up to and including the second degree	100% bonus on company contribution to S.S.		12 months	
<b>Socially excluded</b>		50	600	4 years	
<b>Domestic violence victims</b>		70.83	850	4 years	
<b>Women victims of gender violence</b>		125	1,500		
<b>-Terrorism victims</b>		125	1,500	4 years	
<b>Human trafficking victims</b>		125	1,500	2 years	
<b>Long-term unemployed</b>	Unemployed registered at the Employment Office for 12 months in the last 18 months	Man	108.33	1,300	3 years
		Woman	125	1,500	

Table 10: Social Security incentives for initial indefinite-term contracts [16].

Given the characteristics of the jobs, a person with the disability shown in the table would not be able to perform the tasks required. This would be the best case to apply since it is the one that receives the highest bonuses. Looking at the rest of the cases, the most appropriate would be to hire a long-term unemployed woman if there were the possibility, which would mean an annual saving of €1,500 for 3 years. In addition to the bonuses that

come with hiring these people, it is also social work that the company can do and contribute to providing work to those people who have more difficulties finding it.

## Rent

After analyzing the need for premises for the development of the activity, the premises will be located in Madrid and, since it will not have retail sales, it will not be necessary for it to be located in a commercial area, which will mean a lower price. These premises would be used to store the products, to assemble and package them, and to carry out all the administration activities. This will involve an estimated monthly cost of €1,000, which means that the costs for the next 5 years are:

Year	2022	2023	2024	2025	2026
Rent costs	€12,000	€12,000	€12,000	€12,000	€12,000

Table 11: Rent costs.

The Community of Madrid offers the new entrepreneurs facilities of the Social Housing Agency with very advantageous conditions that would allow them to obtain a reduction of these costs. These conditions are a grace period of the first 6 months and discounts during the first 3 years. Below is a summary of this plan:

	Social Housing Agency's Local Plans for entrepreneurs
First 6 months	<b>GRACE PERIOD</b> at no cost to the holder
Between 7th and 12th month	<b>25%</b> of the rent paid
Between 13th and 24th month	<b>50%</b> of the rent paid
Between 25th and 36th month	<b>75%</b> of the rent paid
From 37th month	<b>100%</b> of the rent paid

Table 12: Summary of Social Housing Agency's Local Plans for entrepreneurs [17].

With this plan and taking into account the cost of €1,000 per month estimated above, if this plan is applied, during the first year the cost would be only €1,500, which represents a saving of €10,500; the second year the cost would be €6,000, which represents a saving of €6,000; and the third year the cost would be €9,000, which would represent a saving of €3,000. In total, the savings would be €19,500, 46% in the first 3 years.

### Cost of web and app

The website is a very important part of the business as it is where the consumer must be convinced to buy the product. All the efforts and expenses involved in online marketing can not affect if the consumer is not attracted to the website. The higher the cost of a website, the more hours are generally invested in its design, which is what is needed in this case. It will be outsourced to an external company. Therefore, the estimated cost of the web page is €2,000 and a monthly maintenance cost of €200 so that modifications can be made in the design and in case any problem occurs it can be solved quickly to avoid losing customers. Therefore, the cost of the website for the next 5 years is summarized as follows:

Year	2022	2023	2024	2025	2026
Cost	€4,400	€2,400	€2,400	€2,400	€2,400

*Table 13: Web costs.*

On the other hand, there is the app, which is essential to allow interaction with the product and for it to work properly. It will also be outsourced and will cost €1,000 with monthly maintenance of €100. The costs of the app over the next 5 years are summarized as follows:

Year	2022	2023	2024	2025	2026
Cost	€2,200	€1,200	€1,200	€1,200	€1,200

*Table 14: App costs.*

## 6.9. Estimated net income

Considering all the costs analyzed above and the sales estimates for the next 5 years in both the optimistic and pessimistic scenarios, the net income for each of the next 5 years will be calculated.

### Taxes

To calculate the net income, it is necessary to first calculate the taxes to be paid each year. According to article 29 of the corporate income tax law, the corporate income tax rate is 25% of the profit for the year. However, newly created entities that develop a new economic activity have a rebate of 10 percentage points during the first year that profits are obtained and the following year. That is to say, the taxation during these years would be 15%. In the years in which profits are not obtained, no taxes are paid and in the case that one-year losses are obtained, these will be compensated in the following years [18]. Taking all this into account, the taxes that would be paid each year in the optimistic scenario are:

Year	2022	2023	2023	2024	2025
Taxes	€0	€0	€5,197.54	€31,089.83	€88,900.64

*Table 15: Taxes in the optimistic scenario.*

And in the pessimistic scenario they are:

Year	2022	2023	2023	2024	2025
Taxes	€0	€0	€1,920.04	€6,180.83	€4,778.14

*Table 16: Taxes in the pessimistic scenario.*

Once all the revenues and expenses have been calculated, the net income is calculated in the optimistic scenario:

	2022	2023	2024	2025	2026
Revenue's growth		100%	100%	70%	50%
Units sold	1000	2000	4000	6800	10200
Revenues	60,000.00 €	120,000.00 €	240,000.00 €	408,000.00 €	612,000.00 €
Cost of goods sold	15,300.00 €	30,600.00 €	61,200.00 €	104,040.00 €	156,060.00 €
<b>Gross Profit</b>	<b>44,700.00 €</b>	<b>89,400.00 €</b>	<b>178,800.00 €</b>	<b>303,960.00 €</b>	<b>455,940.00 €</b>
Marketing	50,000.00 €	50,000.00 €	50,000.00 €	50,000.00 €	50,000.00 €
Web & app	6,600.00 €	3,600.00 €	3,600.00 €	3,600.00 €	3,600.00 €
Rent & distribution	13,000.00 €	14,000.00 €	16,000.00 €	18,800.00 €	22,200.00 €
Wages & salaries	23,580.00 €	23,815.80 €	24,053.96 €	24,294.50 €	24,537.44 €
<b>Total operating expenses</b>	<b>93,180.00 €</b>	<b>91,415.80 €</b>	<b>93,653.96 €</b>	<b>96,694.50 €</b>	<b>100,337.44 €</b>
<b>EBITDA</b>	<b>- 48,480.00 €</b>	<b>- 2,015.80 €</b>	<b>85,146.04 €</b>	<b>207,265.50 €</b>	<b>355,602.56 €</b>
Taxes	0 €	0 €	5,197.54 €	31,089.83 €	88,900.64 €
<b>Net income</b>	<b>- 48,480.00 €</b>	<b>- 2,015.80 €</b>	<b>79,948.51 €</b>	<b>176,175.68 €</b>	<b>266,701.92 €</b>

Table 17: Net income in the optimistic scenario.

And in the pessimistic scenario:

	2022	2023	2024	2025	2026
Revenue's growth		100%	75%	-14%	-17%
Units sold	1000	2000	3500	3000	2500
Revenues	60,000.00 €	120,000.00 €	210,000.00 €	180,000.00 €	150,000.00 €
Cost of goods sold	15,300.00 €	30,600.00 €	53,550.00 €	45,900.00 €	38,250.00 €
<b>Gross Profit</b>	<b>44,700.00 €</b>	<b>89,400.00 €</b>	<b>156,450.00 €</b>	<b>134,100.00 €</b>	<b>111,750.00 €</b>
Marketing	50,000.00 €	50,000.00 €	50,000.00 €	50,000.00 €	50,000.00 €
Web & app	6,600.00 €	3,600.00 €	3,600.00 €	3,600.00 €	3,600.00 €
Rent & distribution	13,000.00 €	14,000.00 €	15,500.00 €	15,000.00 €	14,500.00 €
Wages & salaries	23,580.00 €	23,815.80 €	24,053.96 €	24,294.50 €	24,537.44 €
<b>Total operating expenses</b>	<b>93,180.00 €</b>	<b>91,415.80 €</b>	<b>93,153.96 €</b>	<b>92,894.50 €</b>	<b>92,637.44 €</b>
<b>EBITDA</b>	<b>- 48,480.00 €</b>	<b>- 2,015.80 €</b>	<b>63,296.04 €</b>	<b>41,205.50 €</b>	<b>19,112.56 €</b>
Taxes	0 €	0 €	1,920.04 €	6,180.83 €	4,778.14 €
<b>Net income</b>	<b>- 48,480.00 €</b>	<b>- 2,015.80 €</b>	<b>61,376.01 €</b>	<b>35,024.68 €</b>	<b>14,334.42 €</b>

Table 18: Net income in the pessimistic scenario.

## 6.10. Net present value

The time horizon chosen has been the same as the estimates, as it is considered that 5 years is an adequate period to evaluate whether the product is successful. The same time horizon has been chosen as the previous estimates as it is considered that in 5 years a clear view of whether the product is successful can be obtained.

The discount rate chosen is 20%, taking into account that this is a new product. This generates uncertainty and there is high investment risk since competitors may emerge or the product may not have the expected acceptance among consumers, among other things.

The following formula will be used for the calculation:

$$NPV = \sum_{t=1}^n \frac{R_t}{(1+i)^t}$$

In this case,  $R_t$  is the net income,  $i$  is the discount rate and  $t$  indicates the year with  $t=1$  being the year 2022,  $t=2$  the year 2023, and so on. Taking all this into account, the NPV will be calculated for both the optimistic and pessimistic scenarios.

- Optimistic scenario: NPV = €196,609.42
- Pessimistic scenario: NPV = €16,370.10

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## 8. Annex

### 8.1. Arduino code

```
#include <Servo.h>
#include <WiFiNINA.h>
#include <PubSubClient.h>

#define servoPIN_dispense 3
#define buttonPIN_dispense 7
#define servoPIN_load 2
#define buttonPIN_load 8
#define max_number 10

const char* ssid = "****";
const char* password = "****";
const char* mqttServer = "****";
const char* mqttUsername = "****";
const char* mqttPassword = "****";

char subTopic[] =
"status/cajetilla/collections/cajetilla/things/01F808YSNANZFAACEYSWPJ0J6D/acti
ons/dispense/#";
char dataTopic[] =
"set/cajetilla/collections/cajetilla/things/01F808YSNANZFAACEYSWPJ0J6D/data";
char numberTopic[] =
"set/cajetilla/collections/cajetilla/things/01F808YSNANZFAACEYSWPJ0J6D/propert
ies/npack";
char totalTopic[] =
"set/cajetilla/collections/cajetilla/things/01F808YSNANZFAACEYSWPJ0J6D/propert
ies/ncigarettes";
char unlockedTopic[] =
"set/cajetilla/collections/cajetilla/things/01F808YSNANZFAACEYSWPJ0J6D/propert
ies/unlocked";
char cigaretteTopic[] =
"set/cajetilla/collections/cajetilla/things/01F808YSNANZFAACEYSWPJ0J6D/propert
ies/cigarette";

char consumptionTopic[] =
"set/cajetilla/collections/cajetilla/things/01F808YSNANZFAACEYSWPJ0J6D/events/
consumed";
char loadTopic[] =
"set/cajetilla/collections/cajetilla/things/01F808YSNANZFAACEYSWPJ0J6D/events/
loaded";

WiFiClient wifiClient;
PubSubClient client(wifiClient);

long lastMsg = 0;
char msg[50];
long last_cigarette = 0;
```

```

int pos = 0;
int pos_dispense = 150;
int buttonState_dispense = 1;
int old_buttonState_dispense = 1;
int pos_load = 90;
int buttonState_load = 1;
int old_buttonState_load = 1;
int number = 0;
int total_number = 0;
boolean unlocked = true;

Servo servoMotordispense;
Servo servoMotorload;

void setup_wifi()
{
  delay(10);

  // We start by connecting to a WiFi network
  Serial.println();
  Serial.print("Connecting to ");
  Serial.println(ssid);

  WiFi.begin(ssid, password);

  while (WiFi.status() != WL_CONNECTED)
  {
    delay(500);
    Serial.print(".");
  }

  randomSeed(micros());

  Serial.println("");
  Serial.println("WiFi connected");
  Serial.println("IP address: ");
  Serial.println(WiFi.localIP());
}
void callback(char* topic, byte* payload, unsigned int length)
{
  Serial.print("Message arrived [");
  Serial.print(topic);
  Serial.print("] ");
  for (int i = 0; i < length; i++){
    Serial.print((char)payload[i]);
  }
  Serial.println();
}

void reconnect()
{
  // Loop until we're reconnected
  while (!client.connected())
  {
    Serial.print("Attempting MQTT connection...");
    // Create a random client ID

```

```

String clientId = "ArduinoClient-";
clientId += String(random(0xffff), HEX);
// Attempt to connect
if (client.connect(clientId.c_str(), mqttUsername, mqttPassword))
{
    Serial.println("connected");
    // ... and resubscribe
    client.subscribe(subTopic);
} else
{
    Serial.print("failed, rc=");
    Serial.print(client.state());
    Serial.println(" try again in 5 seconds");
    // Wait 5 seconds before retrying
    delay(5000);
}
}

void setup()
{
    Serial.begin(115000);

    pinMode(servoPIN_dispense, OUTPUT);
    pinMode(buttonPIN_dispense, INPUT_PULLUP);
    pinMode(servoPIN_load, OUTPUT);
    pinMode(buttonPIN_load, INPUT_PULLUP);

    setup_wifi();
    client.setServer(mqttServer, 1883);
    client.setCallback(callback);

    servoMotordispense.attach(servoPIN_dispense, 500, 2500);
    servoMotordispense.write(pos_dispense);
    servoMotorload.attach(servoPIN_load, 500, 2500);
    servoMotorload.write(pos_load);
}

void loop()
{
    String json_string_data;
    char json_char_data[200];
    char json_char_consumption[200];
    char json_char_load[200];
    String json_string_cigarette;
    char json_char_cigarette[200];

    String opening = "{";
    String closing = "}";
    String comma = ",";

    if (!client.connected())
    {
        reconnect();
    }
}

```

```

client.loop();

if (count == months_quit*30/actualn*nnow){
  nnow--;
  count=0;
}
long now = millis();
if (now - last_cigarette < 16/nnow*3600000){
  unlocked = false;
}else{
  unlocked = true;
}

buttonState_dispense = digitalRead(buttonPIN_dispense);
if ((buttonState_dispense == HIGH)&&(old_buttonState_dispense ==
LOW)&&(unlocked == true)){
  pos_dispense=150-pos_dispense;
  if(pos_dispense == 0){
    for (pos = 150; pos >= pos_dispense; pos -= 1){
      servoMotordispense.write(pos);
      delay(5);
    }
  }else{
    for (pos = 0; pos <= pos_dispense; pos += 1){
      servoMotordispense.write(pos);
      delay(5);
    }
  }
  if(pos_dispense == 150){
    if (number > 0){
      number--;
      total_number++;
      last_cigarette = now;
      count++;

      String cigarette_str = "\"cigarette\": ";
      json_string_cigarette = opening + cigarette_str + String(1) + closing;
      json_string_cigarette.toCharArray(json_char_cigarette, 200);
      client.publish(cigaretteTopic, json_char_cigarette);
      Serial.println("New property upadted:");
      Serial.println(json_string_cigarette);

      String cigarette = "\"cigarette\": ";
      String id = "\"ID\": cajetilla";
      json_string_data = opening + cigarette + String(1) + comma + id +
closing;
      json_string_data.toCharArray(json_char_data, 200);
      client.publish(dataTopic, json_char_data);
      Serial.println("New message sent:");
      Serial.println(json_string_data);
    }
  }
  old_buttonState_dispense = buttonState_dispense;

  if (number == 0){

```

```

buttonState_load = digitalRead(buttonPIN_load);
if ((buttonState_load == HIGH)&&(old_buttonState_load == LOW)){
  Serial.println(buttonState_load);
  pos_load=90-pos_load;
  servoMotorload.write(pos_load);
  if(pos_load == 90){
    number = 10;

    sprintf(json_char_load,
"{\r\n\t\"loaded\":{\r\n\t\t\"data\":{\r\n\t\t\t\t\"ncase\":
%d\r\n\t\t}\r\n\t}\r\n}", number);
    client.publish(loadTopic, json_char_load);
    Serial.println("New event sent:");
    Serial.println(json_char_load);
  }
}
old_buttonState_load = buttonState_load;

delay(10);
}

```

## 8.2.SmartWorks code

```
import requests
import json

API_HOST = 'https://api.swx.altairone.com'

CLIENT_ID = "*****"
CLIENT_SECRET = "*****"

def get_access_token():
    payload = f'grant_type=client_credentials&' \
             f'client_id={CLIENT_ID}&' \
             f'client_secret={CLIENT_SECRET}&' \
             f'scope=thing.read thing.update'

    headers = {'Content-Type': 'application/x-www-form-urlencoded'}
    response = requests.request("POST", API_HOST + "/oauth2/token",
                               headers=headers, data=payload)

    return response.json()['access_token']

def handle(req):
    PATH="*****"
    headers = {"Authorization": "Bearer " + get_access_token()}
    response = requests.request("GET", API_HOST + PATH , headers=headers)
    properties=response.json()['properties']

    ncigarettes = properties['ncigarettes']
    npack = properties['npack']
    money= properties['money']

    ncigarettes =ncigarettes+1
    money =ncigarettes*0.25
    money=round(money,2)

    if npack > 0:
        npack =npack-1

    PATH_MONEY = "*****"
    headers = {"Authorization": "Bearer " + get_access_token()}
    response = requests.request("PUT", API_HOST + PATH_MONEY ,
    headers=headers,json={"money": money})

    PATH_NCIGARETTES="*****"
    headers = {"Authorization": "Bearer " + get_access_token()}
    response = requests.request("PUT", API_HOST + PATH_NCIGARETTES ,
    headers=headers,json={"ncigarettes": ncigarettes})

    PATH_NPACK="*****"
    headers = {"Authorization": "Bearer " + get_access_token()}
    response = requests.request("PUT", API_HOST + PATH_NPACK ,
    headers=headers,json={"npack": npack})

    return {
```

```
"body": response.json(),  
"status_code": response.status_code  
}
```

## 8.2. Sustainable development goals

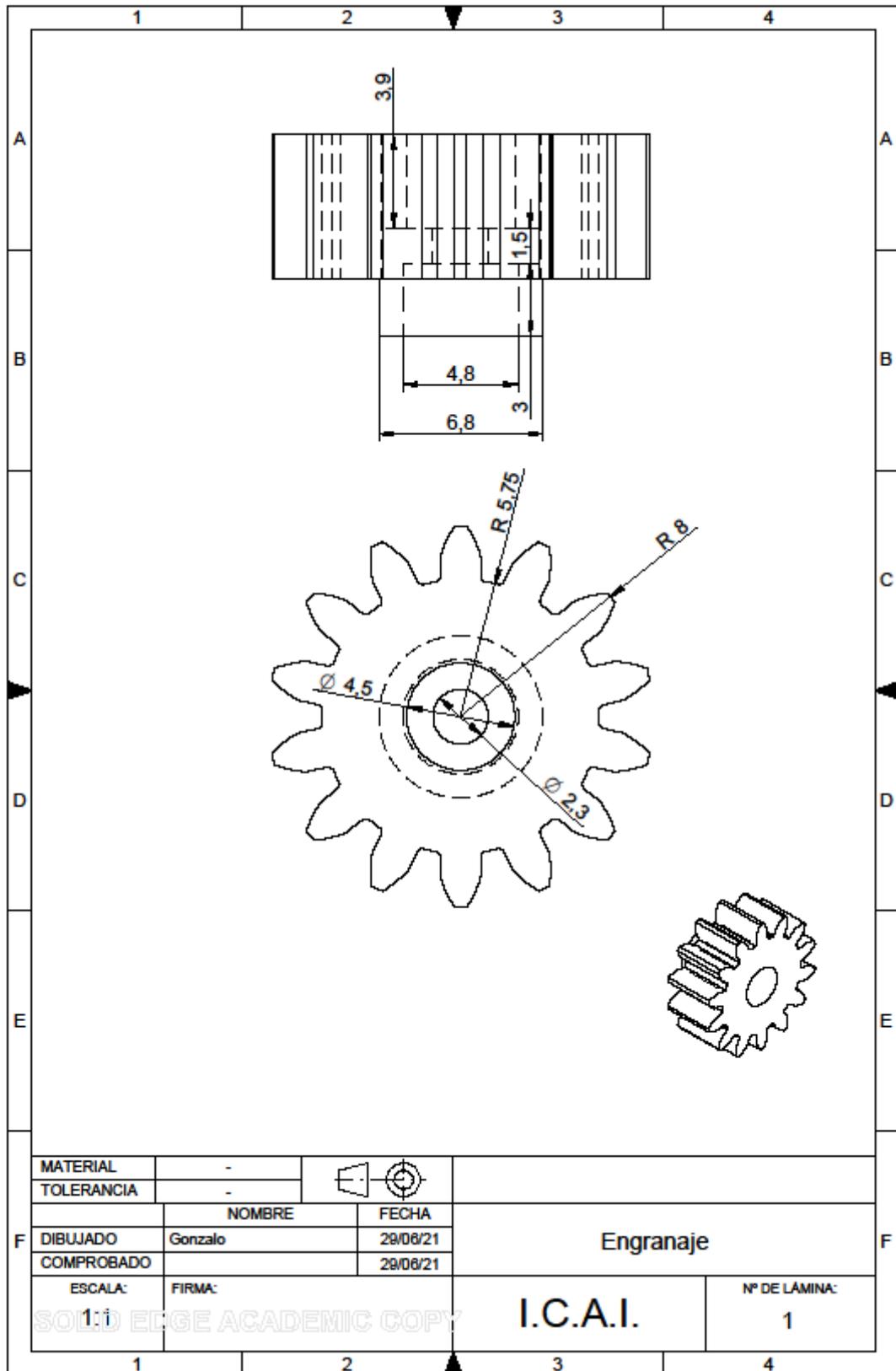
The main objective of this project is Sustainable Development Goal 3 (SDG 3) entitled Health and well-being, which seeks to ensure healthy lives and promote healthy living at all ages. Smoking does not only affect the smoker, but it also affects all the people around them, therefore, it affects all ages as indicated in this SDG. More specifically, this project is aligned with target 3.5 Strengthen prevention and treatment of substance abuse, including drug abuse and harmful use of alcohol. Tobacco is an addictive substance and this device to be designed is intended to address this tobacco abuse.

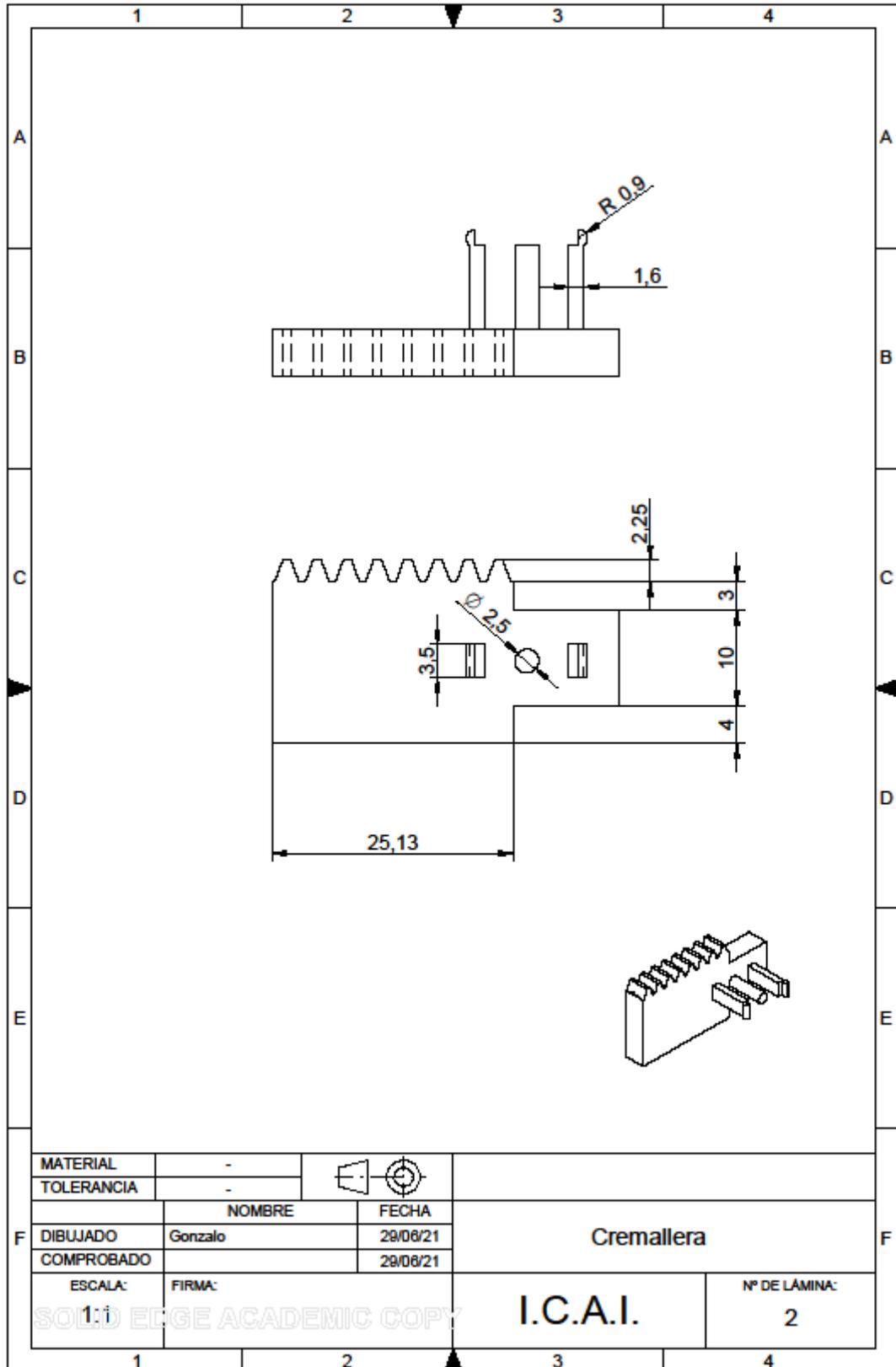
SDG 8: “Decent work and economic growth” aims to promote inclusive and sustainable economic growth, employment, and decent work for all. Part of the project is to design a business plan, therefore, if it is implemented, it will generate jobs.

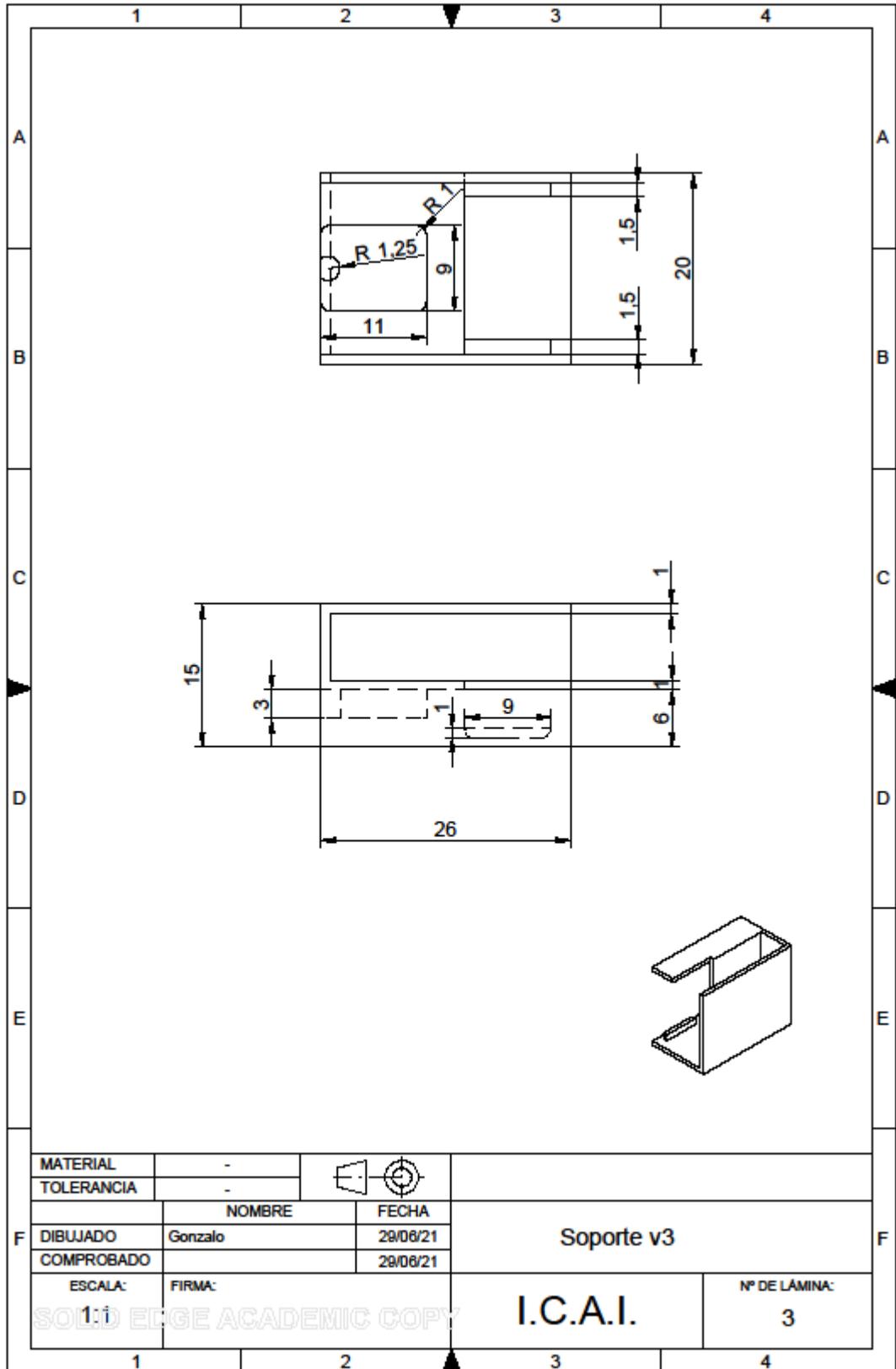
## SUSTAINABLE DEVELOPMENT GOALS

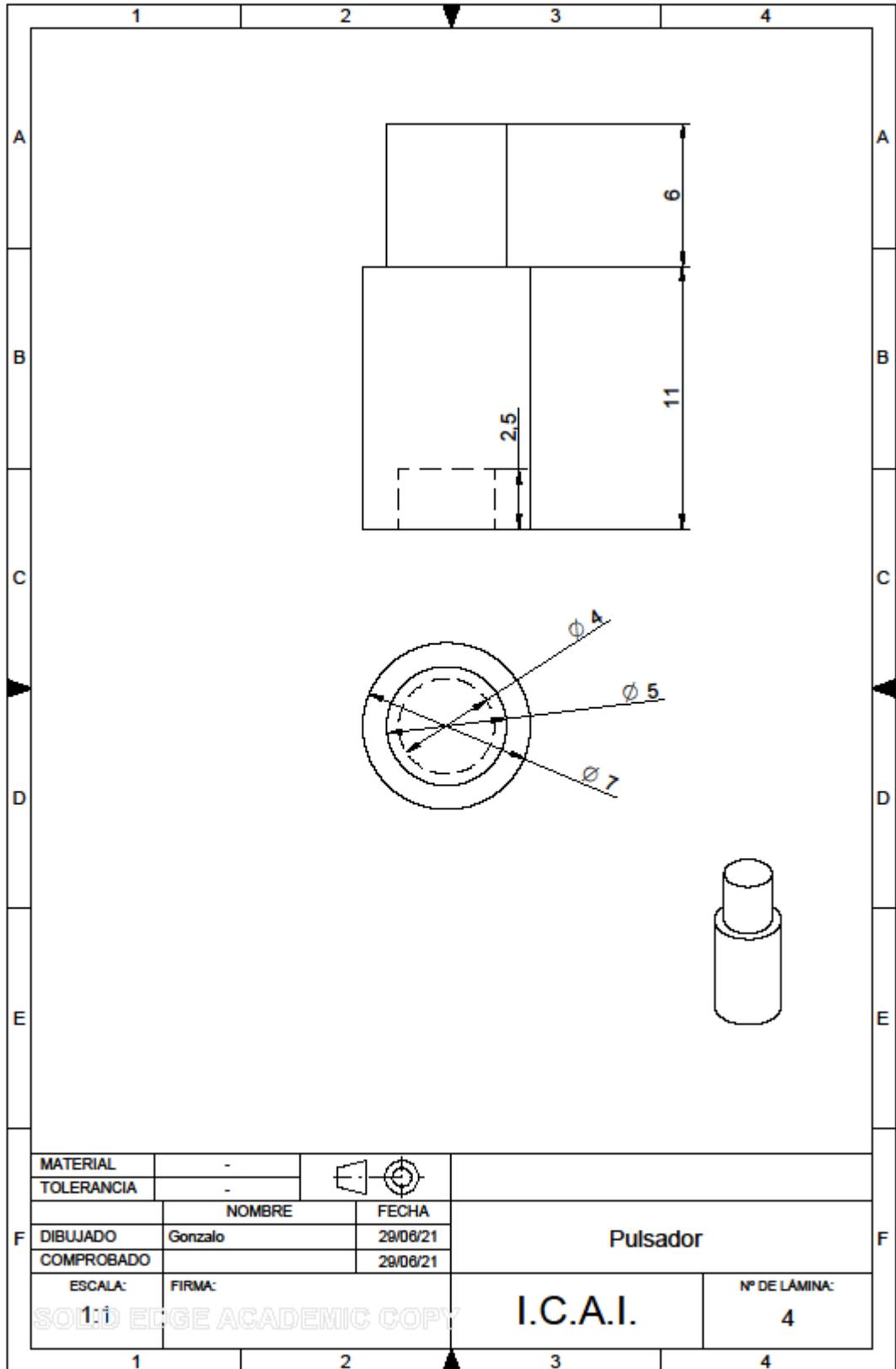


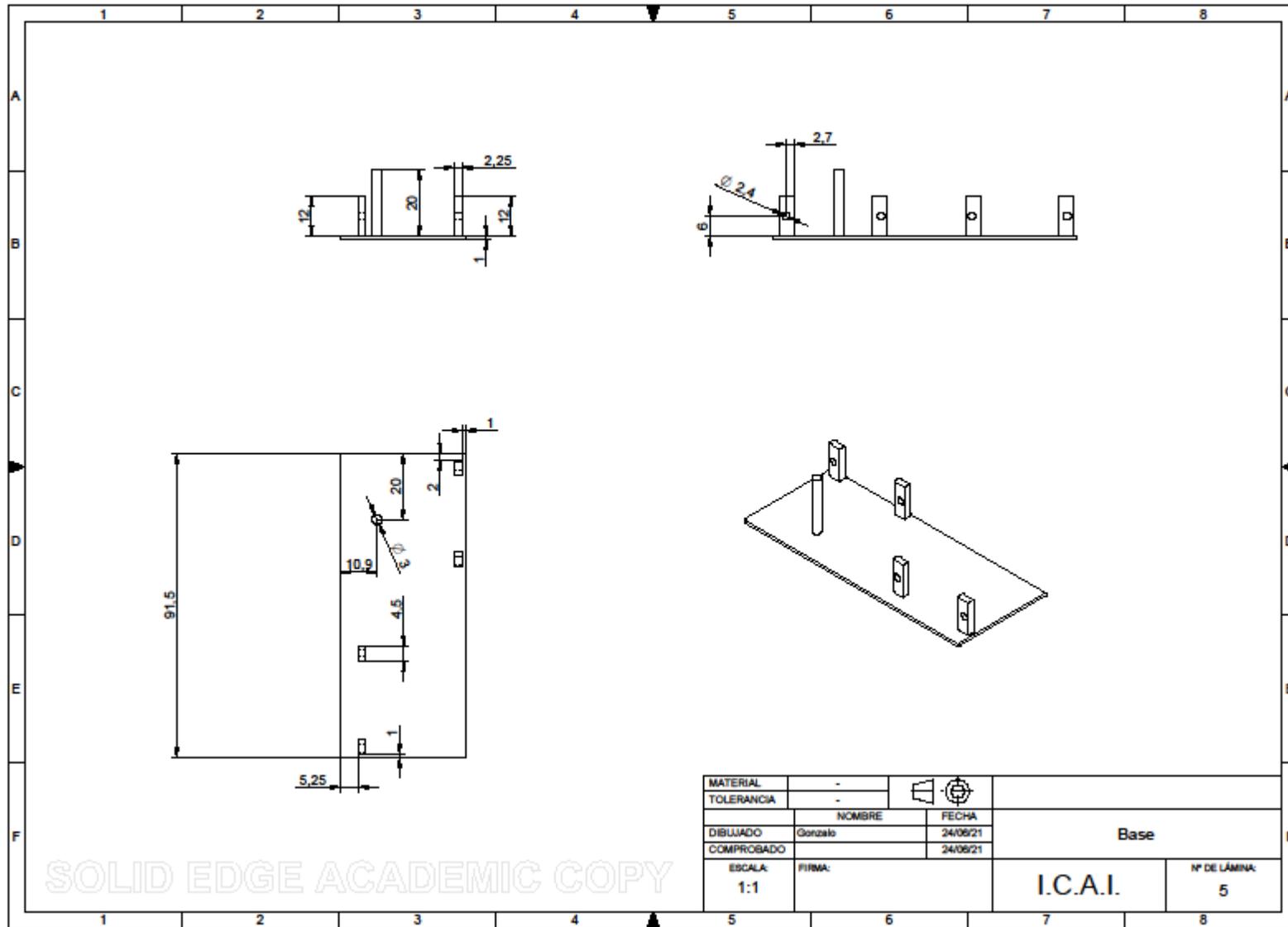
### 8.3. Blueprints



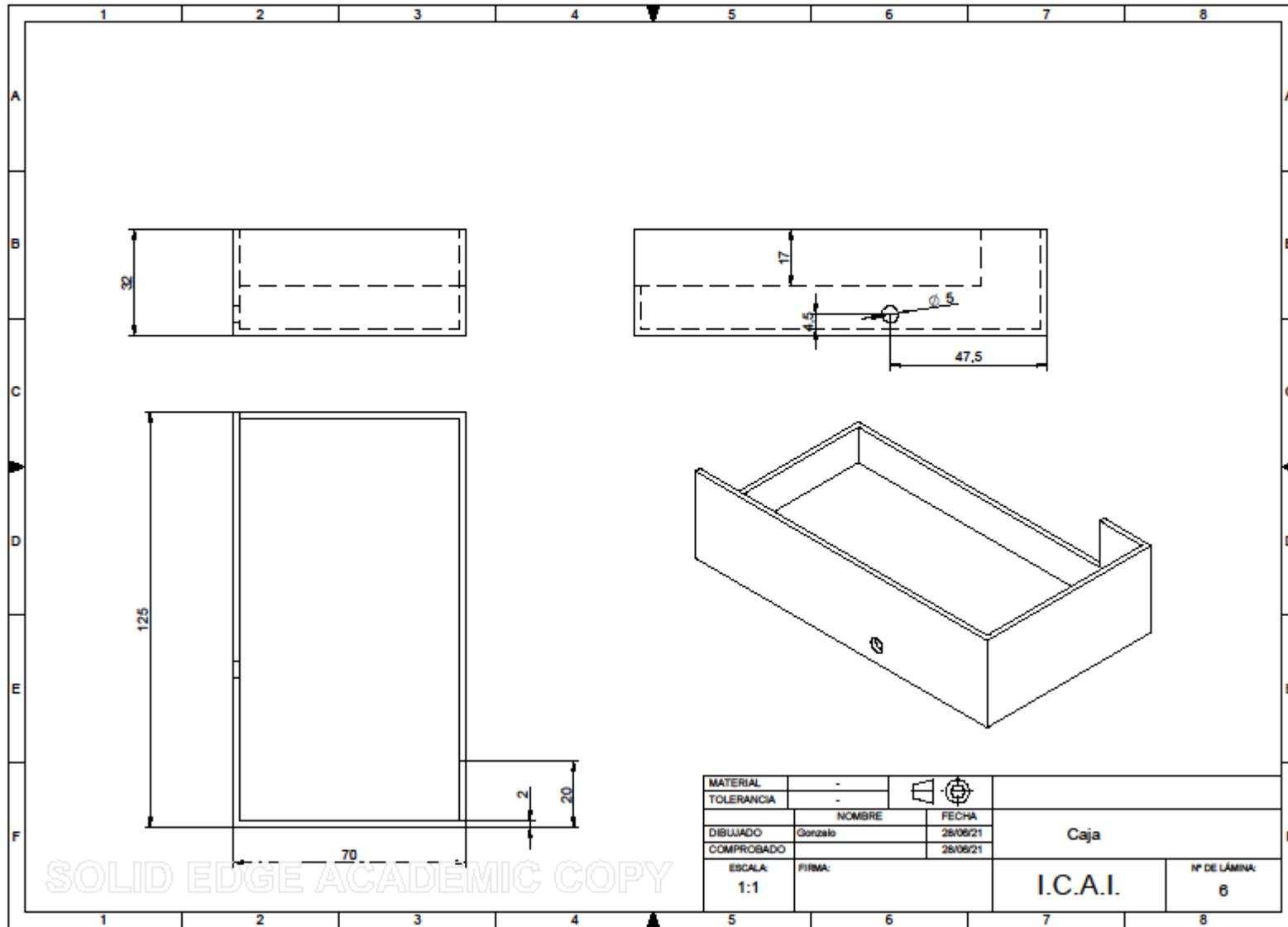








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