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Project report
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Project Report Group SDG15

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Abstract

This report presents the development of Group SDG15 solution to enhance industry accountability for pollution, thereby contributing to Sustainable Development Goal 15 (Life on Land). Utilizing a service design approach and leveraging the Double Diamond model and design thinking methods, we identified SnifferDRONE technology, equipped with CO2 sensors and RandomPower encryption, as the most promising solution for comprehensive emissions monitoring. This innovative approach offers several advantages, including real-time data collection, extensive coverage of industrial sites, and guaranteed data integrity through advanced encryption. The proposed solution has the potential to measure emissions accurately, leading to a significant reduction in industrial pollution, which in turn mitigates biodiversity loss and contributes to a more sustainable future.

This project is part of ATTRACT, funded by the European Union's Horizon 2020 Research and Innovation Programme.

1 Introduction

The challenge faced by our group, Group SDG15, was related to Sustainable Development Goal (SDG) 15 – Life on Land. This goal aims to "protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and end biodiversity loss" (Globalgoals.org, 2024). Our objective was to develop solutions linked to SDG 15 using service design methods and leveraging technologies from the ATTRACT program.

In the early stages of our process, we narrowed our focus to habitat loss. Habitat loss is defined as "a decline in species-specific habitat quality that leads to reduced survival and/or reproductive success in populations, e.g., related to changes in food availability, cover, or climate" (UNEP, 2020, based on IUCN). This phenomenon can occur due to the destruction, fragmentation, or degradation of a habitat, and is primarily caused by human activities (National Wildlife Federation, 2024). This focus aligns with one of the twelve SDG 15 targets: Protect Biodiversity and Natural Habitats, which aims to "take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity, and, by 2020, protect and prevent the extinction of threatened species" (Globalgoals.org, 2024).

As the process progressed, we further refined our focus. Utilizing service design methods, our group concentrated on the environmental effects, particularly pollution, that contribute to habitat loss. The problem statement was defined as follows: Global industries are not held accountable for pollution, and it's hard to measure their CO2 emissions accurately.

This CERN bootcamp report presents the work we conducted primarily at CERN in June 2024. We begin by outlining our development approach, which included design thinking, service design, and sprint methodology. We then describe the evaluation of our design process, from the inception of the course to the final day at CERN. Subsequently, we provide a detailed description of our solution, including an explanation of how the selected SnifferDRONE technology was employed. The conclusion offers final insights into the process and the developed solution.

2 Development approach

Our project utilized the Double Diamond model (Figure 1) developed by the British Design Council as the main framework for our service design process. We approached the development task with flexibility, without pre-determining the methods to be used. The core principle of the Double Diamond model is that the optimal way to develop a functional and user-centered service is by focusing on user needs and iterating on ideas. Initially, the process aims to achieve a deep understanding of user needs, while the second diamond focuses on the practical testing of the service with users. According to the model, it is crucial to navigate through two distinct phases (the "diamonds") and iterate on ideas between these stages (The Design Council, 2023). The service design project development process typically follows the Double Diamond model, which consists of four stages: discover, define, develop, and deliver. This model involves alternating between divergent (creative) and convergent (decision-making) thinking. The "discover" and "develop" stages are characterized by divergent thinking, whereas the "define" and "deliver" stages are more convergent in nature. (Stickdorn et al., 2018, pp. 88–89.)

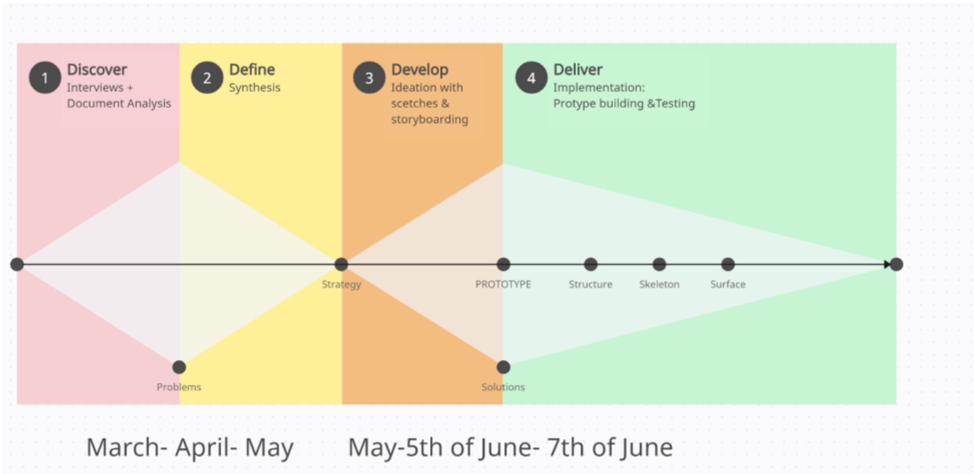

Figure 1: Double Diamond model with the group's working timetable

Another key methodological framework we adopted was from the book "Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days" by Knapp, Zeratsky, and Kowitz (2016). The book introduces a practical approach to problem-solving. Unlike typical stage names found in models like the Double Diamond (The Design Council, 2023), the authors of "Sprint" use a novel approach by structuring the process around days of the week. This method adds a sense of rhythm and structure, making it more relatable and less theoretical, especially for novices to agile methods or service design. However, we noted a desire for more in-depth discussion on the challenges of implementation and scaling that often arise after the sprint process. While the book emphasizes the importance of testing and iterating prototypes, additional guidance on navigating the complexities of bringing a solution to market and ensuring its long-term success would have been beneficial. Developing a prototype is one aspect but transforming it into a sustainable and impactful solution requires a different set of skills and considerations.

We also employed the Service Design Thinking (SDT) method, which is based on iterative development. Service design helps organizations view services from the customer's perspective. It is a creative and human-centered co-creation process, especially suitable for creating and developing services. (Stickdorn et al., 2018, p. 20.). Service design is a systematic approach that aligns user needs and expectations with the business goals of the service provider, aiming to create a customer-oriented, holistic, and positive service experience (Tuulaniemi, 2011, p. 78).

Throughout our process, we found storyboarding to be one of the most valuable tools in focusing on who our client is and what jobs they need to be done. Storyboarding involves presenting different stages visually using images, photographs, screenshots, or sketches. The purpose is to narrate the story of specific situations within their own context and environment. (Stickdorn et al., 2018, p. 45.)

In order to execute the first part of the double diamond process - to discover - we chose interviews as the primary research method and document analysis as the secondary research method for data gathering. The latest is ideal for examining existing materials, such as transcribed interviews, websites, newspaper articles, discussions, reports, and other written documents.

Document analysis is particularly effective because it is context sensitive. It allows us to understand how the phenomenon under study appears in its natural environment, providing a robust basis for drawing clear and reliable conclusions. This method is valuable for evaluating the current state of the phenomenon and identifying future research trends. Figure 2 illustrates a general model of qualitative research, effectively outlining the main stages of document analysis (Ojasalo, Moilanen & Ritalahti 2018, 136-138).

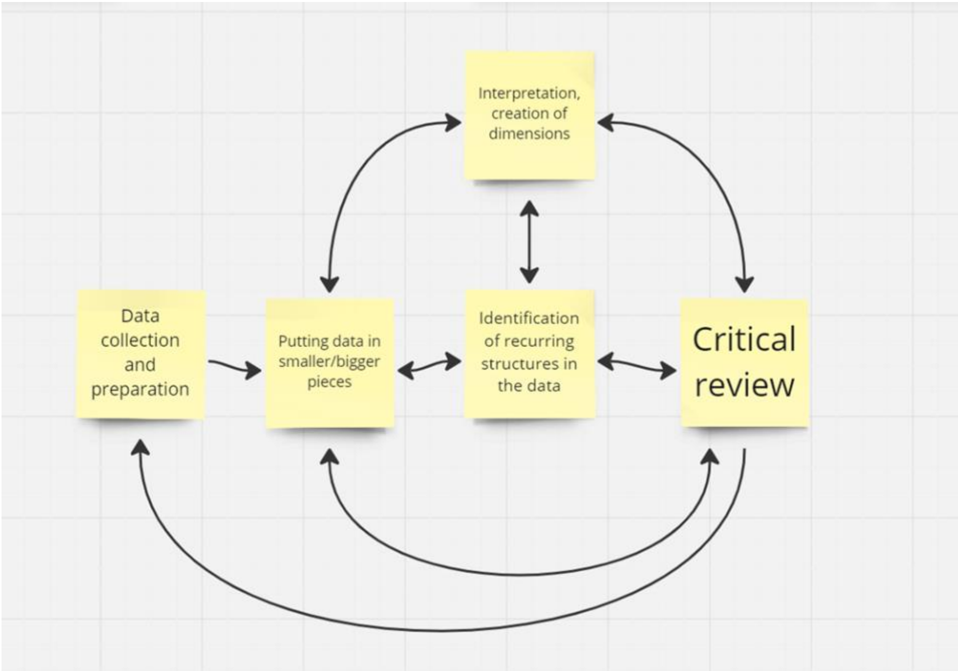

Figure 2: General model of qualitative research

The interview is one of the most common data collection methods. It allows for a discussion between the researcher and the interviewee on topics related to the research, using various types of interviews that can be more or less structured or informal. In this case, we decided to choose a semi-structured interview, where all interviewees are asked the same or nearly the same questions in the same order, adjusting them according to the interviewee's role. (Puusniekka & Saaranen-Kauppinen 2006.)

We decided to invite individuals with different roles to the interviews, ranging from scientific experts to stakeholders with insights into the implementation of political decisions. Specific sections of questions were crafted for our interviews. In total, we conducted 7 interviews covering 5 sections: challenges & limitations, international cooperation & panels, initiatives & improvement suggestions, consequences & stakeholder perspectives, and technological innovations.

The structuring of the material and qualitative analysis were carried out so that each person was responsible for reviewing their own interviews and conducting the analysis based on themes and responses received. The material was structured using the thematic analysis method. Thematic analysis is a method where the material is examined based on key topics, or themes. Themes can be formed by analyzing the material and looking for common or distinctive features in the interviews, responses, or writings (Puusniekka & Saaranen-Kauppinen, 2006). For practical guidelines that we used to implement this method, we utilized instructions from Jodi Aronson's (1995) article "A Pragmatic View of Thematic Analysis."

As for technical support for transcription and analysis, we were backed up with Google Forms, Turboscribe, and MAXQDA. We have the opportunity to leverage technical tools to ensure that all members of the group can review all the interviews, as we obtained permission to record the interviews at the beginning of each session.

3 Evolution of the design

This chapter outlines the evolution of our design process, starting from the initial data gathering to the definition of the problem and solution, and culminating in the prototype of the product. We present the tools and methods we used, as well as the rationale behind our selection of ATTRACT technologies.

The first phase of our design process involved data gathering, corresponding to the initial stage of the double diamond model. During this phase, we collected general information about the challenge while simultaneously researching the latest findings, conducting expert interviews, and exploring relevant topics, which are discussed in subsequent chapters. The data gathering process consisted of five steps: problem analysis, stakeholder analysis, the 5 Whys analysis, constructing a research wall, and using a decision matrix. All information was documented in Miro. Throughout these steps, we incorporated the latest research, interview insights, and other sources to ensure a comprehensive understanding of the problem. This allowed us to define our final problem with a solid foundation of relevant data.

The second phase of our process took place at CERN and involved defining the final problem (the midpoint of the double diamond model), brainstorming and detailing the solution (the second phase of the double diamond model), and developing the business model and product prototype. This phase included defining the final problem, sketching various solution options, using sticky decisions, creating a storyboard and a product prototype, and completing both the value proposition and business model canvas.

3.1 Problem analysis on biodiversity loss

The aim of the problem analysis (URBACT, 2024) was to develop a comprehensive understanding of biodiversity loss. The analysis was conducted by dividing into two groups: one focused on the consequences of biodiversity loss, while the other examined the underlying causes. Both groups explored various causes and consequences, which were then discussed collectively. Ultimately, the group members voted on the most compelling topic for further research. As a result, habitat loss was selected as a more specific aspect related to biodiversity loss.

3.2 Stakeholder analysis

The aim of the stakeholder analysis (Mindtools, 2024) was to identify key stakeholders relevant to the selected topic of habitat loss and biodiversity in general and to understand their roles in relation to these issues. Stakeholders were categorized into different beneficiary groups, including direct beneficiaries affected by the problem, primary cooperation partners, those providing useful information, potential opponents to the initiatives, and other relevant stakeholders. This analysis resulted in the creation of a comprehensive list of experts to be interviewed for further insights.

3.3 5xWhy analysis on habitat loss

The aim of this activity was to deepen our understanding of the causes behind habitat loss. Each group member independently researched specific reasons for habitat loss using the 5 Whys method to uncover the underlying causes (5 Whys, 2024). The group chose to focus on anthropogenic causes, which led us to research topics such as urbanization, resource extraction, deforestation, climate change, pollution, and agriculture. During this activity, we utilized various sources, including scientific articles and websites of expert organizations. Additionally, we incorporated information from interviews into our analysis. At the conclusion of this activity, group members shared their knowledge, and our findings were compared with insights from the expert interviews.

The 5 Whys analysis clearly demonstrated the interdependency of various factors contributing to habitat loss: urbanization, resource extraction, deforestation, climate change, pollution, and agriculture. For example, the increasing demand for natural resources, driven by population growth and economic activities, leads to deforestation, urbanization, and agricultural expansion, which destroy or alter habitats (Williams et al., 2021). Societal attitudes often view nature primarily as a resource for exploitation, contributing to unsustainable practices that prioritize short-term economic gains over long-term sustainability, undervaluing the ecosystem services provided by biodiversity (Wessing, 1995; Narvaez et al., 2023). In addition, weak governance and inadequate regulations allow illegal logging, mining, and wildlife trade to flourish, further driving habitat loss (Williams et al., 2021). Pollution from industrial, agricultural, and urban sources degrades land and water quality, rendering habitats uninhabitable (Chu & Karr, 2017). Moreover, future climatic changes are expected to significantly reduce the capacity of landscapes to support biodiversity, exemplified by temperature-induced wildfires that threaten endangered species globally.

These examples illustrate the interconnected nature of the causes of habitat loss and their respective consequences. Despite the complexity of these interrelationships, we identified population growth, pollution, land degradation and the increasing demand for human needs, including overconsumption, as some of the most critical and pervasive underlying causes of habitat loss.

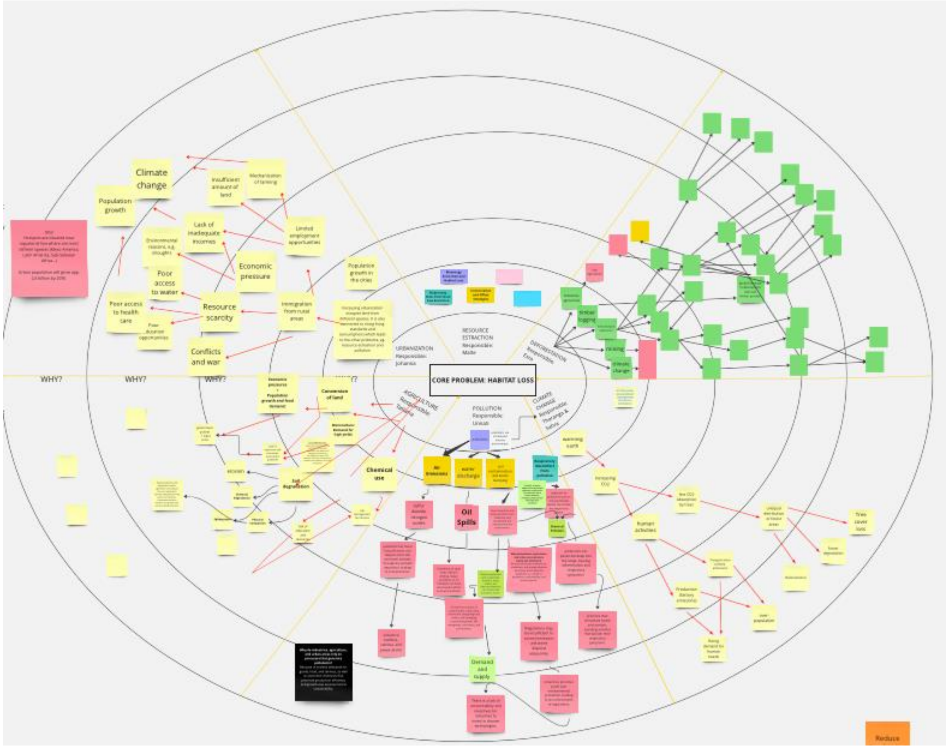

Figure 3: 5xWhy analysis

Otsikko on kansilehden rivillä 11 (vastaa vakioasetellun asiakirjan pääotsikon paikkaa), ensimmäisessä sarkaimessa. Pitkä otsikko voidaan myös keskittää. Mikäli haluat lisätä kuvan etusivulle, sijoita se otsikon alle keskitettynä, kokonaisuuteen sopivassa koossa.

3.4 Research wall

After the problem analysis on habitat loss, we collaboratively constructed the research wall. This tool enabled us to identify various patterns within the data (This is Service Design Doing, 2024, Chapter 5: Research, Building a Research Wall). We used it to uncover new connections and groupings based on our prior analysis of the topic and information obtained from expert interviews. Although our focus was on habitat loss, we also included information on biodiversity loss due to the interconnected nature of these issues.

By the end of the second-to-last week of May, we identified six new ways to group the information on habitat loss and decline in biodiversity, based on our research wall analysis. This work was set to continue into the last week of May.

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1. **Good Intentions, Bad Outcomes**: This category includes activities that, although intended to mitigate the negative impacts on biodiversity and habitat loss, have inadvertently caused further harm or deterioration in sustainability.

2. **Lack of Knowledge**: This grouping highlights the general lack of awareness regarding the causes and consequences of biodiversity and habitat loss, the sustainable products and activities available, and the deep scientific understanding of the cascading effects of these losses.

3. **Environmental Effects:** This category encompasses various actions and activities that have adverse effects on biodiversity and contribute to habitat loss.

4. **Lifestyle & Decision Making**: This group compiles information on the impact of consumer habits, the role of decision-makers in biodiversity and habitat loss, and the need for new visions for a sustainable future and lifestyle.

5. **Inequality Between North and South**: This grouping underscores the disparity between the entities responsible for biodiversity and habitat loss and those who suffer the most from its consequences. It also emphasizes the importance of intersectional and international cooperation to address these problems effectively.

6. **SnifferDrone with Camera:** This group offered an initial perspective on how SnifferDrone technology could be applied to biodiversity and habitat loss, based on the information compiled on the research wall. (This grouping was changed to be a selection criterion in the next phase)

Figure 4: Research wall

3.5 Decision matrix

Based on the results from the previous phase (research wall and new groupings), we refined our problem using a decision matrix (Stickdorn et al., 2018, p. 184). The various options were derived from the groupings established during the research wall phase (e.g., good intentions, bad outcomes). The selection criteria included the desired impact, scalability potential, and the compatibility of different ATTRACT technologies.

Each group member was given three votes, which they could distribute among different options or allocated entirely to a single option. Consequently, "environmental effects" was selected as our focus area, with pollution identified as a critical topic. The chosen technology for addressing this issue was SnifferDRONE.

3.6 Defining the final problem (Monday)

The first task at CERN was to define our final problem based on all the prior work completed in Finland, with a specific focus on the narrowed topic of “Environmental Effects” and the application of SnifferDRONE technology.

We utilized a modified version of the think-pair-share method (The Teacher Toolkit, 2024). Group members were divided into pairs, with one trio due to the group size. Each pair was tasked with formulating concrete problem statements related to habitat loss and environmental effects. These statements were then shared with the entire group, and their common features were collectively discussed. The prevailing commonality in all problem statements was the lack of accountability in the industry. Consequently, the three problem statements were synthesized into a single unified statement.

Problem statement: Global industries are not held accountable for pollution, and it’s hard to measure their CO2 emissions accurately.

3.7 Sketching different solutions (Tuesday)

The aim of sketching is to transform abstract ideas into concrete solutions. Once these ideas are made tangible, they can be evaluated more easily and objectively by other group members (Knapp, Zeratsky, and Kowitz, 2016, p. 103). Our group used this method to independently sketch various solution options for the identified problem. This process resulted in six different solution ideas, as one group member was unable to participate due to illness during the week.

3.8 Sticky decision for defining the final solution (Wednesday)

Given the diverse solutions generated during the sketching phase, the group needed to converge on a single, unified solution. To achieve this, we employed a modified version of the "Sticky Decision" method, which included the following three steps: art museum, speed critique, and straw poll (Knapp, Zeratsky, and Kowitz, 2016, pp.

131-139), along with an additional step for collaboratively formulating the final solution.

First, the different options were presented in an "art museum" format: each solution was displayed on the wall, and group members independently read and evaluated them in silence, adding comments and questions next to each idea.

Second, we conducted a speed critique session to discuss the solution options. Each option was examined individually. The facilitator summarized the main ideas of the sketches, after which team members provided feedback on the solutions. The designer of each sketch then had the opportunity to clarify any misunderstandings and elaborate on the main concepts if necessary.

Third, we conducted a vote to select the best features from the different solutions. Each group member was allocated three votes, which they could use either to support a single feature or to distribute among various features from different options.

Finally, based on the features that received the most votes, we combined the best elements from the different solutions and collaboratively formulated the final solution.

Final solution: An application using SnifferDRONE and RandomPower technology to tract and regulate industrial emissions, holding industries accountable for lowering their CO2 levels.

This solution sentence was further developed during the rest of the week, and reformulated as: Enhancing SnifferDRONE with CO2 Sensors and Integrating RandomPower Technology into the “Sniffer Field Ops” Mobile App. We decided to call this solution as “Sniffo application”.

3.9 Storyboard (Wednesday)

The next step, before developing the prototype of our solution, was to create a storyboard. The purpose of the storyboard is to visualize how a prototype would function in practice and to identify potential issues before the actual creation of the prototype (Knapp, Zeratsky, and Kowitz, 2016, p. 149).

We designed a storyboard with eight frames, detailing the actions in each frame. This process enabled us to outline how our application would work in practice from the user’s perspective. This exercise was instrumental in analyzing and considering the different practical features of the app, forming a solid foundation for prototype development.

3.10 Prototype (Wednesday – Thursday)

Following our storyboard development, we proceeded to the prototyping phase of our design process. The purpose of a prototype is to quickly test an idea in a practical setting. Although it is not a real product, it is designed to resemble one closely enough to allow us to focus on its core functionalities. This approach enables us to concentrate on the product itself without the need to consider branding, sales, or other activities associated with a fully developed product (Knapp, Zeratsky, and Kowitz, 2016, p. 184).

Initially, we planned to create a model application using Figma. However, we ultimately decided to conduct a role-play. We began by writing a script and assigning roles and responsibilities among group members. For instance, two members were tasked with drawing pictures that represented the different pages of the app, based on our storyboard. These visual aids played a crucial role in our role-play. The prototype (role-play) was presented on Friday during our final presentation. Before this, we completed two additional steps in our final product design. The role-play script was refined based on the outcomes of these steps, and the final version was ready by Friday morning.

3.11 Value proposition canvas (Thursday)

To further refine our project, we developed a value proposition canvas. This tool is designed to deepen our understanding of customers, including their tasks, challenges, benefits, and the solutions we can offer. The canvas is divided into two parts: the customer profile and the value map. It is crucial to ask numerous “why?” questions when completing the canvas (Design Better Business Tools, 2024a).

Initially, we identified customer pains, jobs, and gains, encompassing both expected and unexpected aspects. We then proceeded to define our value proposition, including pain relievers, gain creators, and related products and services. Although we had previously discussed these topics, the use of the value proposition canvas allowed us to further clarify our product idea and enhance our understanding of customer value.

The value proposition canvas below (Figure 5) highlights the key findings of our analysis.

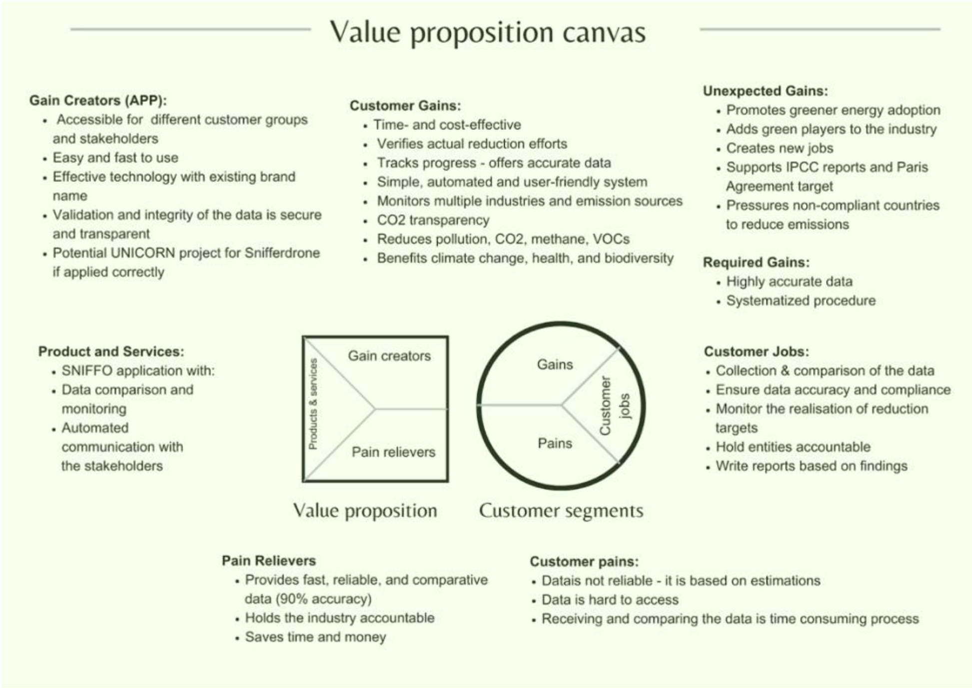

Figure 5: Value proposition canvas

3.12 Business proposition canvas (Thursday)

Our final step in identifying and developing our solution was the creation of a business model canvas. The purpose of this tool is to facilitate a clear and structured understanding of the created business model (Design Better Business Tools, 2024b).

Having already defined our value proposition in the previous phase, we focused on other critical components of our product. We identified our key partners, key activities, key resources, customer relationships, channels, customer segments, cost structure, and revenue streams.

Below, the business model canvas (figure 6) is presented with its central elements.

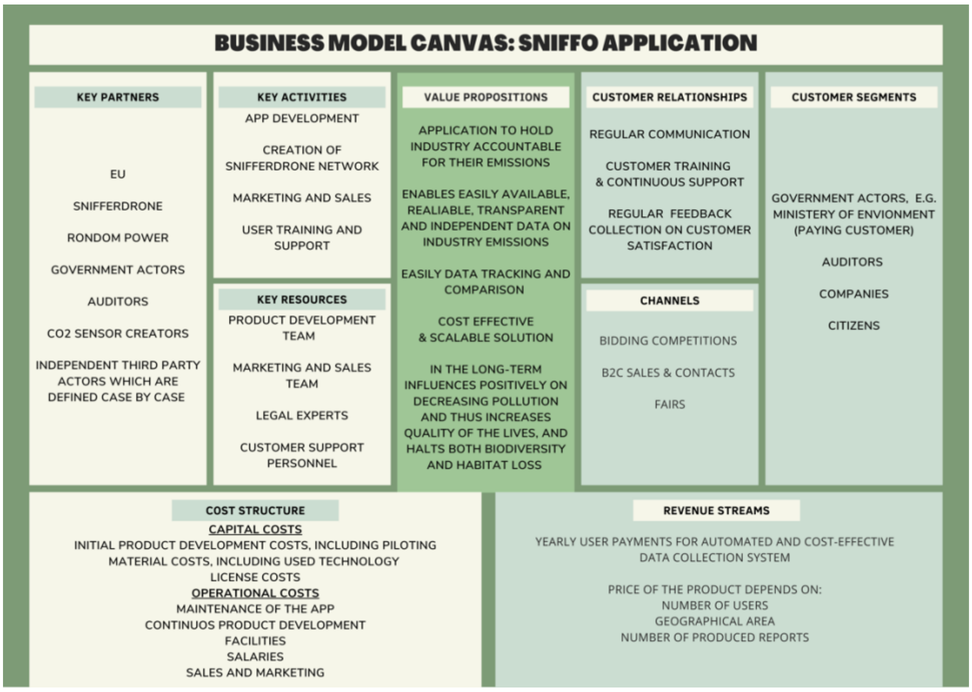

Figure 6: Business model canvas

This exercise in developing the business model canvas shifted our focus towards the commercialization of our product. It required us to transition from thinking about the concrete functions and technical aspects of our proposed solution to considering its marketing and sales potential. We analyzed how our product differs from competitors and the unique value it offers.

In the next chapter, we will describe our solution in greater detail.

4 Final solution

This chapter provides background for our solution with existing challenges, a detailed examination of our solution's functionality, application of ATTRACT technology, potential commercial applications, and societal implications, highlighting solution’s relevance and feasibility as a comprehensive response to industrial pollution. In the end, we present preconditions for our solution.

4.1 Background for our solution

Industrial pollution, a widespread challenge in sectors such as energy, metals, chemicals, and waste management, significantly contributes to habitat degradation and species decline worldwide. Sánchez-Bayo and Wyckhuys (2019) review several key factors from industrial pollution that contribute to the global decline of insect populations. Similarly, Zvereva et al. (2008) observed the impact of air pollution on the diversity of vascular plant species across various ecosystems. Matanle (2020) explains that pollutants from industrial activities have contaminated ecosystems, causing species decline and severe health issues. Emissions of greenhouse gasses from these activities have exacerbated climate change, leading to extreme weather events, degradation of natural habitats and ecosystem disruptions. Matanle stresses the need for stringent regulatory frameworks and industry actions, such as reducing emissions, transitioning to cleaner energy sources, and implementing sustainable practices to minimize environmental damage. This highlights the urgent need for robust policies and international cooperation to mitigate the extensive impacts of industrial pollution (Matanle, 2020). Industrial pollution inevitably drives biodiversity loss and accelerates global warming, making it imperative for our work with SDG15 to find and implement global solutions to mitigate its effects.

The urgency of developing robust mechanisms for monitoring and mitigating the environmental impacts of industrial pollution cannot be overstated. Conventional approaches to emissions tracking are often plagued by inefficiencies and the potential for data manipulation (IEA, 2023). Traditional emissions monitoring heavily relies on manual processes that are time-consuming and prone to inaccuracies or static CO2 sensors placed at leak sources. Additionally, data reported by industries can be subjective and easily manipulated, which undermines regulatory efforts to hold polluters accountable.

4.2 Our solution in a nutshell

To address before mentioned challenges, we have developed an innovative solution that integrates advanced CO2 sensors with existing SnifferDRONE technology, reinforced by RandomPower to ensure data integrity. Combining SnifferDRONE with CO2 sensor allows a comprehensive solution for emission monitoring.

The main customers of our solution are governmental actors, such as Ministries of Environment, and independent auditors who can use the solution in their work. Other customers for the solution are companies whose emissions are measured and monitored. From a wider perspective, the citizens are also customers, as the solutions impacts the reduction of pollution and thus improves air quality. This has a positive long-term impact on people’s health. In the chapter “4.3. Potential commercial applications” different possible customer groups are analyzed further.

New value elements of our solutions in the are:

Comprehensive Coverage: Drones can cover vast industrial complexes, providing a more holistic view of emissions compared to stationary sensors.

Policy Compliance: It supports regulatory compliance by providing reliable data that can be used to enforce environmental laws and regulations.

Enhanced Transparency: The use of RandomPower ensures that the collected data cannot be manipulated, increasing trust and transparency.

Cost-effectiveness and scalability

More comprehensive information on customer values and the business model is offered in Figures 5 and 6 in the chapter “3. Evolution of the design”.

4.3 Application of ATTRACT technology

The existing SnifferDRONE technology forms the cornerstone of our solution, designed to monitor and quantify methane emissions from landfills with high accuracy. This technology can create spatial interpolation maps, estimate fugitive gas emissions, locate leak sources, and perform geospatial and temporal analytics. In addition to the SnifferDRONE hardware, the accompanying mobile app, ‘Sniffer Field Ops,’ enables technicians to conduct manual inspections efficiently, synchronizing with SnifferDRONE flights. Current data can be viewed in near-real time on mobile devices and is filtered to provide binary and actionable information for compliance reporting. The existing technology solves some of the processes we have identified already, but not all.

As such, the functionality of our solution is centered on the synergy between CO2 sensors and the existing SnifferDRONE hardware and software platform. By integrating CO2 sensors, SnifferDRONE technology can offer an automated and precise method for measuring carbon dioxide concentrations from industrial plant exhaust systems and multiple pipes to the atmosphere (TU, n.d.). These sensors convert CO2 levels into electrical signals, which are processed by a dedicated digital addition of software that we call ‘Sniffo application’ to the existing application. The data collected in ‘Sniffo’ is encrypted using RandomPower technology to prevent tampering, ensuring that the information is both reliable and trustworthy. This approach significantly reduces errors and enhances the overall credibility of emissions data, which is critical for informed policy-making and regulatory enforcement. Our addition to the existing technology is aimed to be user-friendly, featuring a comprehensive dashboard that displays key metrics such as current CO2 levels, historical CO2 emissions, trends, and alerts for emissions that exceed permissible thresholds. This facilitates a more streamlined approach to monitoring and regulatory compliance, enabling users to quickly access and interpret data without the need for extensive technical expertise.

In practical terms, consider an industrial complex with multiple emission points. The SnifferDRONE, equipped with CO2 sensors, can navigate over the site and capture emissions data from each source. This data is then transmitted to the application, where it is analyzed and presented in a detailed report. Regulatory bodies can use this information to verify compliance with environmental standards, while industries can leverage the data to optimize their operations and reduce their carbon footprint.

CO_2 Sensors: These are placed on multiple SnifferDRONEs to measure the concentration of carbon dioxide accurately. The sensors are capable of detecting CO_2 levels from various sources within a complex industrial site.

SnifferDRONE Technology: Drones equipped with advanced sensors and GPS technology can fly over large areas, capturing emissions data more quickly and accurately than traditional methods. The advantage of SnifferDRONE is also linked to the ability to determine wind direction and determine the emissions with 90% accuracy to the numerous leak and gas release points of an industry complex.

Digital Software Application: By applying collected CO_2 emission data from the drones and analyzing it in real-time, the digital software application; which we have named 'Sniffo,' provides a user-friendly interface. This capability enables regulators to access accurate data, allowing them to interpret and assess whether reduction initiatives have been effectively implemented or if there has been any implementation at all. If the gathered emission data shows no reduction in carbon dioxide or other harmful gas pollution, regulators can impose punitive measures on the industries or factories responsible. These measures may begin with warnings and escalate to fines if non-compliance continues.

RandomPower Encryption: This feature secures the data collected by the drones, ensuring that it is reliable and cannot be manipulated by internal or external entities, including SnifferDRONE pilots, industrial entities, regulators, and agencies. This addition to the SnifferDRONE data is crucial because it guarantees the integrity and trustworthiness of the emissions data. By safeguarding the data from modification and falsifying it enhances the credibility of the information, which is essential for regulatory compliance and effective environmental monitoring.kkk

4.4 Potential commercial applications

The commercial potential of our solution is extensive. For industrial entities, the SnifferDRONE technology offers a cost-effective and efficient method for monitoring emissions, thereby facilitating compliance with environmental regulations. Accurate and reliable data not only helps industries mitigate operational risks and avoid penalties but also enhances their sustainability reporting, which is increasingly demanded by stakeholders and investors. The key stakeholders for this solution include environmental regulatory bodies, governmental agencies, industries, and non-governmental organizations (NGOs) focused on environmental protection. The users primarily involve environmental authorities who need accurate data for policy-making, industries that require monitoring to comply with regulations, and NGOs that advocate for environmental accountability.

Government agencies can utilize the data provided by the SnifferDRONE to develop and enforce more effective environmental policies and to check if reduction targets meet the legal agreements. The ability to access accurate emissions data enables regulators to create targeted and evidence-based interventions, which are essential for reducing industrial pollution and achieving national and international climate objectives.

Non-governmental organizations (NGOs) can also benefit from our solution. The robust data collected by the SnifferDRONE can be used to advocate for stronger environmental protections and hold industries accountable for their emissions. This data can support campaigns aimed at increasing public awareness of industrial pollution and driving policy change.

In addition, the insurance and risk management sectors can leverage the emissions data to better assess the environmental risks associated with industrial activities. This can lead to the development of new insurance products that incentivize cleaner practices and promote more sustainable business operations.

4.5 Societal impact

The societal implications of our solution extend beyond immediate commercial benefits to include significant contributions to public health and environmental sustainability. By providing accurate, real-time data on industrial emissions, our solution helps mitigate the adverse effects of pollution, which is crucial for combating climate change. Reduced emissions lead to improved air quality, which has direct benefits for public health, particularly in reducing respiratory and cardiovascular diseases among populations exposed to industrial pollutants. The existing SnifferDRONE sensors that measure nitrogen oxides, volatile organic compounds and methane will also be valuable in regards to public health (Sniffer Robotics, n.d.).

Moreover, our solution supports the preservation of biodiversity by reducing the pollution that degrades natural habitats. Healthier ecosystems, in turn, support a wide range of species, contributing to greater biodiversity and ecological resilience.

Economically, the adoption of our technology promotes job creation in sectors such as environmental monitoring, data analysis, and drone technology. This not only drives economic growth but also fosters the development of a green economy, which is essential for sustainable development.

Furthermore, by providing a standardized and reliable method for monitoring industrial emissions, our solution facilitates international cooperation in addressing climate change. Accurate data is essential for the formulation of global agreements and initiatives aimed at reducing greenhouse gas emissions. Our technology thus contributes to the development of a more transparent and accountable system for tracking and mitigating industrial pollution on a global scale. We believe that decision-making bodies require a robust tool to accurately monitor and verify the carbon emissions of industries, ensuring accountability and transparency. Such a tool is essential for enforcing regulations and demanding a genuine green transition.

It allows these bodies to hold industries responsible for their environmental impact, track progress towards emission reduction targets, and facilitate the transition to sustainable practices. By providing precise and reliable data of the greenhouse gas emission, we are confident that this tool will support informed policy-making and foster a more effective and credible shift towards a low-carbon economy.

4.6 Preconditions for our solution with competitor analysis

Our current regulatory environment prohibits the use of sniffer drones on private property. For our solution to be viable, it is essential that legislation permits the deployment of sniffer drones for monitoring emissions on private properties. Currently, companies are required to self-report their emissions and perform their own CO_2 calculations. Under the Corporate Sustainability Reporting Directive (CSRD), carbon reporting is mandatory for many businesses in the European Union. Starting in 2024, all large companies and big industries, operating in the EU, including those headquartered outside the EU, will be required to disclose their emissions, including scope 3 value chain emissions. (EU 2024.) We assume, as a precondition, that the European Union will enact new legislation mandating unannounced emissions inspections, thereby allowing the deployment of specialized drones on private property.

Let us conduct a brief analysis of our existing and potential competitors, considering the specific preconditions necessary for the implementation of our solution. Existing competitor companies can be grouped into three major categories based on the limitations of their solutions compared to ours.

Group 1: This category includes companies that provide both emission calculation services and consulting on emission reduction, which can lead to a conflict of interest. By offering both services, these companies may face challenges in maintaining impartiality in their emissions assessments.

Group 2: This category consists of companies that create emissions reports based on estimations and existing data, with some overlap with Group 1. Examples include NxtLog and Pulsora.

NxtLog, established in 2022 and headquartered in Würzburg, Bayern, Germany, specializes in analyzing and reducing supply chain emissions through advanced analytics and recommendation tools (Crunchbase, 2024). Their platform measures, reports, and reduces transport emissions in compliance with ISO-14083, EN 16258, and GLEC standards. It supports data integration from various formats and uses algorithms for accurate emissions calculations. NxtLog offers detailed CO_2e emissions calculations for all transport modes, providing customized analyses to help logistics and supply chain managers enhance sustainability efforts.

Pulsora, founded in 2021, is a corporation dedicated to helping enterprises manage and improve their ESG (Environmental, Social, and Governance) footprint through an integrated SaaS platform. The platform facilitates compliance tracking and offers insights to enhance ESG performance, making it essential for businesses committed to sustainability. With an estimated annual revenue of $19.4 million, Pulsora supports companies in their pursuit of comprehensive sustainability (Growjo, 2024).

Group 3: This category includes companies that use sensors fixed at emission points, such as pipes. Our drone solution is more cost-effective and scalable, as a single drone can replace multiple fixed sensors. Additionally, drone technology allows for dynamic data collection by flying back and circling around to gather detailed data, whereas fixed sensors provide only static, single-point data without a comprehensive overview (Lampen, 2024).

5 Conclusion and reflection

Our project tackled the critical issue of monitoring industrial pollution, which poses a significant threat to biodiversity and contributes to global warming. We adopted a service design approach, culminating in a solution that integrates CO2 sensors with SnifferDRONE technology. This enhanced system provides real-time monitoring of industrial emissions over extensive areas, with RandomPower encryption ensuring the accuracy and reliability of the collected data.

The proposed solution offers substantial advantages over traditional methods. SnifferDRONE technology enables comprehensive coverage of industrial sites, while real-time data collection enhances the effectiveness of monitoring and regulatory enforcement. RandomPower encryption addresses concerns about data manipulation, fostering trust and transparency in emissions reporting.

Successful implementation of this solution, which relies on legislative implementation, has the potential to revolutionize industrial emissions monitoring. By equipping regulatory bodies with accurate data, the system offers a tool to hold industries accountable for their environmental impact, thereby incentivizing the adoption of cleaner practices. This leads to significant reductions in pollution, resulting in improved air quality and positive impacts on public health. Healthier ecosystems foster greater biodiversity, contributing to environmental sustainability. Additionally, the solution promotes economic growth through job creation and supports the development of a green economy. On a global scale, this technology can facilitate international cooperation in addressing climate change by providing a standardized and reliable method for tracking emissions.

In essence, this solution provides a robust tool for monitoring and verifying industrial emissions, ensuring transparency and accountability. It empowers decision-making bodies to enforce regulations, monitor progress towards environmental goals, and promote a sustainable future. By delivering accurate data on greenhouse gas emissions, this system fosters informed policy-making and facilitates a credible shift towards a low-carbon economy. We believe this innovation has the potential to make a substantial contribution to achieving Sustainable Development Goal 15 and safeguarding the planet for future generations.

The project provided valuable insights into the application of design thinking to sustainable development goals. The Double Diamond model offered a structured approach, while stakeholder analysis ensured a comprehensive understanding of the needs of all parties involved. Identifying the appropriate technology posed a challenge, but the mobility and data collection capabilities of SnifferDRONE, enhanced with CO2 sensors and encryption, proved highly effective.

Collaboration across disciplines was crucial for the success of our project. The diverse expertise within our team facilitated the development of a comprehensive solution, demonstrating the importance of effective communication and teamwork in navigating the design process. To achieve tangible, real-world impact, it is imperative to secure industry support and obtain regulatory approval. Addressing potential concerns and clearly demonstrating the value of the technology will be essential. Partnering with environmental NGOs and regulatory bodies can further advance the solution, promoting broader efforts towards a sustainable future.

By incorporating CO2 monitoring into SnifferDRONE technology and utilizing it to measure emissions from large industrial plants, we have created a tool that could significantly enhance the accuracy of CO2 emissions data. This innovation provides a practical asset in discussions about environmental issues, enhancing our understanding of the complexity of these challenges. It has the potential to motivate networks, institutions, countries, regulators, decision-makers, and governments to work together towards establishing an ecologically sound future.

Sources

Citation Sources:

Design Better Business Tools (2024a) Value proposition canvas. Available at: https://www.designabetterbusiness.tools/tools/value-proposition-canvas (Accessed: 11 June 2024).

Design Better Business Tools (2024b) Business model canvas. Available at: https://www.designabetterbusiness.tools/tools/business-model-canvas?utm_source=dbb&utm_medium=link&utm_campaign=Business%20Model%20Canvas&utm_content=title (Accessed: 11 June 2024).

EU. (2024) 'Corporate Sustainability Reporting' https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en (Accessed: 13 June 2024).

Globalgoals.org (2024) 'Goal 15: Life on Land'. Available at: https://www.globalgoals.org/goals/15-life-on-land/ (Accessed: 11 June 2024).

IEA (2023) CO2 Emissions in 2022, IEA, Paris. Available at: https://www.iea.org/reports/co2-emissions-in-2022 (Licence: CC BY 4.0).

Knapp, J., Zeratsky, J. & Kowitz, B. (2016) Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days. Simon & Schuster. Available at: https://ebookcentral.proquest.com/lib/Laurea/detail.action?docID=5685612 (Accessed: 11 June 2024).

Matanle, P. (2020) 'Japan and the Environment: Industrial Pollution, Biodiversity Loss, and Climate Change', in Routledge Handbook of Contemporary Japan. Routledge, pp. 291-303.

National Wildlife Federation (2024) Habitat loss. Available at: https://www.nwf.org/Educational-Resources/Wildlife-Guide/Threats-to-Wildlife/Habitat-Loss (Accessed: 11 June 2024).

Sánchez-Bayo, F. and Wyckhuys, K.A. (2019) 'Worldwide Decline of the Entomofauna: A Review of Its Drivers', Biological Conservation, 232, pp. 8-27.

The Teacher Toolkit (2024) Think-Pair-Share. Available at: https://www.theteachertoolkit.com/index.php/tool/think-pair-share (Accessed: 11 June 2024).

Tuulaniemi, J. (2011) Palvelumuotoilu. E-book. Helsinki: Talentum Media Oy.

UNEP-WCMC (2024) State of the World's Migratory Species. UNEP-WCMC, Cambridge, United Kingdom.

Zvereva, E.L., Toivonen, E. and Kozlov, M.V. (2008) 'Changes in Species Richness of Vascular Plants Under the Impact of Air Pollution: A Global Perspective', Global Ecology and Biogeography, 17(3), pp. 305-319.

Internet Sources:

Crunchbase (2024) NxtLog. Available at: https://www.crunchbase.com/organization/nxtlog (Accessed 7 June 2024).

Growjo (2024) Pulsora. Available at: https://growjo.com/company/Pulsora (Accessed 7 June 2024).

The SnifferDRONE | Sniffer Robotics. Available at: https://www.snifferrobotics.com/snifferdrone (Accessed 5 June 2024).

TU Ilmenau - UniOnline: CO2 reduction: TU Ilmenau develops novel sensor for exhaust systems. Available at: https://www.tu-ilmenau.de/unionline/en/research (Accessed 8 June 2024).

Unpublished sources:

Lampen, T. (2024) Conversation with Tapio Lampen at Cern, 9 June 2024.

Liite 1: Ensimmäisen liitteen otsikko

Liite 2: Toisen liitteen otsikko