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A Practical Approach to Navigating Uncertainty within Innovative Markets for Carthago, a Fire  
Prevention and Response Startup Concept -

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## **Abstract**

Despite efforts to establish methods for innovation and market entry, the element of uncertainty makes it difficult for firms to ensure success when introducing a new product. Therefore, mitigation of uncertainty is paramount to cultivating innovation and growth. This paper provides a practical example of uncertainty reduction in the context of Carthago, a developing startup looking to provide technological solutions to the growing wildfire problems in Portugal and Europe. Structured around the Innovator's Method, additional frameworks like the social business model canvas, strategic foresight and scenario planning will be used to advise Carthago's approach to uncertainty mitigation and market entry.

**Keywords** (Wildfire Prevention, Entrepreneurship, Social Business Model, Scenario Planning, Data Analytics, Innovation, Digital Strategy and Transformation)

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## **Introduction**

### **Executive Summary**

The Carthago team ideated a “smoke alarm” for farmers to detect fires before they become uncontrollable. Impacts of wildfires on farmers in Portugal are catastrophic. In 2017 alone, wildfires caused 117 deaths and an estimated EUR 1,5 billion in costs. Heat waves, coupled with delay in fire detection resulted in severe damage to local agriculture, water shortages, loss of biodiversity, bad air quality, and desertification (San-Miguel-Ayanz, et al., 2020). The global risk of wildfires is increasing, resulting in drastic impacts on all stakeholders. Individual households, insurance providers, and governmental entities are all at risk from economic consequences of climate change. Wildfire threats have resulted in record losses over the previous few years, according to insurance companies and government organizations (Lüthi, 2021). Current fire prevention and response methods, like manual supervising, are inefficient and time consuming. The Carthago team designed an innovative integrated system to aid local authorities in handling these extreme conditions. The solution relies on sensors placed in the forest, providing constant monitoring and early detection of fires. The sensors transmit data to an alarm system via SMS, allowing specialized staff to respond in real time to danger. Moreover, the system includes a weather station and a data collection system to map potential hazards and examine the condition of areas. The data collected will also allow to build future prediction models for wildfire risk and determine whether a wildfire was ignited by human hand, or metrological factors. Most of all, the versatility of the technology will allow Carthago to make a major impact by leveraging the potential for scalability.

## **Birth of the Project**

The course Design Thinking for Social Innovation, taught by Professor Anne-Laure Fayard at Nova SBE University, stipulated that the class participated in an international challenge dedicated to adapting to the effects of climate change. This contest was hosted by the Egis Group, a leading global consulting, construction engineering and operating firm. The core assignment was to design a project that helps a region cope with the effects of climate change. Preselected groups within the class then started to brainstorm topics before actively diving into extensive field research. Because of Carthago's location and climatical circumstances in Portugal, the Carthago group then decided to investigate problems associated with water scarcity. As a result, numerous farmers in different areas of the country were interviewed. The field research allowed Carthago to conclude that the main threat farmers are facing is uncontrolled wildfires. Diverse concepts were sketched and designed, resulting in a first draft of a wildfire alarm system for farmers. The final design for a smart integrated system for the detection of wildfires won third place in the challenge and was presented, as well as awarded in November 2022 at the UNESCO headquarters in Paris during the *"Université de la terre"* event.

## **Continuing the Project**

The project is actively supported by different employees of the Egis Group from Franke, UK, and Portugal. With the help of Professor Antonio Valente head research faculty of University UTAD in Villa Real and professor and researcher José Lima from Instituto Politécnico de Bragança, the feasibility of the idea could be validated. Both are currently working on a very similar project and have already reached the experimental phase. Although technology is a key factor for the success of this project, it is important to have a connectivity between the managerial/entrepreneurial skills

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and the technical solution of the idea. Connecting these stakeholders adds value by generating momentum for the further development of the final product.

## **The Problem**

### **Wildfire Problem**

Portugal is highly susceptible to wildfires, particularly beginning in mid-July, lasting for about 14 weeks. In the last 20 years, Portugal has lost 388 kha of tree cover, just from fires, with 131 kha lost in 2017 alone, reflecting a worsening trend (Global Forest Watch, 2021). The increased incidence of fires in Portugal can be attributed to several factors, ranging from Portugal's climate, location, anthropogenic interventions, or negligence.

### **Location and Climate**

Portugal's location and climate are often indicated as a primary cause of fires as Mediterranean climates provide the necessary environment to spark them. More specifically, the combination of humidity, drought, temperature, and low moisture in vegetation contribute significantly to the start of wildfires (NOAA, 2022). These attributes are found more commonly in countries like Portugal rather than other, colder, and wetter climates in Europe, and are exacerbated by hotter temperatures. Dryness, for example, makes vegetation and fire fuels more flammable, once the moisture level drops below a certain point and enough water has been evaporated, the fire fuels will ignite due to a heat source. As a result, vegetation, and shrubbery with naturally dryer biochemistry are at higher risk of causing wildfires (Oak Savannas, n.d). Another influential factor is the size of the fire fuel, for example, small shrubbery and vegetation like grass, burn more quickly, leading them to be less dangerous than large sources of fire fuel like trees (Moore, 2021). When coupled with drought and wind, ignition rates and area distance spread will increase as well. Wind contributes to the spread

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of fire as it provides wildfires with oxygen to continue burning and can act as a medium to transport the fire to other areas of the environment. Naturally, these factors are being worsened by climate change as the global average temperature increases and precipitation decreases. In fact, a study of the Portuguese municipality, Vila Nova de Foz Côa, found mean average precipitation and temperatures equal or greater than 20 degrees Celsius to be predictors of high fire susceptibility (Padrão et al., 2022).

### **Anthropogenic Causes**

Anthropogenic causes of wildfires are, in many cases, the leading instigator of fire ignitions. According to Hyde (2018), many fires in Portugal are caused by anthropogenic ignitions. The two primary causes of human-based fires are negligence and intentional ignition. This is demonstrated by the higher rate of fires near urban areas, as there are simply more people in congested areas that can spark fires. Statistically, 85% of fires occur in or close to these urban centers, further highlighting the connection between fire occurrence and proximity to humans (Hyde, 2018). However, it should be noted that fires in urban areas are typically less dangerous and aggressive than fires in rural areas that have a lot of vegetation and dry land to spread. Portugal has an alarming rate of human caused fires spread throughout the country, with significantly higher occurrences when compared to other European countries. Finally, mismanagement of highly flammable areas is also contributing to the spread of wildfires in the country. Many forested and agricultural areas are not properly monitored or maintained, resulting in the growth of highly flammable vegetation and shrubbery. Due to a lack of human monitoring, once fires are sparked in these areas, they tend to spread quickly and aggressively. Unfortunately, because of complicated land ownership dynamics, fire management investments are often neglected and not implemented in the necessary areas (Hyde, 2018).

### **Impacts of wildfires in Portugal**

Globally, the risk of wildfires is rising quickly, having significant effects on ecosystems, biodiversity, and society (Lüthi, 2021). The faster the firefighters get to the scene, the easier it usually is to control a fire; thus, it is crucial to spot the first flames and notify the authorities (Brito, et al., 2020). In fact, the impact of a wildfire is far greater than the economic loss and the infrastructural destruction it causes. Firstly, it is important to mention that nearly all biodiversity and vegetation in the area close to a fire will get fully destroyed, leaving burnt area and destruction behind. Putting out large fires also has a negative long-term impact on national water resources due to the large amounts of water required for responsive measures (Southwell, 2021). Furthermore, a large wildfire has a direct impact on the water quality of the surrounding soil and water. This phenomenon occurred already in Zêzere, where the primary drinking water reservoir for Portugal's mainland is located. However, it is still to be assessed what impacts the recent big wildfires will have on water resources that are used for water consumption in the Lisbon area (Meneses, et al., 2019). After a wildfire, the burned area is more likely to experience an increase in soil erosion, turning the soil eventually more hydrophobic and infertile. This process makes reforestation, as well as agricultural practices much more difficult. (Brown, et al., 2018). The Portuguese community, especially farmers, are suffering from these catastrophic consequences of wildfires. Local agriculture and its products are negatively affected because wildfires decrease agricultural yield while either maintaining or increasing costs. Furthermore, Uncontrolled wildfires emit a variety of pollutants which are worsening the air quality and can additionally be harmful to human health. These include methane, nitrous oxide, nitrous oxides, volatile organic compounds, and other secondary pollutants. The European Directive 2008/50/EC of May 21, 2008, in fact, regulates some of these chemicals to effectively manage health resources and the necessary public money for

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prevention and remediation. (Tarín-Carrasco, et al. 2021) Given these facts, early fire detection is becoming increasingly important to mitigate the range of damage caused by rapidly spreading wildfires.

### **Current Approach**

After 2017, when a cost of 1.5B was estimated to be directly attributable to the damage caused by uncontrolled fires, the Portuguese government decided that trees and brushwood should be removed from the sides of roads to create a 10-metre 'buffer zone' on both sides, using asphalt to slow the progress of the flames and to create an escape route in the event of a fire (Rempel, 2020). This decision raised quite a few debates and perplexities. Given that the strategies of "mitigation" and "urban resilience" have been globally recognized as the trajectories to follow to combat the rise in temperatures and its consequences, it becomes natural to wonder whether adopting desertification practices and the consequent loss of biodiversity is the most recommendable option. The main culprits of uncontrolled fires are indicated as maritime pines and eucalyptus plants, due to their high concentration and flammability (Bowman, 2018). Uncontrolled and ineffectively targeted 'no matter what' felling would lead to further damage to biodiversity: eucalyptus trees are crucial for species such as honeybees, birds, and butterflies, especially in the winter months when other plants are flowering. Honeybees are an endangered species worldwide; they are crucial for pollination and all the consequent benefits for humans and the ecosystem, to such an extent that international beekeepers and honey producers, from South Africa to Uruguay and California, are demanding that the Eucalpto forests not be removed (Bowman, 2018). Due to fires and man-made deforestation, honey production in Portugal has plummeted by 80 per cent since 2017 (Bowman, 2018). "Fighting fire with fire" can definitely be a practical and useful choice in some situations; uncontrolled growth of vegetation can lead to considerable economic and social damage. Also,

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considering the fact that brushwood and weeds are the ideal fuel for the uncontrolled spread of a fire (Bowman, 2018). However, the fact remains that this direction would lead to a fossilization of the adaptation strategy, not directly addressing the problem, but bypassing it. The risk of adopting adaptive rather than disruptive techniques may lead in the long run to a problem of crystallization of procedures, failing to incentivize concrete investments in the direction of sustainable development. This procedure, in addition to a debate fueled by ethical drivers, also appears to have feasibility problems; Portugal appears to be the country, within the European Union, that owns the most private property (97%) (Bowman, 2018), making the identification of landowners a difficult task in many cases: in order for the felling to be carried out, it is necessary for them to give their consent. Several surveys have also shown that most landowners own forests and woodlands but live in distant urban areas and cities, leaving the areas unattended, uncontrolled, and uncared for. Those who are physically present on their property, in most cases turn out to be farmers who have to adopt self-made solutions, often rudimentary and artisanal, lacking high spending and investment power. During primary research, Carthago had the opportunity to interview Michael, the wine farmer, who was introduced in an earlier chapter. Michael told Carthago how the most widely adopted strategy in his vineyard and the region is daily patrolling of the property with the help of a vehicle. This approach appears ineffective for several reasons, identifying itself as:

1. Time consuming
2. Energy Consuming
3. Labor man demanding
4. Polluting
5. Ineffective

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This rudimentary strategy requires a disproportionate use and consumption of resources: moreover, fires are detected after they have already flared up and spread, disastrously shortening the time for intervention. The cost, the energy required and the expense of fuel, the prices of which knowingly are constantly rising due to the energy crisis Europe is experiencing, are certainly not worth the yield obtained.

As stressed by UNEP on an ongoing basis, there is a need for investments that move towards a prevention focus, beyond just fire management per se. Investments in mitigation are significantly more expensive than traditional adaptation techniques and require the combined efforts of multiple parties, including an effective commitment of government players, policy makers and capital providers. Responding to and counteracting the challenges of climate change through mitigation strategies requires the cooperation of all stakeholders, involving both small local and national governments. "More than ever, this requires policy coherence; adaptation to climate change itself can become a vehicle and proof of this" (Italian Alliance for Sustainable Development, 2021). Carthago needs to rely on science to improve their understanding and management of the relationship between climate risks and socio-economic inequalities. Investments in new technologies require, especially in the initial phase of experimentation, considerable sums of money, although insignificant sums when compared to the costs that Portugal has had to bear due to uncontrolled fires. With an assumption of an initial investment of one million euros, this expenditure would be 0.06% of the 1.5B that the nation lost in the year 2017 alone. National governments are not the only geopolitical actors that need to steer the economy towards sustainable development: for global change to be possible, they need to collaborate with multinationals, in defining and applying incentives to invest in research and development to enable the use of new technologies that can not only directly address the problem of rising temperatures, but also offer

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an alternative and a weapon of defense to those who suffer most from the climate consequences: local, rural and poor communities.

Within this context is Carthago's idea, the development of a start-up aimed at offering the Portuguese government an innovative and scalable technology that can help citizens prevent, and potentially predict, the spread of uncontrolled fires.

## **The Innovator's Method**

The Innovators method is a series of experimentation circles that resolve uncertainty around a product of innovation and therefore maximize its chances of success in the market (Furr, et al., 2014, p. 15). It aids managers in creating a customer persona to eventually build a strong business model that is distinguished by certainty (Furr, et al., 2014, p. 18). The Innovators Method that will be applied in following sections, is divided into 4 simple steps: 1. Insight; 2. Problem; 3. Solution; 4. Business Model.

### **Step 1: Insight, Savor Surprises**

The first step facilitates in generating insights into potential customer problems by looking for surprises or other clues, such as the symptoms of a problem. Insights at this stage can come from any stakeholder related to the problem. In fact, they are most likely to be developed through user or customer observations and through conversations (Furr, et al., 2014, p. 31).

### **Step 2: Problem: Discover the Job to be Done**

The second step attempts to deeply understand the most pressing problem that requires an active solution, ultimately, the job to be done. Once a job needs to get done regularly by customers, they become aware of them as problems. Therefore, they start looking for products or services that create solutions for these jobs. (Furr, et al., 2014, p. 81). By understanding what the job is, you can generate various insights into the problem or a solution. (Furr, et al., 2014, p. 87). For managers and entrepreneurs, it is important to understand whether you are trying to solve a problem that is worth solving.

### **Step 3: Solution: Prototype the Minimum Awesome Product**

The third step of Clayton Christiansen's lean Start-Up approach refers to the solution or the minimum awesome product. Step three introduces a tool called solution-storming that works to generate many potential solutions (Furr, et al., 2014, p. 113).

When developing a solution for a problem in an uncertain market, it is not advisable to wait and develop a full-featured, error-free product. This only makes sense in familiar markets, however, in uncertain markets managers should search broadly for a variety of solutions and then use a series of four prototypes to converge on the solution that best solves the job to be done (theoretical prototype, virtual prototype, minimum viable prototype, and minimum awesome product) (Furr, et al., 2014, p. 127).

#### **Step 4: Validate the Go to Market Strategy**

Once a product that customers want has been successfully identified, the organization needs to determine the best mode of delivery for the product to consumers, factoring in the costs and revenues that will ultimately result in the profit (Furr, et al., 2014, p. 143). Most innovations require their own business model, regardless of similarities to other innovations that have successfully been introduced into the market. Proper business model alignment requires figuring out and testing your go-to-market strategy with actual customers (Furr, et al., 2014, p. 145). To prospect the potential market's development, future scenarios will be developed through the intuitive logics school to facilitate decision making.

#### **Uncertainty**

Many familiar management practices, such as the creation of a business model, were designed to capture conditions of relative certainty. However, most new business ideas are characterized by the

unknown. Under conditions of uncertainty, planning becomes difficult (Furr, et al., 2014, p. 7). This indicates that innovative, at the same time dynamic ways of approaching the construction of a business model are highly important for new companies in markets that are characterized by uncertainty.

There are two types of uncertainty that can influence an organization's ability to create a customer persona. The first type: demand uncertainty relates to whether a customer will or will not buy the final product. The second type of uncertainty is technological and relates to the ability to create a desirable solution. It results from uncertainty regarding the technologies that might emerge or need to be created for a new solution to emerge. A third type of uncertainty related to the macro-environment exists, however it is not directly related to creating a customer persona (Furr, et al., 2014, p. 18). Macro-environment uncertainty in this context will be mitigated through the application of a strategic foresight and scenario analysis later in the paper.

The growth of technological uncertainty is directly related to the rate of new inventions across industries. As new technologies emerge, the customer demand for a mix of new products shifts. Leading to an accelerated fall of established companies and the rise of new players in the market (Furr, et al., 2014, p. 21).

There are many causes for the sudden rise in uncertainty. However, two disruptive technologies—personal computing and the internet—have been especially significant for this phenomenon. This implies that more innovative products could be introduced to a wider market more quickly than ever before. Additionally, the rise of capitalism in countries like China, India, Russia, and Brazil has further increased uncertainty on the market (Furr, et al., 2014, p. 21).

### **Uncertainty as an Opportunity**

There are several opportunities for effectuation when entrepreneurs are dealing with high levels of uncertainty. This means looking for information, examining early results, initiating experiments early, studying the evolution of any likely models that emerge, and then taking advantages of them (Thompson, et al., 2010, p. 293).

The main pillar for the following part of the research is the Clayton M. Christensen's book: *The Innovator's Method: Bringing the Lean Start-up into Your Organization*. The book is a great fit for the project because the team aims to work in a field of high uncertainty regarding technology as well as demand. Furthermore, entrepreneurial management is characterized by a high level of uncertainty, when compared to traditional management (Furr, et al., 2014, p. 46). The book analyzes new ways of thinking are revolutionizing ways managers succeed in bringing new ideas into market, new tools help to lower uncertainty through early-stage experiments. It further introduces tools to create, refine and introduce new products into market while lowering the uncertainty a company is facing.

However, due to the various experiments that help lowering the level of uncertainty a company is facing, dynamics seem to be the answer to this problem— dynamics and the dynamic of the process changing. Given this fact, one can derive managerial implications for uncertainty and adapt an entrepreneurial mindset. Entrepreneurial ability allows managers to imagine new ways of combinations between the "services of resources," the development of chances for using the resources, or the drive to develop and/or acquire new ones (Demil, et al., 2010, p. 230).

### **Applying the Innovator's Method**

The Innovator's Method will be applied to the Carthago project to maximize product success, minimizing uncertainty, and planning a successful entry into the market. Each step will be thoroughly explored in the context of Carthago's product within the fire prevention and response market. Carthago's solution and approach will also be expanded upon in step 3. Additionally, other frame works like the business social model canvas, intuitive logics school, PESTEL analysis, and Porter's 5 forces will be used to supplement decision-making in present and future environments.

#### **Step 1: Insight Savor Surprises**

During this step, the "Carthago" team observed farmers across three weeks in fields, in villages, and the markets where they conducted business. While conducting these observations they were surprised about the incredible challenges farmers faced when trying to sell their produce at a good price. While observing the daily business at BioVilla, water scarcity was determined to be one of their main problems. The feedback gained from the farmers during the interviews focused on their worries, complaints, and loss of profit, this gave clues of a potential problem to solve. When interviewing wine farmers during a further step, they realized that there could be an opportunity for fire prevention systems (Appendix 12: Observation Biovilla).

For instance, Michael, who is working in one of his families' vineyards in Portugal. Their property is in Muge, a small wine and farming community about an hour from Lisbon, and it has more than 400 hectares of land. Along with vineyards, they labor with horses and raise other crops and vegetables, such as sweet potatoes, or tomatoes. He noted that it has been a very dry year and that he is persuaded that climate change is to blame for it. He informed, that they already experienced their first fires in January in addition to having to water their plants in January, which is highly unusual. He continued explaining that there is an employee who is patrolling their property daily

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with a vehicle. This manual and reactive fire tracing approach can often lead to delayed detection and therefore resulting in uncontrollable wildfires. Now there's an employee who has to every night and drive around the property to check if there are fires “. He continued: “If you're living in like around pine trees you are also aware that, if they burn the pinecones explode. This makes the fires spread even faster. If the land is dry on top of that the fire spreads faster. Considering that the houses are made of wood, it is quite dangerous.” He continued by stating how innovation may be used to solve the problem: Talking about the fires, for example, there could be sensors that send out information about the heat of different areas and automatically warning when temperatures exceed certain points. Usually, this is an indicator of fire. This would innovate vineyards drastically” (Appendix 13: Interview Michael).

Biovilla was also visited, a non-profit organization situated in the National Park of Arrabida, 40 minutes from Lisbon, to confirm that wildfires are a huge threat for farmers throughout Portugal and are not just a local issue in Muge. At Biovilla, it was discovered that the garden's plants were unable to soak any water in January since the soil was so dry. Solutions to soil dryness, such as irrigation systems were not possible due to the location, resulting in an immensely decreased yield. They added that there had already been a wildfire in February 2022 and that the nearby Pinetree forests pose significant risks during the fire season. The Egis group Portugal that is managing various projects in Portugal, such as maintaining and protecting the Highway A24 reported a wildfire in early 2022 that crossed their highway and spread over to Spain. They were never able to identify the initial spark and therefore the cause of the fire. The more interviews conducted, the more it became clear that Wildfires are the main threat for not only Portuguese farmers but rural areas and areas transitioning into urban land.

## **Step 2: The Problem – the Job to be Done**

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Instead of initially confirming that they have identified a problem worth solving, the majority of managers actually begin with the solution. As a result, despite developing innovative solutions, failure to fulfill an actual need causes the product or service to fail. To properly capture the problem at hand and successfully innovate, the functional, social, and emotional aspects of a job must be understood (Furr, et al., 2014, p. 87,88). Easily expressed, this means: What do customers want? Problems can constitute a customer's pains or desires like expression, fulfilment, and connection. It is crucial to keep in mind that there may be up to three clients for any given job: the economic customer (the person paying), the technical customer (the person installing the solution), and the end consumer (the person utilizing the solution) (Furr, et al., 2014, p. 89). The innovators method offers 3 main tools that will be applied in the further part of the document and significantly helped breaking down the problem.

“As we like to say, innovators innovate, customers validate, and not the other way around” (Furr, et al.2014, p. 110).

Interviewing all different kind of stakeholders in the first step gave the Carthago team more than a hint of the job farmers and property owners in Portugal are dealing with on a regular basis – fire patrolling their properties. During this step, the team also understood that especially wine farmers in Portugal could pose a sizable set of clients who: (1) have money; and (2) are willing to pay to solve it. (Furr, et al., 2014, p. 89). For the highly important task of capturing the problem properly, the team was lucky to count on the organizational support of the Egis Group. They arranged a workshop with the 16 final teams. Firstly, a 5-step pain-storming was conducted with the following steps: (Furr, et al., 2014, p. 92)

1. *Generate a problem hypothesis identifying the customer and the job-to-be-done*

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For this matter, the team firstly used the help of the customer perspective template (Furr, et al., 2014, p. 93).

- I am a wine farmer in Portugal who is struggling with the effects of uncontrolled wildfires
- I am trying to detect fires as soon as possible to prevent the spread of wildfires and therefore guarantee my harvest as well as protect my farm, land, and family
- But detecting wildfires is time and money consuming
- Because I don't have the technology, or knowledge about technology,
- Additional heatwaves and droughts make the situation even worse

### *2. Create a journey-line for the customer and identify pain points and emotions*

This part of the pain storming session was also undertaken in the Design Thinking class of Prof. Fayard (See Appendix 1: Pain Storming). Customers usually firstly must hire an employee who is patrolling the land daily to detect wildfires as soon as possible. For that reason, they also must buy a vehicle that is able to drive beyond paved roads. Usually, these types of cars are costly and on top of that need a lot of gas. Further, this car has to be maintained and fixed regularly. The job of patrolling large areas of land is a never-ending and resourceful task that feels at the same time highly frustrating. Additionally, there is typically a delay in fire detection because it will be much more difficult to put out a fire once it has grown large enough that you can already see the smoke on the horizon. Mapping out on a large table the single steps and work the potential customers had to take to get their job done, significantly helped to gain a different view of the customer's problem (Furr, et al., 2014, p. 95).

### *3. Select the biggest pain points, and conduct a root-cause analysis*

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This step was conducted during the Design Thinking class as well as during the workshop organized by the Egis group. The outcome of this step showed clearly that wildfires and their impacts as well as prevention are the biggest pain point for the identified customer. Then the three why's were asked in form of a root-cause analysis (Furr, et al., 2014, p. 95). There are two causes that polarized when asking potential customers about their pain. Firstly, because they pose a danger to their families and livelihoods. In the root cause analysis this cause will be excluded. The second cause relates to the cost of wildfires. When asking why the cost of wildfires are a problem for customers, the three answers were: a. the cost that occurs after a fire, the cost of putting out fire and the cost of fire prevention and monitoring. When further questioning the reason behind the pain of the cost of fire prevention and monitoring, the following three main reasons could be identified: a. Target customers still make use of manual fire detecting approaches; b. these approaches are time and money intensive; c. the risk of a late detection of a fire is present.

### *4: Pick a root cause that you think is most important to customers*

The fourth step demands choosing a root cause that you want to investigate further since you believe it is a key factor in the customer's issue. A particular root cause could appear more than once as you create a root-cause tree (the diagram of root causes discovered by repeatedly asking "Why") for numerous issues. This suggests a crucial root cause to investigate (Furr, et al., 2014, p. 96). The main reason behind the target customer's pain where then explored with the help of the root cause analysis (Appendix 2: Root Cause Analysis)

The root cause for that will be further explored in the following part of this research is the cost of wildfire. Involving customers into the pain storming process helped in this stage to deeply understand why the cost of fire is posing such a great problem and is creating a monetizable job.

*5: Questions and assumptions behind the root cause*

During the fifth step, a list of questions and assumptions about the root cause was created. Firstly, it was questioned what prevents or troubles the target customer from getting his job done. Clearly, there is no technology, or knowledge about technology on the Portuguese fire-fighting market that could help the customer getting his job done better and cheaper. Detecting wildfires on large properties is therefore a time and money consuming job that must be done.

The benefits that the customer would expect from the job and what may satisfy him were the subjects of the second question that was explored. Clearly, they want to detect fires as soon as possible to prevent the spread of wildfires. This should be done in an innovative, convenient, yet cheap solution benefiting the customer in form of a guaranteed harvest, less cost of fire monitoring and the protection of his family.

**Step 3: Solution – The Minimum Awesome Product**

How can all these outcomes from pain storming-session be translated into a pain reliever for the target customer before, while and or after the job? Firstly, an affordable 24hr monitoring sensor-technology for property that detects wildfires early has to be developed. Costs the customer will have to pay for this solution must be lower than current solution he is using. The gathered data should be analyzed and used for visualization of property and high-fire-risk areas. Meanwhile the customer must not worry about the maintenance of the sensors. For the visualization of the surveilled property, an application for the smartphone can be developed, that allows an overview of the land, as well as one-connection to authorities in case of a wildfire.

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Before conducting customer testing to help it limit the alternatives to a single solution, a tool called solution storming facilitates this step's broad search for ideas (Appendix 3: Idea Storming). The team found that sensor techniques are used for other areas and industries such as temperature or air quality measuring, plant irrigation for gardening, yet not in the fire prevention field. Jeynathan Dasan, mentor, and head of IT of the Egis group then confirmed the findings and explained how he uses this sensor technology for traffic measuring and decongesting in the greater suburban area of London. For his project he installed moist sensors in the Parisian metro tunnels that allows them to monitor the water level and close gullies to prevent flooding.

Theoretical prototypes or pretend-o-types help responding to key questions while not spending capital on the development on solutions (Furr, et al., 2014, p. 122). For that purpose, once again, customers were questioned, "If you could check on your property visually from your smart phone, and monitor the ignition wildfires, would you want to?" as a first try for a theoretical prototype - The reactions were of high excitement A list of potential customers, that are excited about Carthago's product and willing to have a prototype on their land, was created. The list consists of over 20 wine farmers in Portugal (Appendix 5: Customer List Example).

## **Step 4: Go to Market Strategy**

### **BM Theory**

In recent years, Business Models have become a subject of considerable interest within both academic and business circles. Nevertheless, a full agreement on what a business model is yet to be defined. Some literature explains Business Models as descriptions, others as an activity system, a framework, or a template (Angelis, 2018, p. 47). Articles and books describing business models consistently state that the concept of a business model does not only exist out of a simple explanation of the different building blocks of an organization. Most business models have in common that they of the main pillars about an organization's value creation, distribution, capturing and describing the interactions between the building blocks as concepts (Sund, et al., 2021). In fact, business model literature or a business model canvas is generally centered around an organization's values (Angelis, 2018, p. 47)

Examples for common business models that are widely used on the market are freemium business models where a company offers basic products for free and only charges for premium products, subscription business models where a customer pays a regular fee to get access to the products, or free trial business models where a business lets its customer test their product free of charge. There are many different definitions of business models out there, making the selection for oneself much more complicated. Various tools can help an organization to develop a strong business model, making it particularly important to structure them ahead to determine the right tool for oneself. (Zott, et al., 2011).

Business model innovation is a further part of BM literature and of extremely high interest by organizations and leaders. Business model innovation is considered to contribute significantly to

an organization's competitive advantage and can be even more important than innovation. This is because constant business model innovation is crucial for an organization's ability to adapt to shifting customer needs and environmental change (Angelis, 2018, p. 47).

The Business Model Canvas is a one-page template for outlining a new business model or describing an old one. It is particularly helpful for new organization having to develop a completely new business plan from scratch. With each component being condensed into one or two sentences, it provides a flexible way to convey the essential components of the Business Model. The template consists of 9 blocks that describe how an organization generates, delivers, and captures value. The BMC main goal is to focus more on a customer centric business model thinking than the traditional business plan (Osterwalder, 2013). To enable marketing and operational planning, however, there has not previously been a simple approach to create a complete Business Architecture model starting from a Business Model Canvas (Lambert, 2021).

Structuring a business solely on the business model canvas limits the organizational planning of social aspects that are critical for a strong business model architecture. For this purpose, the Social Business Model Canva (SBMC) can help adapting to an organization that grounds its foundation on a high social corporate responsibility because they have a much more diverse composition of stakeholders (Spiess-Knafl, et al., 2015, p. 114).

The social business model canvas was also selected for the development of the project because it further captures the social impact of the activities of a venture while measuring financial viability (Liaison Entreprises-Universités, 2016). Building a business model based on the SBMC emphasizes much more on the social impact a company is generating, therefore promotes cross-sector partnerships often involving government, trans governmental organizations, firms, and

NGOs (Dahan, et al., 2010, p. 334). This way a dynamic business model was developed including all stakeholders and therefore able to best predict the changes that will be faced.

Once a product that customers want has been successfully identified, it needs to determine how to best deliver it to them at a cost that will result in the profits the organizational strategy requires (Furr, et al., 2014, p. 143). Most innovations require their own business model, even though they might appear highly related to innovations that have successfully been introduced into the market already. Proper business model alignment requires figuring out and testing your go-to-market strategy with actual customers (Furr, et al., 2014, p. 145).

Firstly, the business model canvas template will be used to assess and facilitate creating a current, relevant strategy. The business model canvas will then be followed by a strategic foresight and scenario planning analysis centered around the intuitive logics school.

### **Social Business Model Canvas**

The BMC is one of the most popular and widely spread tools when creating a business model (Furr, et al., 2014, p. 143). As part of the mentoring sessions that were won in the Egis: Team up for Climate Challenge, the company organized two workshops about the Social Business Model Canvas (SBMC) which is a derived version of the Business Model Canvas. For this purpose, the SBMC template, a tool that helps create a solid business model for a social enterprise, was introduced (Appendix 6). In this context the first important building blocks that were focused on are value proposition, segment, and key activities. After clarifying these first three fundamental blocks of the SBMC, the complete template can be taken into consideration. The SBMC template distributed in 4 main topics, consisting of 1) value 2) market 3) implementation and 4) finance (Appendix 6).

Clayton Christensen's Innovator's Method recommends starting with evaluating the pricing strategy of the BMC first because it will aid to a general overview of the prospected revenue (Furr, et al., 2014, p. 145). Since the Carthago team is currently facing high uncertainty regarding the development, as well as running costs of their project, Carthago decided to base the research on an earlier explained SBMC tool (Appendix 6) to analyze each block of the template and develop a strong business model.

## **1. Segment**

This chapter aims to further shed light on Carthago's segment for the beneficiary, as well as the customer that have been identified throughout the research. Monitoring large properties will not be a cheap solution, especially when installing the infrastructure needed. Nevertheless, a large group of possible customers could be identified because the higher the economic value a land has the higher the incentive to work with Carthago will be. The level of Capex the customer is willing to invest further implies two certain factors: 1. The size of the land, and 2. The level of economic value this land has. Further factors for the interest in Carthago's product are the surroundings of the property (such as highly flammable vegetation, as well as the probability of fire igniting in the area).

Taking these influences into consideration, Carthago aims to create a solution for farmers that have valuable land, business owners with their location in high fire risk areas, and business owners that work on paper and need a special protection for their property. Further segments that could be identified were private landowners having to monitor their property and local authorities such national parks in Portugal. This implies that the final customer segmentation will be B2B, B2C and B2G. Once the company has grown to a certain size, insurance companies could also be identified

as a possible customer segment. A possible business model with lower insurance cost for the customer could then be a further incentive for the adaptation of Carthago's technology. Due to more simplicity however, as a market entry strategy, the business model will focus on a strategy for Carthago's B2B and B2C segment that was identified earlier.

The customer's job to be done is to prevent the spread of uncontrollable wildfires. With the help of the solution created, Carthago's customer has the possibility of full-time property monitoring, allowing real-time fire detection (Appendix 7: Customer Persona). The beneficiaries that will be impacted by the project are the customers directly. Altogether, this will support producers in efficient management of their farms, allowing increased quality while contributing to environmental and economic sustainability. Nevertheless, other stakeholders who benefit from Carthago's project, could be identified throughout the research. The local community that lives around places where the solution is integrated, benefit from fewer uncontrollable wildfires, as well as the derived costs and resources needed to put out the fire. The Portuguese biodiversity, flora, and fauna, further benefits directly from the solution because fewer uncontrollable wildfires are directly correlated to burned surface in the country.

## **2. Value Proposition**

The value proposition is defined as the added value of a solution. It entails understanding the problematic and target customer, as well as beneficiary (Appendix 8: Value Proposition Canva). Therefore, it is crucial to understand who benefits the most from the developed product. Even though population density is directly correlated with the number of wildfires igniting, fires in rural areas are usually the ones resulting in large damage (Beighley, et al., 2018, p. 17). Indicating that Carthago will have significant impact on rural areas. Furthermore, there are municipalities like the

city of Mortagua, where Eucalyptus trees are the largest channel of income for citizens. As they grow as much as €4000 per hour (Beighley, et al., 2018, p. 27), the cost of investment appears to be much lower than the derived benefits. The average annual cost of fire suppression in Portugal is three times higher than the cost of prevention and has increased almost 20 percent between 2000 and 2016 (Beighley, et al., 2018, p. 24).

To measure the impact that Carthago will have, it is advisable to clarify some measurable KPI's. Time to fire will be the key KPI for the project, as it allows to detect fires before they become uncontrollable (Brito, et al., 2020). Social KPI's that can be used to give credit to social value proposition of Carthago's project are the number of uncontrolled wildfires in a surveilled area. Further social KPI's are conservation of land biodiversity, as well as the soil fertility in and surrounding the surveilled property. Further, derived from omitting these wildfires resources such as water will be impacted. The long term KPI's of this project could go as far as higher property prices due to less danger due to uncontrolled wildfires. Although these KPI's are trackable, an achievement can only be measured over time. A successful implementation of the project will aid solving several of Carthago's customers' needs and problems. At the same time the business can be sustained while the daily cost for fire prevention and monitoring are lowering thanks to a sustainable, cheap, and convenient solution.

**Mission Statement:** The Carthago project innovates the monitoring of high fire risk areas through an integrated sensor system resulting in fewer uncontrollable wildfires and omits the derived social, economic, and ecologic impacts.

### **3. Activities**

The following section will be dedicated to the necessary key activities that will be carried out. To deliver on the value proposition the team will make use of innovative technologies that enables them to surveille large properties, analyze the data, and alarm in case of an emergency. For that reason, they firstly must develop the product and services around it. Starting with the development of the first prototype by setting the sensors that communicating through a Lo-Ra-Wan technology. This technology requires a certain infrastructure that is already set up by the research team of University UTAD in the north of Portugal. They verbally agreed on sharing this infrastructure with us for prototyping purposes. At the same time, adequate partners for the outsourcing of data analyzation and the development of a customer centric smartphone application.

To attract customers, Carthago will create popularity by talking to municipalities, therefore creating awareness of the project, and additionally contacting all the beforehand collected potential customers (Excel). Carthago's customer will have the final product as an application for the smartphone, allowing monitoring and connection to authorities – from everywhere (Figure 7: Visual Prototype). The future maintenance of the system will be done by technicians allowing a convenient customer centric experience. After evaluating this step of the SBMC, the whole template can be taken into consideration in the order of the 4 groups (Appendix 4)

### **4. Relationship**

In terms of customer relationship, the connection will be operating closely to the customer. For the installment of the project on the customers property the team deeply has to understand the individual needs of the customer, as well as the specialties around his property. This enables Carthago to offer a fully customized product and generates trust between the company and the

customer. Due to maintenance of the sensors while serving a small group of customers with large properties they will stay in close contact after the installment of the product.

## **5. Channels**

The channels that Carthago makes use of to reach and communicate to their customers will in the beginning be mainly face-to-face. This is because, especially for the first projects, Carthago will first have to learn how to standardize the project as much as possible to use the gained knowledge from one customer to the other. These projects are only standardizable to a certain but low level because Carthago offers a highly customized product. Therefore, the team will mainly make use of direct forms of communication. (face-to-face, telephone, E-mail) Further, Carthago plans on taking advantage of their own application in terms of communication channels to the customer. Allowing customers to conveniently manage their account.

## **6. Resources**

Firstly, financial resources are crucial for success, that is why Carthago needs reliable and solid partnerships with organizations that want to develop this project with them, or an investment. However, this topic will be discussed later following the financial part of this paper. Human resources identified were data analytics for the evaluation of the collected data, app development, as well as technical support to install the sensors. As a first physical resource, the hardware in form of sensors, computers, as well as the infrastructure was identified. For the MVP project, Carthago will not outsource the data yet, because they still need it to fully validate the feasibility. The intellectual resources required involves data evaluation and analyzation, coding the machine learning part in the Python program. The development of the App will be outsourced. Further

intellectual engineering knowledge from UTAD and ISTECH Universities for the sensor development, trial, and evaluation will be needed.

## **7. Partners**

Throughout the duration of the project, Carthago was able to acquire a variety of partners that not only helped them advancing their research, but also enabled them to start looking out for investors (Appendix 9: Stakeholder Matrix). Firstly, they were able to count on the advice of all Nova professors that they contacted. Thanks to the Team up for Climate challenge that was organized by the foundation Egis, the Egis group helped with organizational support, mentoring, and gave them the possibility of presenting their project in front of various investors. Paulo Barreto, general Manager of Egis Portugal then connected Carthago to its two most important partners, Professor Antonio Valente, UTAD University and Professor Jose Lima, ISTECH University. With their help not only the feasibility of the idea could be proven, but they also contributed significantly to the development of an estimated cost of a prototype. Furthermore, Carthago has the possibility to produce the prototype with the Universities, before starting to produce in a large manufactory. Another partner worth mentioning is Jeynathan Dasan, Head of IT of Egis group and mentor for the project. He is deeply rooted and known in the sensor industry.

## **8. Cost**

The final cost of Carthago's product still poses high uncertainty while it must be lower than the current cost of fire prevention. For the development of a Prototype, that will monitor 100 hectares of land, it was estimated with the help of Jose Lima and Antonio Valente a need of €50000, distributed as follows: € 10.000 for the construction of the sensors, €2000 for the Lo-Ra gateway enabling the transmission of data, €30.000 for App development, and €5000 for data examination

and processing. Further Carthago plans on holding an additional €5000 for unforeseen cost that can occur throughout the process.

Significant changes will happen to this part of the model as Carthago will be scaling up. As the App will be developed at an early stage of the project, this cost will significantly decrease overtime. Nevertheless, a fraction of the revenue will be dedicated to constant development of the App. After the prototyping phase, when Carthago starts working with their first customers, outsourcing data examination is planned. Especially when serving the first customers, the manufacturing of the sensors will be the largest cost proposition. The maintenance of the sensors is another area that must be kept in mind when planning future financials. This area will grow, not only along the amount of area surveilled, but also with time that the sensors are in the fields, and it is a cost factor that should stay in mind. It is possible to include a warranty of a certain number of years for each sensor. After this time the customer will pay for the replacement of defective sensors. Additional positions that will grow alongside the company are marketing costs, salaries, insurance, R&D etc.

## **9. Projected Revenues**

This chapter still lacks certainty because some crucial factors for the development must be determined. However, the identified revenue sources will be distributed as follows: revenue will be generated through the installment of the sensors and infrastructure in the form of a one-time payment. Further data evaluation and maintenance will then be sold to the customer in the form of a monthly membership. The cost of the product for both the installation and the data examination will differ due to the size of their property. The projected revenue will grow as the number of customers and surveilled land increases. The revenue generated will be from stakeholders with a very high level of influence (investor, customer) (Appendix 9: Stakeholder Matrix). In the future

Carthago plans to include the regional government, and insurance companies into the revenue streams.

## **10. Surplus**

As the Carthago project is currently in a very early stage of the development of the product, to this day there is no projected surplus. However, Carthago decided on dedicating its surplus to reforestation, as well as reinvesting into Carthago by forest monitoring and R&D of the product.

## **Limitations**

The frameworks and methodologies used in this paper were selected based on their perceived effectiveness in reducing uncertainty and ensuring success for Carthago. However, it should be noted that each of the methods utilized have various limitations that hinder their efficiency.

### **Limitations of Social Business Model Canvas**

Following the SBMC, the framework was being utilized to assess how Carthago should approach a forward-looking strategy. This tool was particularly helpful to visualize the necessary activities to start the Project. At the same time, it assisted in understanding the added value of the range partners. Only by combining entrepreneurial and managerial skills with technological knowledge from engineering, will it be possible to carry out the project into the market. Although the SBMC is a great introduction in a company's business model, it lacks clarification in financial details and methodology. The disregard of the SBMC for outside factors such as competitors, risk, and market were a bottleneck for the development of a competitive strategy (Coes, 2014, p. 32).

### **Strategic Foresight and Scenario Planning Limitations**

Strategic Foresight and Scenario Planning suffers from its nature of being an intuitive process, ultimately this results in it having a strong element of subjectivity and qualitative data. While subjectivity offers a more flexible approach and can consider many variables that may be overlooked, a lack of objectivity in some areas of the process may result in a lack of direction. Therefore, to combat this issue, emphasis must be placed on maximizing the plausibility, differentiation, consistency, decision making utility and challenges of the scenarios (Mietzner & Reger, 2005, p. 233). Additionally, the focus on subjectivity may mean that objective data,

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quantitative forecasting, and other techniques are put to the side in favor of hypothetical projections of the future. There is also a reliance on assumptions that may be limited in quality due to the participants that create them, and they may suffer from either bias or wishful thinking (Mietzner & Reger, 2005, p. 236).

## Conclusion

Currently, Carthago is still at the beginning of the S-curve, i.e. the point at which a new product is introduced to the market. At this early stage, it will be crucial to be able to develop a dominant design, so as to discourage the entry of other possible competitors. It is believed that Carthago's proposed technology lies between TRL 3 and TRL 6 on the Technology Readiness Level (TRL) scale. This means that Carthago's technology must be considered somewhat developed and tested, but there is still work to be done before it can be considered fully operational. In this regard, the next steps will focus on trials, experimentation, and further testing directly in the field, thanks to the terrain provided by the potential customers illustrated in Appendix 5. Once the sensor prototypes have been tested and made operational together with Gateways and Servers, they can be introduced into the market by formalizing the product launch. The start of the design and development of the Machine-Learning algorithm will take place at the same time as the initial commercialisation of the sensors, forming the core of Carthago's R&D division. Once finalised and formalised, this functionality will be integrated as a product upgrade, thus completing the conceived Technological Ecosystem.

From a strategic standpoint, there are several steps Carthago can take to mitigate uncertainty and promote success through scenarios. First, it is strongly recommended that Carthago enter the market early to gain a first mover advantage. It has been established in more than one scenario that

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early market entry is beneficial for Carthago, as it will ensure customer loyalty, brand recognition, and increase the company's market share. Secondly, Carthago needs to invest in building partnerships with the public sector to establish steady sales and improve government cooperation. Third, in the face of numerous competitors, Carthago should implement a product differentiation strategy, focusing on convenience, ease of use and high switching costs. In this way, Carthago will be able to influence consumers who are unwilling to adopt the technology due to its complexity of use, securing Carthago's future for scenarios 1 and 3, but also 2 and 4, as ease of use is still attractive to technology-savvy consumers. A key role will be played by the structuring of a monitoring model that allows for the proper quantification of Carthago's achievements one year into its existence. This will allow objective evaluations to be made in determining ambitious but achievable targets, so that the technology can be consolidated within the market and any gaps or shortcomings in consumer expectations and production efficiency can be addressed.

*“No industry creates more value in today’s economy than the technology industry. Its innovations fuel the digital world. But tech is also one of the most volatile industries, experiencing constant disruption that challenges even the strongest organizations. Incumbency is often a liability. And with its outsized impact, the tech industry is subject to increased scrutiny—which means leaders are in a state of always-on transformation and must constantly examine how they contribute to society.” (The Boston Consulting Group, n.d)*

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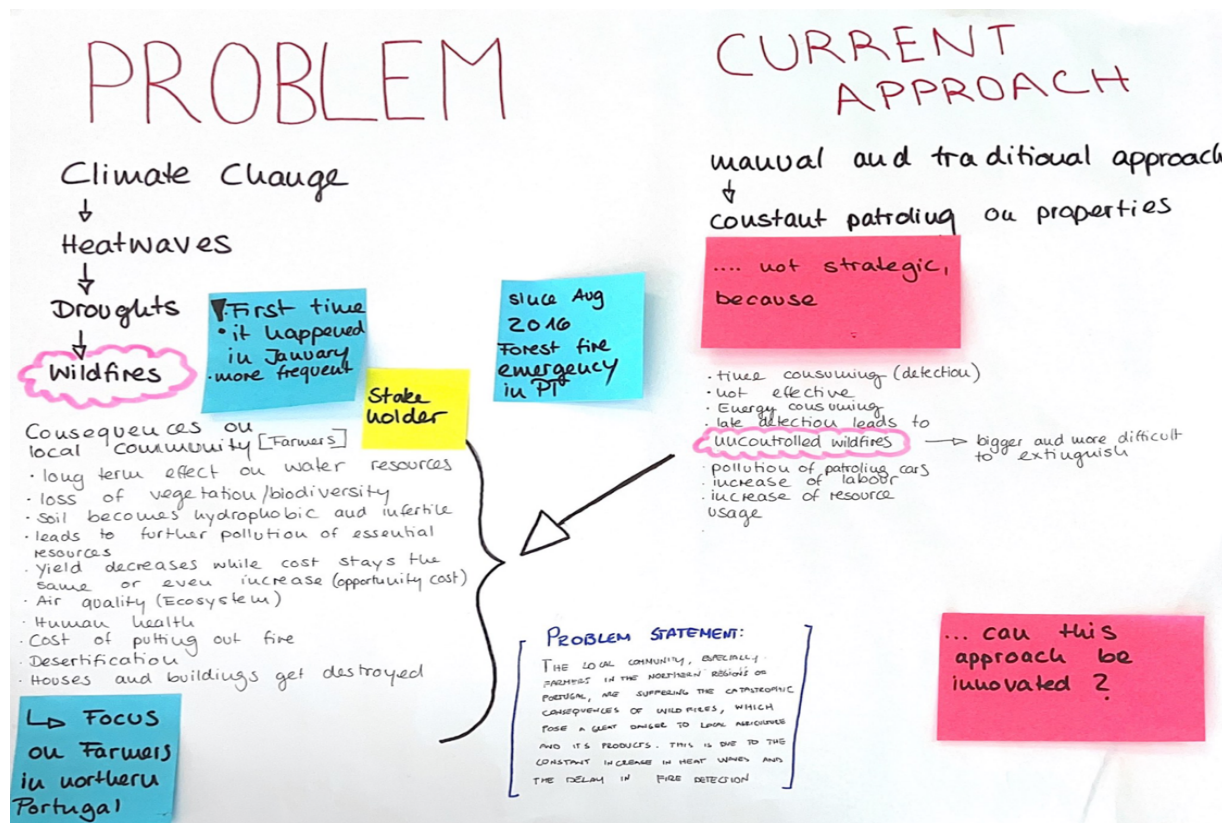
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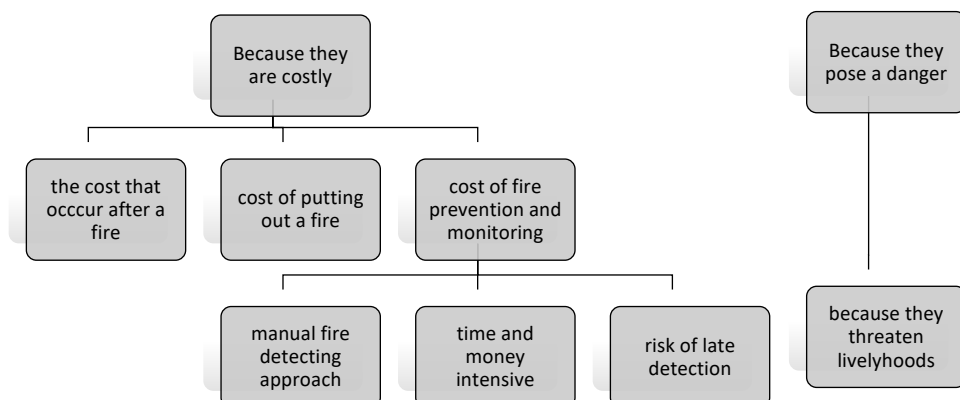
## Appendix

## Appendix

### Appendix 1: Pain Storming

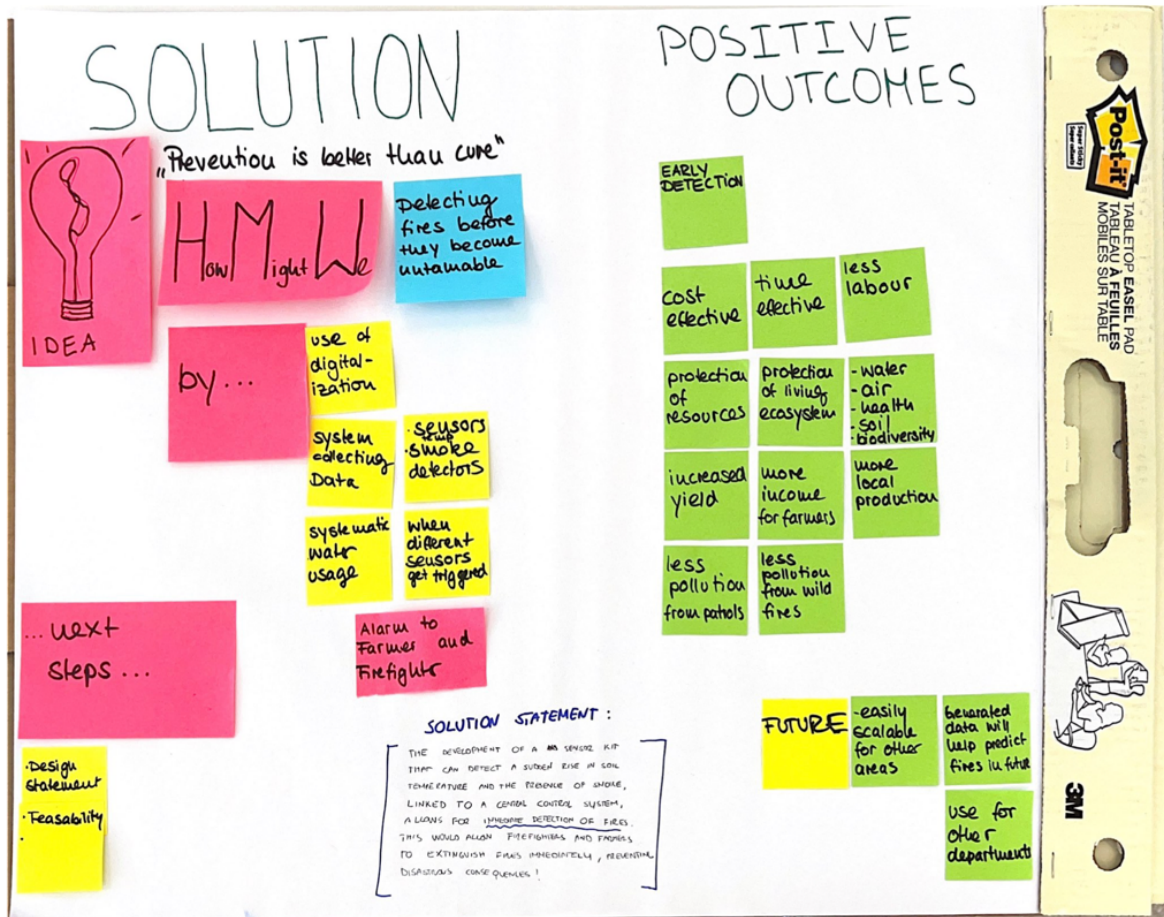


### Appendix 2: Root Cause Analysis

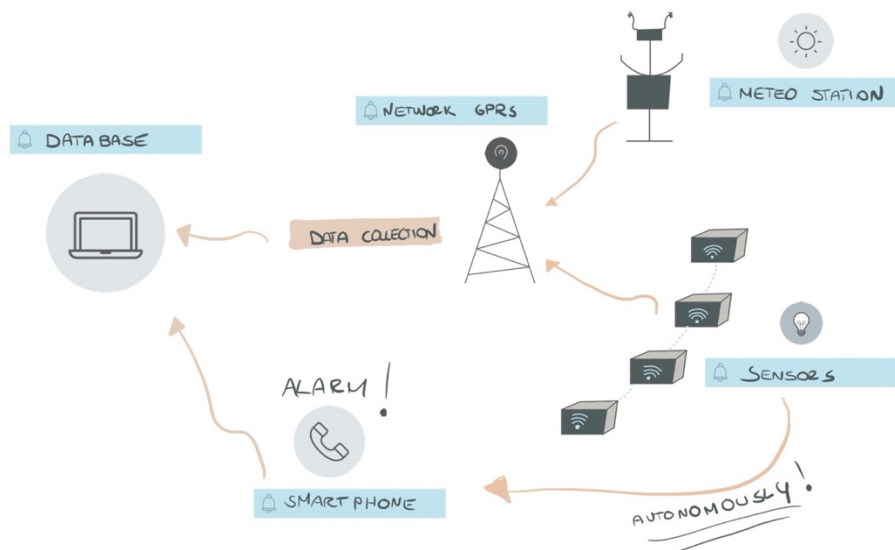


## Appendix

### Appendix 3: Idea Storming



### Appendix 4: Visual Prototype

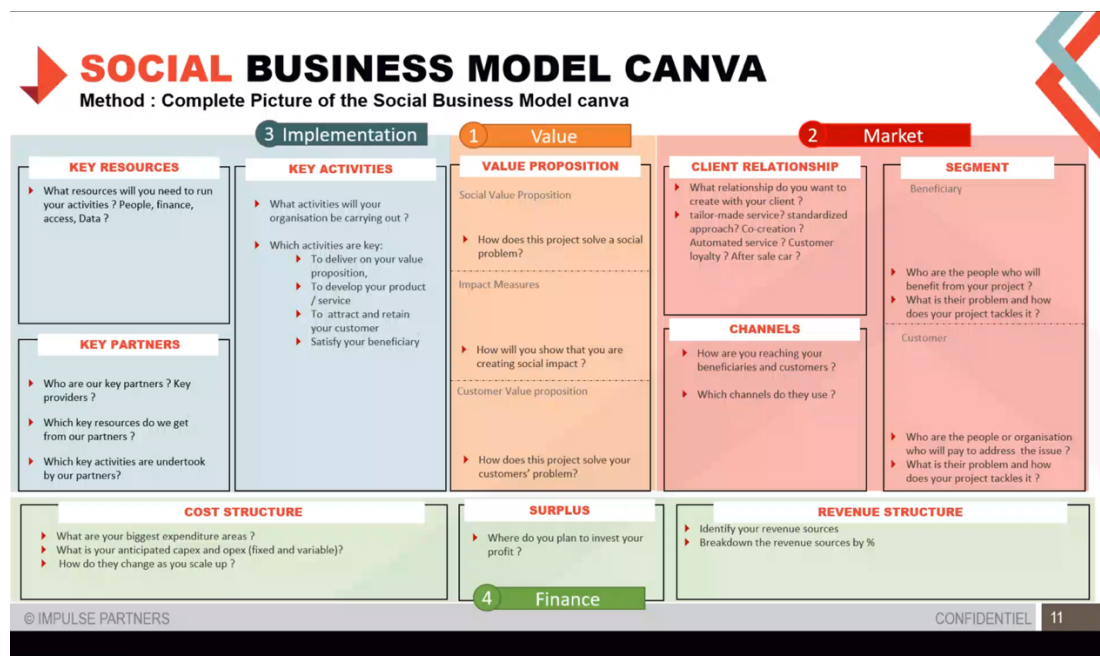


## Appendix

### Appendix 5: Customer List Example

|                                                                                                                  |                                                  |                                                  |  |
|------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|--------------------------------------------------|--|
| <b>1 - IDENTIFICAÇÃO DO PROPRIETÁRIO</b>                                                                         |                                                  |                                                  |  |
| NOME: <u>CITAGO, LDA</u>                                                                                         | MORADA: <u>Rua da Fonte n.º 4 Sta. Margarida</u> |                                                  |  |
| CONTACTO: <u>919361088</u>                                                                                       | NºCONTRIBUINTE: <u>501748245</u>                 | RESPONSÁVEL: <u>Luís Gonçalves</u>               |  |
| Nº CONTRIBUINTE: _____                                                                                           | CONTACTO: <u>919361088</u>                       |                                                  |  |
| <b>2 - IDENTIFICAÇÃO E LOCALIZAÇÃO DA EXPLORAÇÃO</b>                                                             |                                                  |                                                  |  |
| NOME DA EMPRESA: <u>CITAGO</u>                                                                                   | LOCAL: <u>Stª. Margarida...</u>                  | FREGUESIA: <u>Alte / Benafim/ Lagos/ Paderne</u> |  |
| CONCELHO: <u>Loulé</u>                                                                                           | DISTRITO: <u>Faro</u>                            |                                                  |  |
| ÁREA : 300 há                                                                                                    |                                                  |                                                  |  |
| <b>1 - IDENTIFICAÇÃO DO PROPRIETÁRIO</b>                                                                         |                                                  |                                                  |  |
| NOME: <u>Citropedraiva, Lda</u>                                                                                  | MORADA: <u>Ferrarias - 8365 - 084 Algoz</u>      |                                                  |  |
| CONTACTO: <u>917213213</u>                                                                                       | NºCONTRIBUINTE: <u>507946294</u>                 | RESPONSÁVEL: <u>David Ferreira</u>               |  |
| <b>2 - IDENTIFICAÇÃO E LOCALIZAÇÃO DA EXPLORAÇÃO</b>                                                             |                                                  |                                                  |  |
| NOME DA EXPLORAÇÃO: <u>Carrasqueira; Ruiva; Paderne; Donald; Palmeiras; Mato-à-vista; Cuacra, Montes Velhos.</u> |                                                  |                                                  |  |
| CONCELHO: <u>Messines, Paderne, Portimão, Aljustrel</u>                                                          | DISTRITO: <u>Faro</u>                            |                                                  |  |
| ÁREA : 350 há                                                                                                    |                                                  |                                                  |  |
| <b>1 - IDENTIFICAÇÃO DO PROPRIETÁRIO</b>                                                                         |                                                  |                                                  |  |
| NOME: <u>Beatriz Maria Carvalho Dos Santos</u>                                                                   | MORADA: <u>Ferrarias - 8365 - 084 Algoz</u>      |                                                  |  |
| CONTACTO: <u>919073790</u>                                                                                       | NºCONTRIBUINTE: <u>168465922</u>                 | RESPONSÁVEL: <u>David Ferreira</u>               |  |
| ▶ <u>Folha1</u> +                                                                                                |                                                  |                                                  |  |

### Appendix 6: Social Business Model Canvas



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### Appendix 7: Customer Persona



**MICHAEL**

"We already had a fire this year, two weeks ago. This is not normal for winter. Now there's an employee patrolling the vineyards daily!"

NEEDS to detect fires ASAP

PAINS droughts ; uncontrolled wildfires

CHANNEL in person or telephone

MOTIVATION sustain family business

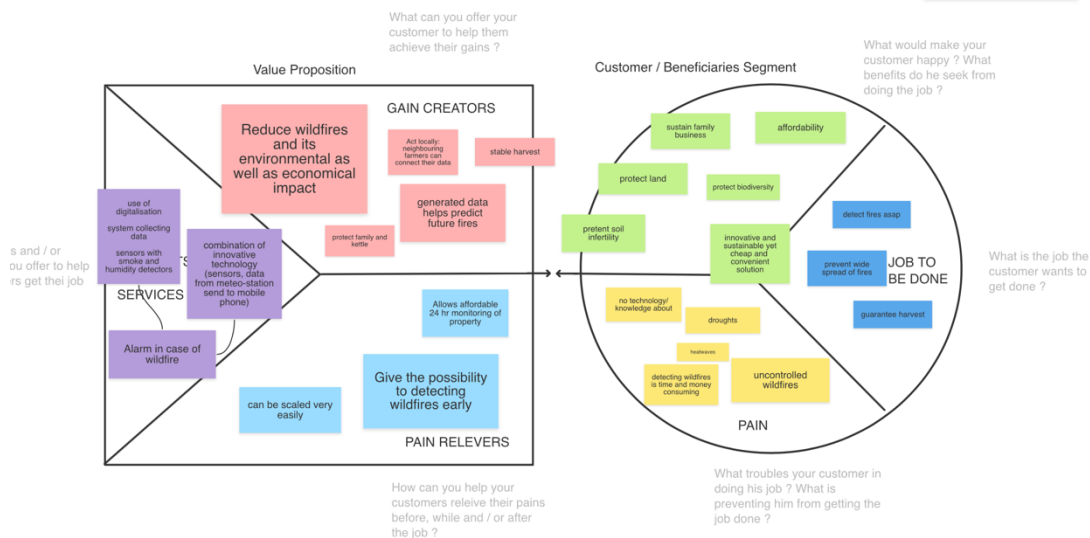
### Appendix 8: Value Proposition Canva

1 based on the Value Proposition Canva (20 min)

## Team Impact Seekers

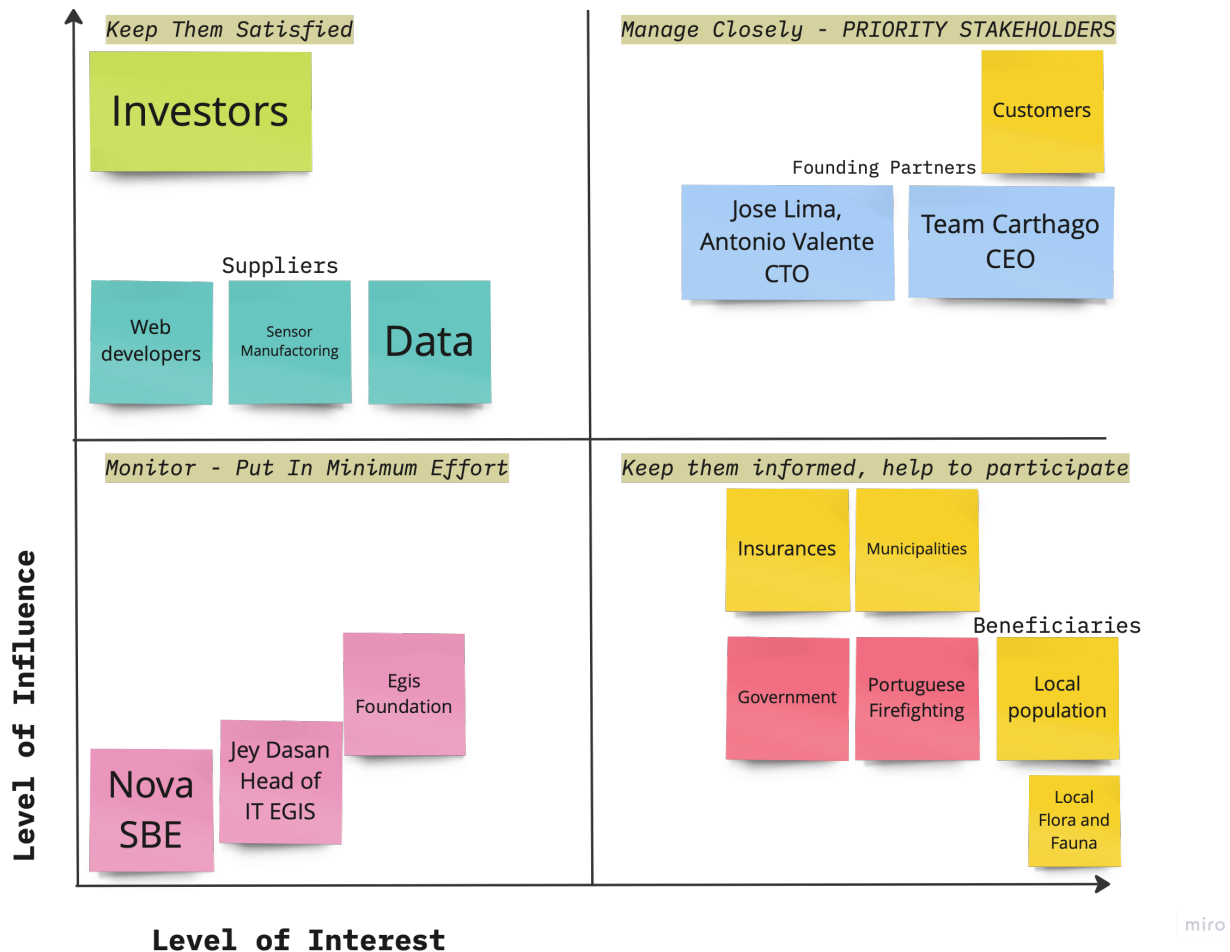
Customer/  
beneficiary:  
Farmer in Portugal

Timer 20 min !



## Appendix

### Appendix 9: Stakeholder Matrix



### Appendix 12: Observation Biovilla

The team conducted a workshop at Biovilla, in the National Parc of Arrabida, 40 minutes outside of Lisbon. It is a space for sustainability via creation, experimentation, and unity, relying on the limitless power of human ingenuity to develop solutions and alternatives to humanity's most urgent issues. Biovilla is a non-profit Organization that generates part of their revenue with sustainable tourism while its main purpose is the conservation of biodiversity, as well as acceleration of

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nature's regeneration. I decided to pick this workshop for my reflection post, not only out of personal interest and because I already went there to conduct an interview, but also because I was sure that they could share much important information with me for the course Design Thinking, StartUp Mastery and Data Science for Social Innovation.

My colleagues and I arrived at Biovilla early in the morning. The volunteers were separated into groups after the director gave a pleasant and informative introduction. My group was given the responsibility of going into the pinewoods and collecting fresh pinecones by climbing up high on trees. The pine seeds are extracted from the cones by drying them in a dehydrator at Biovilla. The project coordinator who also studies Permau then showed me around the Biovillas property and described in detail what we were doing there and why. He began by pointing to the valley's northern hill. According to him, a fire must have occurred in the area some 30 years ago, based on the size of the plants and the presence of only certain flora. He went on to say that the earth is incredibly fruitful after a fire, but it is also very vulnerable. He described how long it takes for nature to recover from such an extreme event, and how, because nature has its own natural order, which plants grow first is far from random. A forest can take up to 100 years to regenerate after a fire, according to him. Then we went to another area of the land where Biovilla is doing agroforestry. Agroforestry in Biovilla is practiced by planting small biotopes measuring 4 by 4 meter. There are different types of plants that belong into an agroforestral biotope. Starting from the ground with one-year lasting plants like weeds and vegetables, then small bushes like raspberries and larger bushes like elderberry which live for up to 30 years. Lastly trees will complete the habitat. Here he explained that is important to have a mix of fruit trees which last up to 70 years and long-term trees like olives and pines. Then we went to check out the habitats. The first one shown was 3 years old. One could already see that the vegetation was much more advanced than on the other side of the

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hill. He then explained me that with this kind of planned agroforestry, humans can accelerate the regeneration of nature by decades. “Those habitats then also have a much higher ability of saving water and protecting the soil. This means that once a forest has regenerated, a fire is much less likely to ignite in that area”, he continued.

It was very exciting to me to not only learn about all of this but also to be able to contribute to the project. Furthermore, I am confident that this idea has a lot of promise for farmers. Perhaps an agroforestral project could be incorporated into our Agorize initiative. It's possible that when the sensors are distributed throughout the properties, agroforest habitats will be planted alongside the sensors. Not only will these small biotopes protect the soil, but they will also reduce the risk of wildfires over time. I'll produce a brief presentation on this extension of our proposal for our next project mentoring session. I'm looking forward to hearing from both my mentor and my team.

### *Appendix 13: Michael*

#### Interview Guide Nova Innovation Lab / Winery in Muge and Sintra

##### Research objectives

As we've done some research about the effects of climate change in Lisbon, we have noticed that one of the biggest threats is concerned with the magnitude and frequency of floods increasing due to the concentration of precipitation in the winter season, and a predicted increase in frequency of heavy rainfall. Water quality will deteriorate as a result of a rise in temperature and a reduction in river flows in the summer season.

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With that in mind, we are aiming at finding an innovative solution allowing the city of Lisbon to respond in a resilient way to these threats.

### Introduction

1. What is your position in the company/club?

I am an Innovation Consultant intern. I have been working there for three months and we're trying to find an insurance together with a big insurance company for people who are being replaced by automation. So, it doesn't have much related to climate change, but I'm trying to answer your questions as good as possible.

2. Do you deal with climate change in your daily life? If yes, how?

The only thing I could think about is Sintra and Muge, where we have wineries. It seems like because of the lack of the rain this year, we have to much more water to water the plants as well as in the wine yards in Muge. We already had a fire, a big fire, two weeks ago which is not normal because usually the fires come in summer. Now there's an employee who has to every night and drive around the property to check if there are fires because it happened super quickly and unforeseen. And I remember in 2017 we were even having fires in Sintra which was super close to our house. If you're living in like around pine trees, they if they burn the pinecones explode. This makes the fires spread even faster. If the land is dry on top of that the fire spreads faster. Considering that the houses are made of wood, it is quite dangerous.

### Opening questions

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3. As a busy citizen of Lisbon, what is the most attractive way for you to contribute? To participate in climate-related actions OR being rewarded for consuming water in a responsible way? (Here we can change the consumption of water to something related to flooding and drought)

Being rewarded for consuming water in a responsible way is a super, super cool, cool question. Because what we do in Sintra is that we have a lake and our own water tank with water from the mountains. I know, that's not really normal, but that's how that's how it is. What we do regarding the fires is we have a contract with the government. If there is a fire there, they're allowed to come in a helicopter and take the water out there. But apart from that, as a busy citizen of Lisbon, I'm not really sure what they're doing there. I believe fires are not the biggest threat for them. And as said I am not living in Lisbon, so I am not quite sure. But I do really believe you should be rewarded for consuming water in a responsible way. Water here in Portugal doesn't come from the mountains and is very limited. Even a toilet flush does use much more water than it would actually need. Maybe this is a thing that you guys should look into.

4. When it comes to resilience towards climate change in the region of Lisbon what do you believe are the biggest threats?

From my point of view, definitely fires. Again, back in 2017, the fire was going all the way back to Guincho. And these were partly not even natural fires. Some were manmade because there was an interest on the Land, especially for touristic reasons. As we know that Portugal is very corrupt there could be this threat as well. Trash is another big problem in this area because many people don't dispose their trash properly. Glass in fields then starts burning super quickly again and we are facing another fire.

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5. What are the concrete action that the municipalities are taking in order to build resilience for climate change?

I am actually not even sure if they are doing that because I know from the box challenge with Luciano Fresco that the sustainability lab is trying to do sustainable farming but that is something completely different. One company which is controlled by the municipality of Cascais they are looking into reurbanization and greening up the city but here I am also not sure how they want to do that. Maybe it would be interesting for you.

### Dig Deep

6. Where do you see opportunities and room for more development? At the university level, city level?

They both have to work together on combating climate change. In Sintra for example there is a tree planting foundation where people from University go into the woods and plant trees. I mean it will not change the world but it is a beginning. There should be many more of these projects.

### Test your hypothesis

7. Do you believe innovation will play a major role in the urban adaption to climate change? If yes, how?

Yes, of course. I think it will definitely. Talking about the fires for example there could be sensors that send out information about the heat of different areas and automatically warning when temperatures get too hot. Usually, this is an indicator for fire. This would innovate vine yards drastically. For the water usage problem I know a guy that you should talk to. He wants to develop a shower that tells you how much water you use and eventually stops at one point.