

Deliverable A

Context study, deepening, and reflection

Team 2

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prevention and control of an infectious disease is already proven in the past. Poorly developed water and sanitation system was reported to be a key determinant of the rapid spread of the 2014 ebola outbreak, as well as an underlying factor in the high number of deaths (Anim & Ofori-Asenso, 2020).

Without access to clean water, people in rural Ethiopia do not even have a fair chance against the virus. Therefore, ensuring access to clean water in these regions is essential for their well-being and development, which brings us to our research question for the design challenge: *How can we create access to clean water in the Ethiopian lowlands?*

1.1 Geography

Ethiopia can be roughly divided into the highlands and the lowlands. The lowlands (below 1500 meters) constitute 60% of country's geography (World Bank Group & U.K. Department of International Development, 2019).

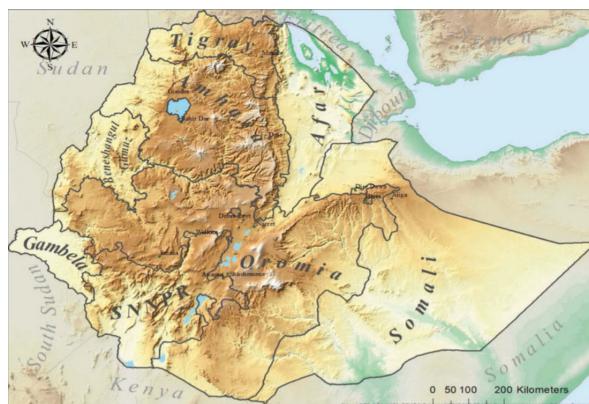


Figure 1: relief map of Ethiopia to illustrate the geography of the high- and lowlands (World Bank Group & U.K. Department of International Development, 2019)

These areas are sparsely populated and are home to 10–12% of the total Ethiopian

population. These people are dependent on livestock and farming for their survival and are one of the most vulnerable communities in Ethiopia. These arid and semi-arid areas are characterised by fluctuating and unpredictable rainfall, poorly developed infrastructure and communications, and are simply undeveloped compared to the highlands (World Bank Group & U.K. Department of International Development, 2019).

Between these two geographical regions, there lies a great inequality when it comes to access to improved water and sanitation (Azage et al., 2020). While in the highlands the majority of the population have access to improved water sources, people in the lowlands rely solely on surface water and unimproved water sources (UNICEF Ethiopia, 2020; World Bank Group & U.K. Department of International Development, 2019).

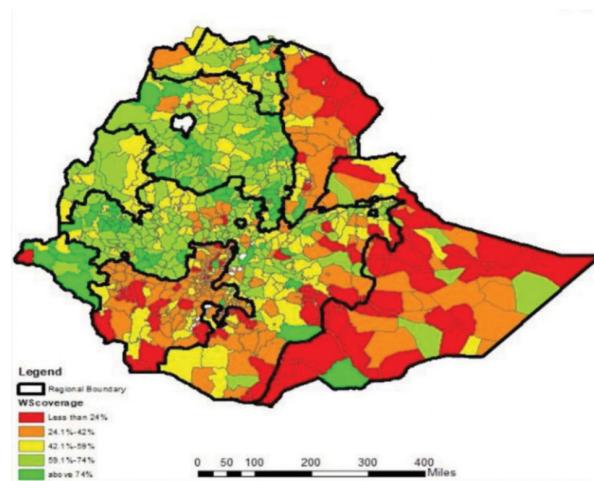


Figure 2: map showing regional water supply in Ethiopia (World Bank Group & U.K. Department of International Development, 2019)

Although the accessibility, reliability, and quality of the improved water services in the highlands could still be significantly improved, parts of the lowlands lack any WASH (water, sanitation, and hygiene) services at all (UNICEF Ethiopia,

2020). Groundwater in a large portion of the area is brackish or salted with a lot of minerals, which makes it unsuitable for most activities. This is one of the reasons water sources in the lowlands are extremely scarce (World Bank Group & U.K. Department of International Development, 2019). The following statistics should serve as evidence to the severity of the situation: In the lowlands access levels for water and sanitation range from 39–61%; sanitation coverage ranges from 6–21% compared to 62–95% and 41–76% respectively in highland areas (World Bank Group & U.K. Department of International Development, 2019).

Furthermore, in both the high- and the lowlands, many households lack handwashing services (UNICEF Ethiopia, 2020). In Ethiopia, 60–80% of the communicable diseases spread due to a lack of access to safe water (UNICEF Ethiopia, n.d.), including COVID-19. Since there is evidence that the lack of water and sanitation heightens the risk of the spread of COVID-19 in sub-Saharan Africa (Ekumah et al., 2020), this challenge requires immediate attention.

1.2 Stakeholders

Our main stakeholders are the people living in the Ethiopian lowlands. These lowlands are culturally subdivided into clans and subclan territories. This division influences the precise distribution and access of, amongst other things, water resources (Whitley et al., 2019).

Many of the inhabitants are pastoralists or agropastoralist (World Bank Group & U.K. Department of International Development, 2019). These are terms describing (economic) activities which primarily involve herding and caring for livestock. Agropastoralists are less dependent on livestock and practise more agriculture than pastoralists. However,

many communities also practice non-pastoral activities, of which the amount depends on the current circumstances. These groups are dependent on milk and – to a smaller extent – meat from their livestock, but this does not provide them enough food to live from. Therefore, the pastoralists are also dependent on the local markets for grain, which are where they exchange and trade their livestock products (World Bank Group & U.K. Department of International Development, 2019).

While men are in charge of both marketing and care of larger animals, women have active roles in the marketing and care of young and weak animals (World Bank Group & U.K. Department of International Development, 2019). Water-related labour work is likewise gendered (Whitley et al., 2019). The women take care of water for domestic use and for young animals, while the men take care of water for larger animals.

In our case, the women play an important role, since handwashing and drinking is directly related to domestic water use. Since the accessibility of water is higher during the wet season than the dry season, this has an impact on the behaviour of the pastoralists. During the wet season, they can wander more easily to find more nutritious pasture for their livestock. On the contrary, during the dry season, they will more likely stay close to permanent water sources (Whitley et al., 2019).

Our design will therefore be used by the (agro)pastoralists in their daily lives. It will provide them with clean drinking water which can be used for drinking, hand washing, cleaning, and other activities that require clean water, in order to guarantee the required level of hygiene to prevent COVID-19 from spreading.

1.3 Other considerations

Our targeted niche for innovating is the rural water supply, which involves several political factors that should be taken into consideration. The management of the rural water supply in Ethiopia is decentralised. It was founded based on a community management model. Ethiopia consists of 805 woredas (districts). Within each woreda, the WASHCO (Water and Sanitation Committees) of that community is responsible for the water supply of their district. WASHCOs are in charge of collecting fees, defining by-laws, liaising with local administration, and managing water access for each individual water point (Pichon, 2019).

Since we want to innovate in security of (clean) water, we need to take already existing circumstances into account. Since (ground)water in the lowlands is often salted or brackish and there is not much known about the hydrology, it is difficult to bore boreholes into the ground and use those as a water source (World Bank Group & U.K. Department of International Development, 2019). This process is expensive and good results cannot be guaranteed. Furthermore, we need to take the environment into account. Many people in the lowlands are pastoralists and care for their livestock. Having a permanent water source at one place, will heighten the risk of overgrazing by animals, since people will be more likely to stay in one place.

1.4 Existing initiatives

Various non-profit organisations and charities have already been working on addressing the water shortage in Ethiopia. Examples of these include charity: water (charity: water, n.d.), The Water Project (The Water Project, n.d.), and The World Bank.

1.4.1 Shortcomings to learn from

A common method found in many of these organisations to provide clean water to African rural areas – including Ethiopian lowlands – is through the drilling of water wells. Advantages include ease of use, generally high quality groundwater, and low costs. However, water wells in Ethiopia – and in many other developing countries – are often dysfunctional, due to inadequate maintenance, unauthorised siting, and weak monitoring systems (Pichon, 2019).

In Ethiopia, the bulk of the WASH sector investments was funded towards creating new water schemes, yet only 4% of the budget was allocated to the maintenance (Pichon, 2019). Ethiopia's community management model assumes communities themselves can sustainably manage and repair water points, but local WASH committees often do not have the technical knowledge required to do so. This results in recurring problems with water point failure (Pichon, 2019).

The second problem is the siting of water points. There are no maps available about groundwater conditions that meet the needs of the WASH sector. This results in failures when drilling the water wells (Pichon, 2019).

A third problem is the monitoring systems. The government does not have a clear view on which water points are functional and which are defective. This is also a reason why water points frequently stay dysfunctional for a long period of time (Pichon, 2019).

1.4.2 Design inspirations

In this section we compile a selection of existing technologies that has inspired and/or influenced our design process. Such

technologies are mainly for the purpose of harvesting water or purifying surface water.

Atmospheric water harvesting



Figure 3: atmospheric water harvesting
(Notman, 2020)

This set-up includes a fan which directs hot air over a cool coil upon which the water in the air condenses. Another way of harvesting water out of the air is with the use of a desiccant. Here, the water is absorbed from the air with a material akin to sponge (Notman, 2020). Atmospheric water harvesting would most likely not be the most suitable for our stakeholders, given the high energy consumption and high initial costs.

Solvatten

This combined portable water treatment and water heating system uses ultraviolet radiation (UV) from sunlight to purify water. The UV radiation destroys microorganisms, preventing them from reproducing and therefore makes the water safe to consume. Each container lasts for seven years on average. So far, Solvatten water containers have already reached 400,000 people all over the world (Solvatten, n.d.). The technology could be suitable for our stakeholders as they are relatively easy to use and do not require much maintenance.



Figure 4: Solvatten water container provides safe water through UV sterilisation. (Solvatten, n.d.)

Water treatment plant



Figure 5: water treatment plant (Euronews, 2019)

The water treatment plant degrades harmful pollutants such as pesticides, inactivate microbes, and pathogens. Researchers are already working on making the system autonomous and built out of as many African-made and green materials as possible. This means that the set up does not use any chemicals to purify water, which makes it quite suitable for our stakeholders as access to synthesised substances is severely limited in Ethiopia (Euronews, 2019).

Rainwater harvesting

This rainwater harvesting tank captures rainwater that runs down roofs (Lifewater International, 2018). The set-up can be found in

many public buildings such as schools. While it would be a suitable option for our stakeholders as it is less expensive than water wells (and also can be used when groundwater is not safe), the dependence on rainfall makes it a poor choice for a main water supply



Figure 6: rainwater harvesting tank (Lifewater International, 2018)

1.5 Design philosophy

The overarching technical theme that has influenced the framing of our challenge can be summed up with the acronym WASH, which stands for 'water, sanitation, and hygiene', and is also the main focus of the UN Sustainable Development Goal 6 (SDG 6) (United Nations, 2020).

Our final design will – as well as successful in its intended function – need to be appropriate within the context of communities in Ethiopian lowlands. In this section we present theories that have influenced our design process.

1.5.1 Appropriateness and inclusivity

Appropriateness is a relational quality; it measures the technology in relation to its user. A technological artefact that is appropriate means that it should be functional in the context in which it is used (Oosterlaken, 2012). A bicycle, for example, is only appropriate when

the user has the physical abilities to ride that bicycle.

Inclusive design tells us that we need to be specific to *who* we are designing for (Oosterlaken, 2012). For example, a high tech design that worked flawlessly would not be useful if it required years of technical experience to operate, hence it would not be an appropriate solution for our main stakeholders who do not have the capability to do so.

1.5.2 Capability approach

The capability approach is a theoretical framework that revolves around the idea that it is not the matter of what you *have* but rather what you *can do*; ie your capability (Oosterlaken, 2012; Robeyns, 2011).

It was first proposed by Amartya Sen in 1980 and was a stark contrast to the traditional method of using Gross Domestic Product (GDP) to measure growth, development, and wealth. It has a strong emphasis on human-centricity, sustainable development, and human diversity (Oosterlaken, 2012).

In this framework, there are three basic types of capabilities:

1. **basic capabilities** innate human abilities such as bodily health
2. **internal capabilities** developed abilities that required practice and training such as physical strength and agility
3. **combined capabilities** internal capabilities combined with external conditions such as local laws and environment (Oosterlaken, 2012).

The main idea of the framework is that possession of a set of capabilities is required to achieve well-being. While being in possession

of the set of capabilities do not guarantee that a person will achieve well-being, capabilities provide *opportunities* in which the person can take in order to move forward in life (Nussbaum, 2001; Oosterlaken, 2012; Sen, 2008).

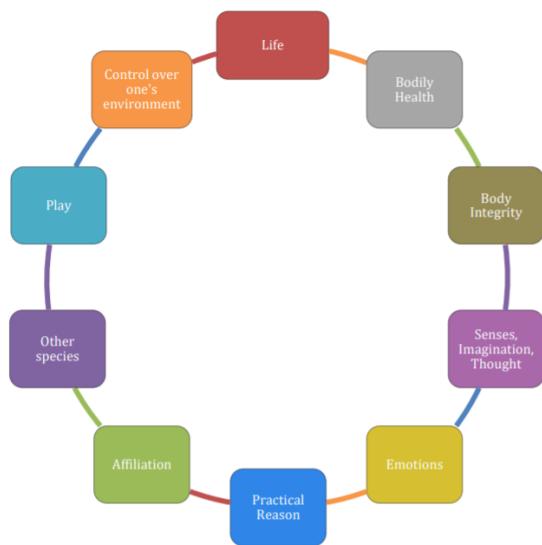


Figure 7: 10 basic human capabilities proposed by Nussbaum (Nussbaum, 2001)

To illustrate, a fitness app, for example, would not be useful to paralysed patients, for they lack the basic capability of bodily health and control over their bodies. In a same way, a fast car would not be useful to someone who does know how to drive (internal capability) or lives in a place with extremely heavy traffic (environment; combined capability).

Technology can extend and expand human capabilities, which is what our design aim to achieve but it is also important that we consider whether or not our stakeholders possess the capability to use our design.

1.5.3 Technological mediation

According to Verbeek (2018), all technologies can be seen as having scripts, being explicit or implicit. A script involves the material build-in prescriptions of the product. Thus,

technological artefacts are not standing on their own, but have an active role in the ways human beings are presented to the world (human action) and how the world is presented to them (human experience).

These different roles are called technological mediations. Technological artefacts are not only functional, but also alter the behaviour of their users, since this specific behaviour would not otherwise be present without the technology. However, there is a difference between mediation of action and mediation of perception. In the latter, technology plays a role in helping people *interpret* (eg a thermometer) and determine (eg glasses) reality.

With mediation of action, the artefact itself can also *invoke* a certain behaviour (present-at-hand), instead of the artefact withdrawing people's attention (ready-at-hand). Both mediations occur in different relationships between artefacts and their users, which are dependent on the context the way the technology is used. Furthermore, one artefact can have different mediating roles in different contexts – this is called 'multistability'. Both mediations are dependent on individual intentions and social structures. Mediation of action is also dependent on the material environment.

Why is this concept of technological mediation relevant? Since technology actively shapes humans behaviour and perception, designers need to think carefully about the potential mediating power the technology they are designing could have. Thinking about these potential mediations will make them aware of the ethical implications of creating a certain technology and will decrease the chance of undesirable scripts (Verbeek, 2006).

1.5.4 Putting things into context

Our challenge is to increase access to improved water sources in rural Ethiopia. With this, we improve the capability of our stakeholders to act hygienic and hence improve their bodily health. Not having to think about clean water and being sick less often because of cleaner water will improve many more life-enabling capabilities. It will give people and children space to think, play and simply live their lives in a better way. Therefore, life, thought and play are also capabilities our design will affect.

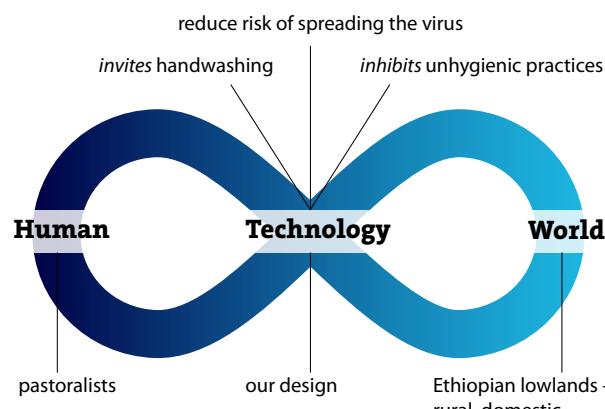


Figure 8: a visualisation of our intended mediation

When implementing technological mediation into our design, the ready-at-hand characteristic will be pursued. Our design has to act in the background, being a reliable and easy to use technology, eliminating the concerns for clean water.

Considering hand washing is proven to be a highly effective preventative measure against the coronavirus, we aim for our design to *invite* people to wash their hands more often and more thoroughly and *inhibit* unhygienic practices such as open defecation and drinking from unimproved water sources. Our design will therefore reduce the risk of spreading the virus. Our design will be mediate between

our stakeholders and the world – a tool to help them gain access to safe water.

As previously mentioned, our design needs to be *appropriate* for our stakeholders. To ensure this, we came up with three criteria:

- The stakeholders should be able to repair the technology themselves if it breaks (without extensive technical knowledge).
- The technology should not have high initial and maintenance costs.
- The technology should remain functional for a long period of time.

1.6 Research and resources

To understand the challenge and the stakeholders, many different resources have been consulted. Various scientific papers and NGO websites have been consulted to get a deeper understanding and more scientific knowledge on the problem. Moreover, multiple personal contacts have been used or are still being exploited. For example, Kaspar is in contact with the CEO of the NGO 'Menschen für Menschen' who have several projects in Ethiopia providing education, water, sanitation, agriculture, and more in an holistic approach. He offered to help us by answering questions. We are trying to find out whether a collaboration with one of their projects is possible.

Considering the time constraints, our current research priorities are as follows:

Exact needs of our stakeholders and their perspectives on the problem. It is important that we understand the problem from our stakeholders' perspectives which could be different from what we currently know. This could involve primary research by contacting our stakeholders directly.

Technology behind existing initiatives.

Examples include the design sciences of water filtering system and rainwater harvesting system.

2 Deepenings

Each team member has chosen an area of academic knowledge, a question, or a problem that sparks their interest and that they want to delve deeper into as well as explain why it matters to them personally and why it is meaningful for the design challenge.

2.1 Mens sana in corpore sano

Written by Jorijn Oosterhuis

‘**M**ens sana in corpore sano’ is a Latin phrase which means: ‘a healthy mind in a healthy body’. In my deepening, I want to extend my knowledge about the connection between bodily and mental health and thereby contribute to our socio-technological challenge.

Preliminary exploration

While people may think our brains control all our processes in our body, the body itself should not be forgotten either. In fact, some mental health issues may be caused due to our bodily health. Thinking about the context of our challenge, we can think of dehydration. This can be a reason for depression, since dehydration impedes your brains serotonin production, of which a lack is often linked to depression. Furthermore, dehydration can also be linked to anxiety and/or panic attacks (Crowell, n.d.).

Not only the lack of water, but also the water itself can cause mental affects. For example, research has shown that water contaminated with arsenic negatively effects mental health. Arsenic may effect certain brain cells and

could thereby increase the chance on a depression, but feeling sick because of the contaminated water worsens mental health as well (Chowdhury et al., 2016).

Lastly, viral viruses could also have an impact on people’s mental health. Although further research is still needed, several influenza viruses, hepatitis C and human immunodeficiency virus are certainly connected to feeling anxious or depressed (Coughlin, 2012).

Why does it matter to me?

As a person, I have always been interested in psychology and mental health. I like reading small articles in magazines about psychological research and discovering how the human brain works. Last year, I took a social psychology course, and I really liked the fact I could immediate apply what I learned and that I was therefore able to better understand the world around me. But, apart from understanding the human world, I love to learn about the natural world as well. Discovering how chemical processes work, or learning about physics. Lastly, I am interested in the link between our body and our thoughts and feelings, which is actually a combination of my first two interests. This link is something I also experience myself, for example having a headache when I am stressed. Therefore, regarding our challenge, I would like to learn more about the other side as well: how our mental health is affected by our bodily health. The information I will gain will contribute to the challenge, but will be also be applicable in my personal life.

Why is it important to the challenge?

One of the capabilities our final design will reinforce is bodily health. But, what are the effects of a better bodily health on our

stakeholders? Of course, being sick less often or not having corona will improve their overall life quality. However, does this effect their mental health as well? How will our final design therefore implicitly mediate between our stakeholders and the way they see their world? These are questions I want to answer in my deepening. The answers will provide our team with a better understanding of the effects of our design on our stakeholders. Not regarding the functionality, but regarding the change in mental state because of our stakeholders' healthier bodies.

Format

I would like to present my deepening writing an essay, combined with pictures. This will allow me to share a lot of information, and convey my findings to others in an appealing way.

2.2 Understanding others' needs

Written by Kaspar Rothenfusser

Often when talking about developing countries, we forget to talk about the definition of development. We assume to know, what it means to make things better, to live better and to be better. We are blind for all the things we could learn from them or which are just different. Even if we are way wealthier than those countries, we can not be sure that we are happier. And what if not happiness is what life is really about?

Over the last decades there were several approaches to define an index for happiness and development in order to compare different countries, such as "Gross National Happiness" (GNH) (Ura et al., 2012) and the "Human Development Index" (HDI) (Nations, 1990). But even those approaches are biased due to the fact that they were developed from scientists of

the wealthy parts of the world. For example are most of these indexes partly based on the Gross National Product and therefore on the amount of money the average citizen has, even though it does not say anything about, how the money is distributed within the country. Besides that research has shown that there is not a direct correlation between more money and a higher amount of satisfaction/happiness (Jebb et al., 2018). In the recent years several institutions started to develop better evaluations, by asking the people directly about their happiness such as the "World happiness report" that is published every year by the "United Nations Sustainable Development Solutions Network" in collaboration with the Gallup world poll, originally developed by the happiness council (happiness council website). When looking at the World happiness report we see that to some extend the happiness can not be explained by money, lifespan et cetera.

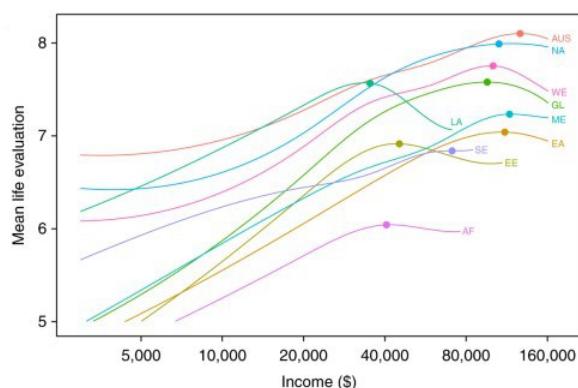


Figure 9: graph illustrating the correlation between income and mean life evaluation (Ura et al., 2012)

This shows, that we do not completely understand what makes people happy and what other cultures want. Therefore, when designing for other cultures its is crucial to have humility and to ask the stakeholders directly, what they need and want. We

furthermore should always think holistically when developing solutions, in which other mechanisms of a culture intervenes. And when it comes to technology, we have to see the long term use: Products often look "cool" at first - solar, battery, etc. – but are there recycling concepts on site? Are there experts who can repair, is there a lot of plastic in the product, or does all scrap metal end up in the field? Many "solutions" of the global North have rotted locally due to lack of infrastructure and have thus created more frustration than hope.

If we don't consider all of this we can not design an appropriate product. Therefore I choose to dive deep into the culture and community life of our stakeholders. I will research using papers as well as personal contacts in order to understand, what is important when designing for a developing country in general, in Africa and precisely in Ethiopia. Thereby I will be able to help my Project team to understand the context of our challenge and to develop an appropriate design, that will make the life of our stakeholders better in their own eyes.

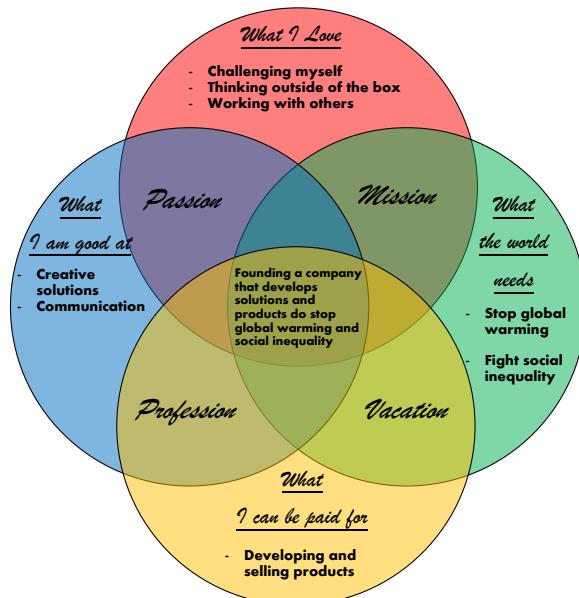


Figure 10: Kaspar's Ikigai

The reason why I choose this deepening is that it is strongly connected to my IKIGAI. My Ikigai is to found a company that addresses the two in my eyes most pressing problems of social inequality and climate change. That means that later in my life in case I really found such a business I need to know how to design for and collaborate with a development country. Therefore this deepening will be a great opportunity for me to take the first steps in following my vision and mission.

2.3 Frugal innovation and design

Written by Merijn Janssen

For my deepening I want to look into **frugal innovation and design**. Frugal innovation and design means designing low-cost innovations for the unserved lower end of the mass market (Lim & Fujimoto, 2019). Since our stakeholders fall under this category, I think my deepening will be very useful for our project. Moreover, I want to use the knowledge I gain during theoretical research to focus on designing itself. Since our challenge is to design something. I want to be very active in this part of our project and want to be prepared to be so because of my deepening. Since we do not know what our design is going to be, it is hard for me to clarify the specific type of designing I will look into, as well as the directions I will gain more expertise in. These directions might include, low cost materials or production, sustainable development or maintenance; or user friendliness for our stakeholders.

I want to look into this, because I think designing combines many skills and disciplines, such as creativity, precision; and physics and mathematics skills. I like all of these parts of designing. I like to be creative and innovative. I like to combine knowledge and ideas into a

visual result, in this case our product. I think design skills are useful in many scientific fields and will therefore also help me throughout my career, whatever path I might take.

I am not sure what I want to use as a format to portray my accomplishments in my deepening. This depends on the eventual designing I end up doing, which is yet to be decided. Right now I would say that I would like to make a poster, combining my theoretical knowledge and the actual designing I did in the end.

2.4 Hydrology of the Ethiopian lowlands

Written by Noa de Been

For our project it is useful to have a clear overview on what water sources are available in the lowlands of Ethiopia. It is important to know which water sources are reliable and what impact climate change will have on the reliability of the water sources. We want to make sure that the water that is provided is safe. Therefore, we must know what the natural composition of the water sources is, and what kind of pollution there is. To get more insight in those topics, I will deepen my knowledge in the Hydrology of the lowlands of Ethiopia.

For this deepening I wanted to investigate a more technical aspect of our challenge. I think this fits my interests that I had in Highschool in Physics, Chemistry and Biology. Hydrology is a discipline where knowledge in geology and chemistry is important. I am excited to broaden my knowledge in those disciplines. I am also interested in the impact climate change has on water management. I am very interested in the subject of climate change. It is a worldwide problem but will affect the people in drought development countries the most.

The definition of hydrology is the following: 'Hydrology is the science that encompasses the occurrence, distribution, movement and properties of the waters of the earth and their relationship with the environment within each phase of the hydrologic cycle' (USGS, n.d.). This means that I can investigate the rainfall in Ethiopia, the geology, the different river basins, but also the composition and pollution of the water.

The lowlands of Ethiopia are prone to drought (Bank, 2020). The most drought areas receive only 200 mm rainfall per year or less. Ethiopia also has a high hydrological variability. This means that the rainfall during the year is exceptionally variable and unpredictable. Due to climate change there is a lower average annual rainfall, and the variability of inter-annual rainfall becomes even higher. This variability results in a variability in very drought years and years with flooding's.

Ethiopia has twelve major river basins. These differ in the extend of utilisation, water quality and reliability. The rivers that are used the most are highly polluted downstream due to domestic wastewater and wastewater from industry and agriculture. Dependent on in which area we are going to innovate, I will conduct more research in those river basins.

Ethiopia has a high variability in its geology. In the lowlands, there are many different sorts of geological conditions. For example: volcanic, karstic, sedimentary and basement formations. This results in a variation of water quality. The groundwater sources in Ethiopia are often brackish or salty, with high mineral content and high temperature. Which makes it unsuitable for drinking water and most other purposes.

The format for the final version of my deepening will be a scientific poster. I think this will be the

best format because I can combine text with clear visualisations.

2.5 Ethics and philosophy

Written by Pookhao Chinpongsuwan

What is the right thing to do? Ask this question in any context to a group of people and chances are you will receive mixed responses, which is expected, for it is a rather subjective question. What does it even mean to do the *right* thing? Adolf Hitler, for example, believed he was doing the right thing for Germany by killing millions of innocent Jews. Clearly, most of the world do not agree with his ideology.

Ethics, or moral philosophy, is all about 'systemising, defending, and recommending concepts of right and wrong behaviour' (Fieser, n.d.). While science strives for true objectivity, it would be difficult to say the same for ethics and philosophy, as illustrated by the example above. That is not to say that the subjectivity of ethics is necessarily a bad thing. In fact, I believe it is just as important, relevant, and fascinating of a academic field as sciences and mathematics in today's rapidly changing world.

Why ethics is still relevant in a science-driven world?

Some people might say that ethics is holding back scientific progress. After all, is there room today for such level of subjectivity in a fast-paced, rational, science-driven global society? I believe a more suitable phrasing would be that it *monitors* and *moderates* research – to keep it in check; to prevent it from overstepping humanity. To illustrate on what happens when we put scientific progress before ethics, take the case study of Unit 731, for example:

During the second World War, a top-secret project, Unit 731, was established in Japan to conduct lethal human experimental research on biological and chemical warfare; the operation was responsible for over 200,000 deaths (Kristof, 1995). Experiments conducted range from amputation and dissection without anaesthetic to exposing subjects to extreme x-ray radiation to forcefully impregnating women, under the rationale of testing human body's limits (Kristof, 1995).

Should we stop giving aid to Africa?

To put it into the context of the design challenge, an example of a philosophical argument regarding global development is that developed Western countries should stop giving aid to Africa as doing so achieves the exact opposite of the intended effect. Economist Dambisa Moyo argues that foreign aid, rather than promoting development, creates problems such as corruption, dependency, and limitations on exports which in turns damages the economy and hinders the development of the country (Moyo, 2009).

Another interesting philosophical idea which I find interesting is the allegory of the cave. In the allegory, Greek philosopher Socrates describes a group of people who have spent their whole lives imprisoned in a cave, facing an empty wall. They observe a shadows of objects outside the cave projected on to the wall. To them, the shadows are their reality and they have no desire to discover the true nature of the outside world, 'for they know no better life' (Ferguson, 1922). Could this be applied to people in rural Ethiopia, or people living in hardship for all the lives in general? What if they could not handle a huge change to their lifestyles – even a positive one – caused by our innovation?

As our challenge is to help people in rural Ethiopia, it is important to consider alternatives perspectives such as the ones mentioned above. It is important to raise difficult philosophical questions in order to be aware of the possible unintended outcome. This relates to the theory of design mediation as previously discussed. What if our design – despite our good intentions – had the opposite mediating effects to what we intended for it to have?

Personal reflection

I find ethics and philosophy highly fascinating because it deals with questions that cannot be answered by science – questions that cannot be answered with pure objectivity or logic. I believe learning about ethics and philosophy will be a rewarding experience that will enable me to see the world and consider global problems not only from the objective perspective of science but also from a more subjective, human-centric, and empathetic point of view of philosophy. I have also been interested in technology and entrepreneurial careers. I believe ethics and philosophy will complement these interests as well.

3 Reflection

Let's solve a global problem! In its simplest form, that was our initial perception of and the starting point for the design challenge. Throughout Phase 1, one of the many things we have learnt, is that socio-technical problems are never so simple and straightforward.

3.1 A learning journey

It would be an understatement to say that the project has broadened our perspectives and enabled us to discover new possibilities. In the

beginning, we were heavily focused on finding the best solution. We quickly realised that this approach was far from ideal, for how could we design a solution if we did not understand the problem we were trying to solve?

The possibilities of fields we could research are virtually endless. An important lesson the past month has taught is to be considerate when selecting a challenge. Try to stand in the stakeholders' shoes and see the issue from their points of view. The design not only has to perform well but also be appropriate specifically for the stakeholders. Thorough research has to be conducted towards understanding what their problems and needs are. Societal ethics have to be understood to carefully predict and control the technological mediation of our design.

Our current ideas will go through many more iterations as we gain more knowledge in the relevant fields, which could alter our perspectives. The main takeaway is that knowledge and understanding of the problem are first and foremost keys to developing an effective solution

3.2 Working together as a team

It is time to take a step back and reflect on our teamwork and group dynamics. So far we have been keeping up with the deadlines. We delivered every milestone on time and received positive feedback from experts. All team members put in a lot of effort and contributed fully to the team's overall progress. The efficiency of our recent team meetings has improved significantly, compared to our first meeting. We achieved that by introducing a very strict, detailed agenda and a chair that keep us on track. We decided to switch the roles for every meeting in the first phase. This gives

Team member	Deepening (format)	Why does it matter to you?	Why is it relevant to the design challenge?
Jorijn	a healthy mind in a healthy body (text essay with pictures)	interested in psychology and natural sciences, link between body and mind, applying my knowledge to everyday life	(indirect) effects of our design, understanding the mediation of our artefact, change in mental health will become clearer
Kaspar	understanding designing for a developing country (talk/presentation)	relevant for my Ikigai and vision of working with development countries	helps to design an appropriate and successful product
Merijn	frugal innovation and design (poster)	multidisciplinary and creativity	designing itself and broad thinking
Noa	hydrology of Ethiopian lowlands (poster)	interested in geology, chemistry, and climate change	understanding about the water resources in Ethiopia is important in order to provide its residents with clean water
Pookhao	ethics and philosophy (text essay)	interested because it answers questions that cannot be answered by science	awareness of potential unintended outcomes to stakeholders is important to consider issue from their perspectives

Table 1: deepening summary table

everyone the chance to learn different aspects of this project challenge.

With regards to research resources, we believe the best way to understand the context of our challenge and our stakeholders is to talk to someone who is directly affected. As previously mentioned, we are in direct contact with relevant NGOs and our stakeholders, in addition to conducting secondary research. For the next phase, the context study, we will try to get even more contacts, by pitching our project to different NGOs, private persons and maybe even a competition online coaching competition. Thereby we hope to get deep insights in the

needs of our stakeholders.

There is always room for improvement. To help us improve ourselves both individually and as a team player, we introduced an internal feedback system where, at the end of each milestone, each member would write a short feedback on the other members of the group. One of the main problems that was frequently brought up was that some of us are naturally outgoing and often took the lead in team discussions. While this was not necessarily a bad thing, sometimes we tended not to listen enough to other less outspoken members. In the same way, members who are naturally more reserved

could benefit by actively participating in team meetings by speaking up and sharing their ideas since we all can benefit by learning from each other.

Lastly, another important improvement action is task delegation. We found it difficult to divide tasks in such a way that no members took on too much workload. This was a problem we encountered in both milestones that negatively affected our efficiency and group dynamics. To improve that we now try to analyse the different tasks beforehand to see how much work everything will be. This will help us to devide the workload better and to work more efficiently.

3.3 Final thoughts

At the start of our project, our challenge was very broad. Iterating our context study helped us identifying the direction we want to go . We will continue refining, while keeping in mind all the lessons we learnt from exploring existing initiatives, the environment of our stakeholders and design philosophy. All in all, we thoroughly enjoyed the learning experience and are looking forward to continuing our journey towards designing a sustainable and effective solution.

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