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TEAM MEMBERS

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AQUA

Executive Summary

The global water crisis is a significant challenge, impacting 2 billion people without access to safe drinking water and 3.6 billion without adequate sanitation. Atmospheric Water Generation (AWG) technology, which extracts moisture from the air to provide clean water, is a promising solution. However, its adoption in humanitarian contexts is limited due to economic constraints and a lack of technical expertise.

The AQUA project aims to create a set of guidelines for Aquaseek to enter the humanitarian water market.
The do so, over 40 interviews with experts, NGOs, and end-users were conducted and in-depth secondary research was perfomed.

Three potential sustainable business models were identified: B2N (NGO as the customer), B2G (Government as the customer), and B2E (Energy provider as the customer). B2N was deemed optimal due to the trust-building potential of NGOs within local communities.
In addition, an 8-stage project cycle for deploying AWG solutions in humanitarian contexts was designed, encompassing a thorough explanatory procedure from the project start-up to the deployment of the machine.

To bring these solutions to the market, Aquaseek must improve its technical product, establish credibility through partnerships with NGOs, engage in marketing initiatives, and participate in trade fairs.

The relevance of the project is twofold: first, thanks to the implementation of the proposed guidelines, Aquaseek can attempt to enter the humanitarian market, extending its current business opportunities; second, the solution could guarantee access to clean and affordable water to some end-users that still suffer from water scarcity.

Key Words
Water, Humanitarian, Atmospheric Water Generators

Project description written by the External Tutor

In a world facing increasing challenges from climate change-induced droughts and water scarcity, groundbreaking advancements in Atmospheric Water Generation (AWG) technology are emerging as potential lifesavers. These innovations allow the extraction of water from the ambient air, even in the most adverse conditions. However, unlocking the full potential of these technologies is an unresolved challenge, especially in resource-limited settings like small communities in developing countries.

This project's core objective is to bridge the gap between state-of-the-art AWG technology and its practical, sustainable implementation in regions where basic needs are not satisfied. Such a challenge requires a multidisciplinary approach, addressing socio-economic and technological dimensions to ensure the success of AWG systems.

Socio-economic empowerment is a fundamental focus, involving the creation of sustainable business models and implementation roadmaps that deeply consider the needs, expectations, and challenges of all stakeholders. By fostering collaboration among diverse parties, including communities, governmental bodies, non-governmental organizations, and technology providers, the project aims to ensure the long-term viability of AWG solutions.

On the technological front, a significant challenge is the potential abandonment of these technologies after their first breakdown or because of their complexity, due to a lack of skills and resources. In this vein, the project encompasses research, application, and evaluation of cutting-edge Design-for-Maintainability techniques customized for AWG devices deployed in developing countries. An approach based on the user experience design and engineering will guarantee that these systems are user-friendly and can be efficiently maintained and repaired by local communities, even when technical expertise is limited.

To sum up, the project's overarching goal is to address issues such as poor stakeholder management, risk mitigation, and technical capacity in the deployment of AWG systems. By doing so, it aims to transform these deep-tech innovations into tangible, sustainable solutions. Ultimately, the project endeavors to make AWG systems not just accessible but also self-sustainable, ensuring that communities facing water scarcity can rely on them as a consistent source of clean water. This, in turn, has the potential to significantly enhance the quality of life for these communities while addressing one of the critical challenges posed by climate change.

Team description by skill

The Aqua team comprises five students with two main areas of expertise: mechanical engineering and management engineering.

From a project management perspective, **Pietro Elli**, elected team leader, and **Francesco Verzobio** were responsible for organizing the workload, scheduling meetings, managing the budget, and being a point of contact with academic and company tutors.

The business side of the project was the responsibility of **Gabriella Caputi** and **Pietro Elli**. Gabriella focused mainly on the humanitarian context and relationship with the local communities. At the same time, Pietro concentrated on the market and how to enter it.

Arnaldo Bigi and **Francesco Verzobio** were responsible for the technical side of the project. Thanks to their expertise in the field, they have taken care of the machine's potential add-ons and performed technical research and analyses – such as the FMEA analysis – installing direct and frequent contact with the R&D department of Aquaseek.

Concerning the design part of the project (communication and production of external material), **Arash Moradi Espeli** supported the team in this domain despite its academic studies focused on automotive engineering. Doing so, he demonstrated, on the one side, great curiosity and interest in a field different from his primary expertise and, on the other side, a great sense of sacrifice for the team.

Last, the over 40 interviews performed were divided equally among the five team members according to availability and expertise.

Despite having suffered at the very beginning of the project, from the withdrawals of two members, we are proud of the results obtained and the job done.

Goal

The objective of this work is to provide Aquaseek with a set of guidelines to enter the humanitarian water market in a profitable, feasible, and scalable way.

Such a goal brought to two pieces of solutions: the development of a sustainable business model, on the one hand, and the establishment of a project procedure, on the other.

Understanding the problem

Currently, the market is characterized by a growing supply of AWGs with rapidly advancing technological capabilities, yet there remains a substantial unmet demand for clean water in numerous countries.

This disparity between supply and demand constitutes a market failure, that is, a situation defined by an inefficient distribution of goods and services in the free market. In an ideally functioning market, the forces of supply and demand balance each other out.
In a market failure, however, something interferes with this balance.

In the context at hand, the water issue presents a multifaceted challenge, encompassing several critical aspects:

- Environmental pressures
- Freshwater scarcity
- Global ramifications - cascade of issues

On the other hand, AWG technologies offer compelling advantages:

- Dependable clean water
- Remote accessibility
- Humanitarian lifeline
- Sustainability

Despite the presence of around 120 companies engaged in AWG production, billions of individuals worldwide continue to face inadequate access to clean drinking water and sanitation facilities.

The primary challenge lies in the inability of AWG companies to meet the needs of individuals grappling with water scarcity, often due to the high cost associated with humanitarian markets.

In the pursuit of understanding the needs and requirements of stakeholders in the AWG market, the team conducted interviews with various actors involved in the industry and in humanitarian projects. These interviews provided valuable insights, helping the team identify key challenges that AWG companies might face during such ventures. The challenges resulted to be seven: costs (including CAPEX & OPEX), maintenance, logistics, trust, legal issues, energy supply, and reaching the end-users.

By addressing these challenges it has been possible to find solutions.

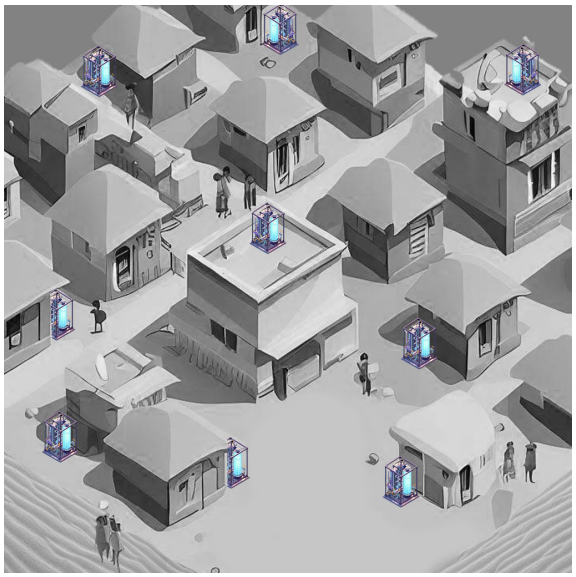
Exploring the opportunities

As the team navigated through the multifaceted landscape of AWG in humanitarian contexts, an array of scenarios of possible scaenarios were encountered, where innovative solutions become paramount.

Four distinct scenarios were identified, each offering a unique perspective on how AWG projects can be tailored to meet the fundamental water needs of communities, particularly in situations of survival and basic needs.

Through these scenarios, it is possible to illustrate how AWG solutions can be thoughtfully customized to suit varying environmental, geographical, and social contexts, ultimately contributing to the well-being and resilience of communities in need.

Scenario 1 - Rural village scenario



Scenario 2 - Developing country scenario

Scenario 3 - Refugee camp in conflict-affected region

Scenario 4 - Refugee camp or small village with central machine and kiosks

Generating a solution

Exploring sustainable business models led to several alternatives since different solutions work based on economic, political, and social conditions. Three major potential sustainable business models were ideated: B2N, where the customer is represented by a Non-Governmental Organization (NGO); B2G, where the customer is a Governmental entity; and B2E, where the customer is an Energy provider.

Based on a multi-criteria analysis that considers qualitative factors categorized into four groups, following the 4As framework – availability, affordability, awareness, acceptability – the B2N was identified as the optimal business model. Reasons to do so must be found in the closer relationship an NGO can build with local communities, meant to gather more trust – the lack of engagement of the local community is a synonym for failure in humanitarian and development projects. Moreover, developing countries often face high political corruption and instability, leading to a lower reliability in governmental institutions. Last, the B2E turned out to be feasible in rare contexts.

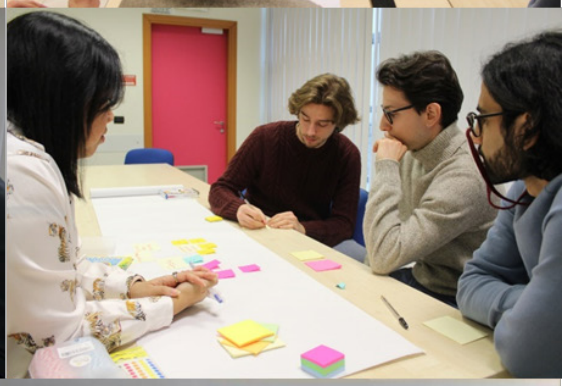
Along with the identification of a sustainable business model, a comprehensive project cycle has been developed. It represents the 8-stage procedure Aquaseek might follow to bring the solution in humanitarian contexts.

The project startup is the first part of the process and consists of different activities like initial outreach, feasibility analysis, economic appraisal, and data collection. The gathered data will be used for the design, and they can be processed to have four main outputs: which machine to use, how many devices, where to place them, and how to use them. The following steps are the manufacture of the components and the delivery of them. In these stages, the collaboration with third parties, used as a bridge to reduce the criticalities to reach the communities, has been highlighted. The following phases are test (valid also for data collection) and distribution, the project's "operational step." Operating in a remote environment will lead to more frequent breakages and the need for maintenance. This is why a Design for Maintainability framework has been developed. After structuring a Failure Mode and Effects Analysis (FMEA) to comprehend the main problems, feasible maintenance strategies have been proposed. The last stage is the deployment of the machine(s).

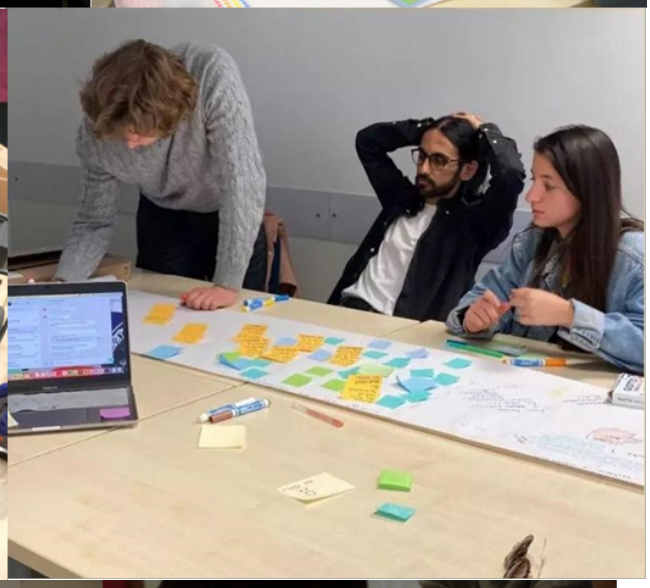
Main bibliographic references

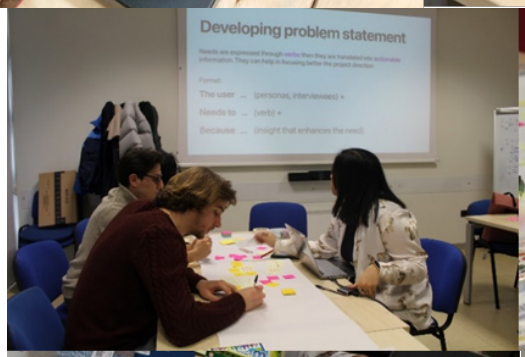
- Copley, M. (2022). Data centers, backbone of the digital economy, face water scarcity and climate risk.
- Initiative, G.F. (2016). Globalization and Water Crisis in Developing Countries.
- Mohapatra, D., Jaeger, J. and Wiemann, M. (2019). Private Sector Driven Business Models for Clean Energy Mini-Grids. Alliance for Rural Electrification.
- Payen, L., Bordeleau, M. and Young T. (2016). Developing Mini-grids in Zambia. How to build sustainable and scalable business models?. Enea.
- Peters, G.M., Blackburn, N.J. and Armedion, M. (2013). Environmental assessment of air to water machines—triangulation to manage scope uncertainty. The International Journal of Life Cycle Assessment, 18(5), pp.1149–1157.
- Safdar, T. (2017). Business models for mini-grids. Smart Villages.
- United Nations (2015). Human right to water and sanitation | International Decade for Action 'Water for Life' 2005-2015.
- United Nations (2023). Goal 6 | Department of Economic and Social Affairs.
- United Nations (2020). Goal 6: Ensure access to water and sanitation for all.
- Wahlgren, R. V. (2016). Water-from-air quick guide. Atmoswater Research.
- wateronline.com. (2012). Performance Contracts Shaking Up The Municipal Water Market
- www.efanews.eu. (2023). Unesco: between 2 and 3 billion people suffer from water shortages.

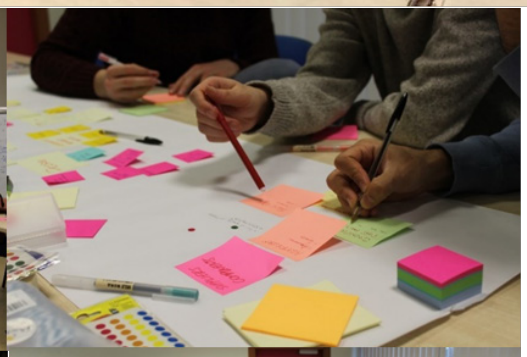

"Design is not just what it looks like and feels like.
Design is how it works"
Steve Jobs

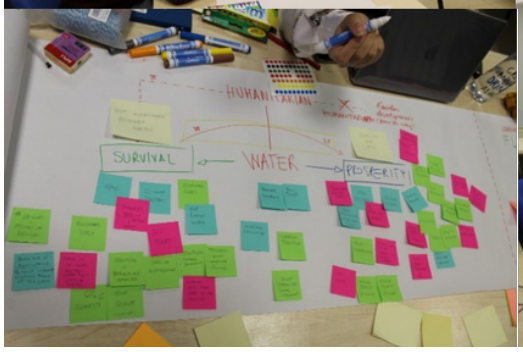



AQUASEEK




Developing problem statement

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