

# Master Thesis 2011

## **Project Report**

KIND ATTENTION

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## Summary of content

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The content in this report has been organised in more or less a chronological sequence, beginning with the forethought and motivation behind the project, followed by the details of how it all has unfolded until the day of the master examination at Konstfack. To introduce the reader to what lies between the next thirty-two pages, I have summarised each of the six chapters below.

*Chapter I, **Beneath the mire***, describes in detail the beginnings of this project, the thesis proposition, the background, and the research means and methods, along with my first thoughts which sought out to define the project's intent and outcomes.

BACKGROUND &amp; RESEARCH

*Chapter II, **Den ständiga resan***, attempts to recreate (*a concise version of*) the Ethiopian experience, covering the pre-trip preparations, and then the actual journey, across Karat-Konso in southern Ethiopia.

REVISITING ETHIOPIA

*Chapter III, **Patterns in the ivy***, presents (*a concise version of*) the dissection of the observations and insights, and the reevaluation of the project intent, direction and process, after returning from Ethiopia. The first thoughts I had before visiting Ethiopia, gave way to the second thoughts regarding the entire project, and this marked a watershed in the evolution of my thesis.

REEVALUATION OF THE PROJECT

*Chapter IV, **Deliverance***, defines and explains the rhyme and reason behind the three product proposals, which intend on alleviating the existing conditions surrounding water scarcity, lack of sanitation and problems arising out of the excessive use of firewood as a fuel.

DEFINING THE DESIGN CONCEPTS

*Chapter V, **A fair judgement***, validates the three product proposals against the thesis proposition, and maps their feasibility against time and complexity in terms of design and real world logistics.

VALIDATING THE DESIGN CONCEPTS

*Chapter VI, **Closure***, concludes the thesis and presents my personal reflection of the project and the process, and my aspirations regarding its future.

CONCLUDING THE THESIS

The **Epilogue** concludes this report and provides references and pointers to the works of people who have inspired my design philosophy and outlook.

## Overview

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### **Thesis working title**

Dream Space

### **Thesis proposition**

The thesis enquires into understanding the scope of industrial design for introducing sustained and unbiased development of quality of life in the underprivileged regions of the world.

### **Background**

Investigating the parallels between living in space and living in resource-poor regions on earth.

### **Planned objective(s)**

1. Understanding the scope of industrial design in aerospace applications.
2. Understanding the factors affecting the development of quality of life in the underprivileged regions of the world.
3. Studying a community in an underprivileged region to apply the above understandings, and subsequently designing a set of solutions to elevate the quality of life (namely water, food, shelter and energy), in similar regions around the world, which can be realised in the near future.
4. Creating and maintaining of a universal standard in the quality of the design and the experience it provides, thereby dignifying the use of the product, by one and all

### **Planned outcome(s)**

Concluding the thesis with a proposal for a set of design solutions, along with a book detailing the entire process, and developing prototype(s) for display during the Konstfack Degree Show in May 2011.

### **External support**

Cecilia Hertz/Umbilical Design AB

## Prologue

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I had aspirations and desires, but almost often, I ended up living at the mercy of circumstance. So when I decided to pursue industrial design studies in Sweden some four odd years ago, I had to not only learn to adapt to the cold and dark, yet solemn land, but also to design the circumstances that would enable me realise my ambitions and potential in the vibrant field of design. Like all valuable experiences in life, it was the beginning of a new journey for me. For me, it is the journey that maketh the traveller.

Every journey has its ups and downs, and in hindsight, the last four years had their fair share of triumphs and tribulations. In times like these, whether high or low, I have mustered enough patience and immunity to not let the circumstances alter my goals and principles of being, which I believe is why I am what I am, and where I am. This has had a positive impact on my work, especially the master thesis.

This master thesis project report presented here is the abridged version of the *book*, **The Making of Master Thesis 2011**, which will be one of the four outcomes of this project. I felt a book is an ideal medium for sharing my experience and, for giving back to creative community at Konstfack and beyond. I will be chuffed if it succeeds in functioning as a supplementary reference for students and interested readers intending to work towards a sustained and unbiased development around the world. To enhance the reading experience of the report though, I have deliberately edited out the rudimentary and narrative material. Nevertheless, I have tried my best to elucidate the journey, in a format suggested by our professor, Teo Enlund. Unlike the book, I have not included any visuals - photographs, illustrations and renders - describing the study trip, research and the design outcomes, in this report. These shall be discussed in depth during the presentation.

## Chapter I

### Beneath the mire

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Throughout the comprehensible existence of us, the thinking-kind, we have subjected ourselves to countless physical and metaphysical boundaries that have hindered a sustained and unbiased development of not just our own species, but that of all life forms on planet Earth. True, we have achieved a certain understanding of life within and around us, but not without compromising and sacrificing the purity and existence of life itself. The state of affairs are conveniently similar when we ascertain our understanding of space, matter and time, and of all things perceived by contemporary science and technology. This relentless progress in our understanding, and thus knowledge, has only manifested itself to the highest degree, in regions and nations within the vested interests of the contemporary industrialised economies, thereby fencing the divide between the civilised and the sympathised.

Then, as we stride in to the next millennia, with remorseless pride and prejudice, the fanatical progress of the industrialised nations is likely to undermine, and even suppress, the growth and development of the geographically and sociologically underprivileged regions of the world. To neutralise the divide is indeed a daunting and to some extent, a pretentious endeavour, as the thinking-kind is nothing but a pretext for the selfish-kind: for our very basic instinct of self-preservation is susceptible to perpetual exploitation and polarisation. It is thus extremely crucial to enlist and comprehend the reasons behind the exploitation to try and enable sustained and unbiased growth and development to permeate all factions of contemporary human civilisation, and thereby standardise the quality of life.

I enjoy writing and often use it as a tool to lay out my thoughts and plans before I begin any *design* project. The above excerpt was the introduction to an essay assignment which was a part of the *Perspectives from the Humanities*<sup>1</sup> course at Konstfack. This was in the beginning of the third semester, by when I had already made up my mind regarding what I wanted to do for my master thesis. In fact, I had already decided what area I wanted to work with, a long while ago.

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<sup>1</sup> *Perspectives from the Humanities* is a cross-disciplinary, theoretical course for the second year master students at Konstfack, to help them formulate and initiate their thesis projects.

## 1.1 Background

It all began with my fascination for everything *aerospace*, when I was about ten years old. As I moved through the academic factions of high school and university, I failed to grasp on to this calling due to my mediocre capabilities with mathematics. Nevertheless, I graduated as a computer science engineer - which has its fair share of mathematics, albeit *discrete* - and then decided to venture into the field of design, to find alternative routes into the aerospace industry.

The move to Sweden was a breath of fresh air. Now I had the opportunities to get ever more closer to what I had desired about thirteen years earlier. It was not easy. After two years at the Umeå Institute of Design, and a year at Konstfack, I felt I had enough credibility to contact Cecilia Hertz of Umbilical Design<sup>2</sup>, to express my ambition and desire to work with the space industry. I was grateful to have her approval, and was glad to know that we shared a similar perspective.

With *space* somewhat conquered, I began concentrating on my other interest that I had picked up after moving to Sweden - design and development for extreme environments in underprivileged regions. There are many parallels between living in outer space and living in underprivileged regions here on earth. Both have limited supply of water and food, among other resources - both are **resource-poor** systems. Can we then apply the billion dollar studies made for living in outer space, to improve the life of a billion people here on earth? I thought of giving it a shot. I began formulating my thesis.

A SYSTEM WITH A SEVERELY  
CONSTRAINED ACCESS TO  
RESOURCES IS RESOURCE-POOR.

The thesis enquires into understanding the scope of industrial design for introducing sustained and unbiased development of *quality of life* in the underprivileged regions of the world.

Before I proceed to describe the background and research in detail, I wish to clarify a few terms and define the way I perceive them.

The nature of nature on this planet is such that no one region can establish complete resource independence whilst sustaining contemporary human settlements. Nevertheless, some geographical regions are extremely favourable, while some are not, for sustaining such modern day societies. With the advent of science and technology, we have proven ourselves to be capable of adapting to even the harshest of circumstances, but unfortunately these developments have not benefited all of humankind. Millions of people living in regions in Africa, Asia, South America and Oceania, which are often resource-rich in terms of resource availability, live without appropriate access to water, food, shelter and energy. I am interested in these underprivileged regions.

UNDERPRIVILEGED REGION

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<sup>2</sup> *Umbilical Design* was founded in 2001 by industrial designer Cecilia Hertz, and since its inception has worked with NASA and the ESA on design for the space industry. Umbilical Design has also been successful in showing how design, technology and material from the space industry can be transferred to Swedish enterprise and society.

In compliance with the definition of the Human Development Index<sup>3</sup>, I have rephrased and constrained my definition of **quality of life**<sup>4</sup> to imply an appropriate access to potable water, food, shelter and energy for the people in a region.

QUALITY OF LIFE

It was particularly important to me to ensure that the solutions which I develop, are not only environmentally sustainable, but are also a catalyst for initiating and sustaining local ecologies and economies. I believe sustainable solutions call upon a fair distribution and consumption of resources, rather than the enforcing of a green agenda. **Sustained**, then, implies a perpetual process of development and evolution, factoring in local ecologies and economies.

SUSTAINED

To ensure a fairness on all levels, the quality of design and the experience it delivers cannot be compromised for the sake of affordability. **Unbiased** implies a maintaining of a universal standard in the quality of the design and the experience it provides, thereby dignifying the use of the product, by *one and all*.

UNBIASED

Such sustained and unbiased solutions may be a challenge to develop, but they are a vital part of the project, and I wanted to investigate open source models as an aid for the development, as well as a source of funding. That said, I did not wish to enforce alien ways of life on the people, but rather, learn from and adapt to their understanding of life.

## 1.2 In search of research

*Research* has become such a cliché in the world of design. So despite there being an abundance of literature on design research, I had actively chosen to find my own way through during this project. I could never isolate *research* into a *temporal phase*, as I believe it to be a perpetual process, lasting the entire duration of this project, and enabling me to learn and unlearn, and adapt to fresh, but credible inputs, to optimise the design and the quality of the outcome.

TOOLS AND TECHNIQUES USED TO GATHER INFORMATION

One of the crucial objectives of the thesis was to validate the feasibility of realising the outcomes in the near future. As stated in the introduction to the essay, in the beginning of this chapter, I felt it was necessary to enlist and comprehend the reasons behind the state of affairs in our society, to try and promote sustained and unbiased growth and development through design. It was important to not only study the avenues of design and human ingenuity, but also the circumstances and conditions surrounding the contemporary society. I wanted to explore a cross-disciplinary approach to design. My methods of research were thus defined by the need to connect and correlate different areas of science, sociology and design, highlighted in the concept map [after page 10].

<sup>3</sup> "Human development, as an approach, is concerned with what I take to be the basic development idea: namely, advancing the richness of human life, rather than the richness of the economy in which human beings live, which is only a part of it." (Prof. Amartya Sen, a proponent of the Human Development Index)

<sup>4</sup> "The term quality of life is used to evaluate the general well-being of individuals and societies. Standard indicators of the quality of life include not only wealth and employment, but also the built environment, physical and mental health, education, recreation and leisure time, and social belonging." (Stockholm Environment Institute)

### **1.2.1 Classic literature and books**

The field of industrial design is a well established one, with sufficient literature covering different aspects of its component design processes. Unfortunately, the literature on industrial design targeted towards developing and underdeveloped regions is dismal. This however, did not present a challenge to me as I was rather keen on studying literature from diverse fields, such as architecture, science and technology, sociology, etc. Consequently, I went through over twenty books, from topics covering urban planning, industrial design for space applications, space architecture, geopolitics, to open source development, sociology and philosophy. Though none have had a lasting impression, I am positive I have subconsciously picked up pointers from these books. The *book* covers the literature review in detail.

### **1.2.2 Periodicals**

One of the major advantages of periodicals is that they periodically provide a snapshot of the society corresponding to their time of publication. Thus, through periodicals, one can keep a track of how the subject of matter evolves over the course of time. I have been subscribing the *New Scientist* for over a year now, primarily to keep up to date with latest developments in science and technology, particularly the ones which can aid my efforts. The subscription gave me access to their archives as well, and I dug up articles as far as the early 90's, which highlighted the growing disparity in Africa, as well as the growth of the continent. Along with the *New Scientist*, the *National Geographic* helped in understanding the status of water, food and other resources in underprivileged regions. Of particular importance were the articles on new developments in water management techniques and the importance of localised food production. The *Foreign Affairs* journal provided a worthwhile insight into geopolitics and how it contains the independence and growth of impoverished nations, albeit from the point of view of the United States. This has affected the nature of this project considerably by challenging me to derive new models and business processes that will be required to evolve and sustain this project. I also referred to the archives of news agencies and newspapers.

### **1.2.3 ESA and NASA publications**

Since space exploration and technology were areas of inspiration for the project, it made perfect sense to look up relevant literature published by the European Space Agency (ESA) and the National Aeronautics and Space Administration (NASA). Of immediate importance were two such publications, *Down to Earth* by ESA and *Spin Off* by NASA. *Spin Off* has been published annually since 1976, and is an extremely good indicator of the space industry over the years. It presented different NASA initiated technologies that have been applied in the commercial industry, for better or for worse. *Down to Earth*, on the other hand, has been published annually just for the last two years. It nevertheless provided similar insights into the spin-offs instigated in Europe. These two publications helped me identify several technologies and processes, that could come handy while developing the concepts for the thesis.

### **1.2.4 Documentaries and films**

Out of all the mediums of research used, documentaries and films were the most effective ones. Such audio-visual experiences provided me with a distinct insight as to what one can expect to find in underprivileged regions, like the ones in Africa and south-east Asia. I tried to analyse not only the content of the films, but also to understand how the films were conceived, produced and narrated, to get a grasp of how one goes about researching in the real world, and then presenting the findings in a lucid, yet convincing manner.

Also of importance were the tricks and techniques used by the presenters while discovering the people and the places. This would be of help when I make the trip to an underprivileged region, I thought. BBC documentaries like the ones by *Michael Palin* (Himalayas and Eastern Europe), *Michael Wood* (India) and *Jonathan Dimbleby* (Africa) were instrumental in shaping up my understanding of the developing world and its people, and helped me in planning for the trip. Other mainstream, and independent films and documentaries, covering a variety of topics like food production, sustainable design and development, politics and human behaviour, were also analysed.

### **1.2.5 Youtube comments**

Using Youtube videos and comments as a research tool was an innovative method of hearing what thousands of people around the world have to say about everyday events, from the comfort of my chair and desk. Finding useful videos was relatively easy, but comments which were insightful, were generally very hard to find. The trouble with comment aggregation was that there is no automated algorithm available - Youtube has a beta, but it is no good yet. So it was a painstakingly slow process, sometimes having to browse through hundreds of comments to find the significant ones. I did not limit myself to Youtube comments only - comments on articles on news websites, science and technology forums, and some blogs were also looked up.

### **1.2.6 People**

Inspirations and motivation seldom come to me from the world of design per se. It is usually the everyday people, and their little idiosyncrasies that spark the evolution of everyday design, which is why they have a promising impact on how I build my knowledge base for a career in design. Apart from meeting the professionals in the field of industrial design and innovation, I wanted to seek guidance from architects, urban planners, engineers, business developers and strategists, and journalists. Classmates and friends were equally valuable. I was also inspired by the work of many individuals from around the world, seldom designers, who I have not met personally. But what I actively sought throughout the project was meeting and interacting with common people, especially the ones who have experienced living in underprivileged regions, whether out here in Sweden, or in Africa, or elsewhere else in the world.

## 1.3 Connecting the dots, and some first thoughts

The concept map [previous page] illustrates the different areas and fields that I reviewed during the research phase. Explaining and elaborating on the map in its entirety is beyond the scope of this report. To keep matters short and simple, I have only included parts of the major areas, namely, water, food, society, energy and shelter, along with few important first thoughts. The *book* shall contain an in depth description and discussion of all the areas highlighted in the concept map.

ANALYSING THE DATA AND IDENTIFYING OPPORTUNITIES FOR INDUSTRIAL DESIGN

### 1.3.1 Water

Water, after oxygen, is the most essential of all resources required for survival. Many of the issues facing people around the world stem from the inaccessibility or unavailability of water. The situation surrounding water is dire in underprivileged regions, and I believe, improving the access and the quality of water can help bring about relative growth in their personal wellbeing and local economy. Similar understanding has been voiced by hundreds of professionals and organisations around the world, and there have been several initiatives developed to address these problems. Unfortunately, the conditions in these regions have not improved as one would expect. One can garner a hundred different reasons why such humane endeavours fail time and again. I for one think, it is the very human nature, and our need for self-preservation that stops us from truly helping the ones in need. To overcome this, I believe we have to empower the people in these regions to take matters in to their own hands. How this can be achieved in the best possible way, is a worthwhile add-on to this project.

IMPROVING THE ACCESS AND THE QUALITY OF WATER CAN HELP BRING ABOUT RELATIVE GROWTH IN THEIR PERSONAL WELLBEING AND LOCAL ECONOMY

EMPOWERING THE PEOPLE TO TAKE MATTERS IN TO THEIR OWN HANDS

#### **Water resources**

As with the case of most natural resources, water sources are unevenly distributed on the face of the earth. If the scientists have got it right, less than 1% of the water on earth is available for direct human consumption. The number sounds apocalyptic, but if we consider the approximate quantity it represents - 31,341 trillion gallons<sup>5</sup>, there is certainly more than enough for the 7 billion humans, or so it seems. Majority of the population gets its daily supply of fresh water from rivers and lakes. A significant population living in arid regions gets its supply from ground water. Since the 1970s regions in the middle east have started relying on expensive desalination technique to meet its water requirements. Water condensation techniques have found their way in well developed regions, with natural water scarcity. Traditional water condensation and rain water harvesting have been employed by indigenous populations around the world for many hundred years, though such initiatives have not yet been developed to meet their full potential.

I saw a tremendous potential in **rainwater harvesting** and **atmospheric water condensation** to provide a steady stream of water to the people in underprivileged regions. This faith stemmed from four observations. First, history has shown to us that human populations have only settled in regions with proximity to water - be it rivers, lakes or groundwater, or regions which

RAINWATER HARVESTING IS THE ACCUMULATING AND STORING, OF RAINWATER. AN ATMOSPHERIC WATER GENERATOR IS A DEVICE THAT EXTRACTS WATER FROM HUMID AMBIENT AIR. (WIKIPEDIA)

<sup>5</sup> *National Geographic*, Special Issue: Water, April 2010.

receive predictable precipitation as rain or snow. This implies that there is always a source of water to rely on, as a primary source or, as a last resort. Second, the atmospheric water vapour percentage is relatively high in the regions near the equator - where most underprivileged regions are located. Third, these two approaches can provide drinking water close to purity, as compared to the water available for direct consumption in the underprivileged regions. Fourth, these approaches can be implemented on a micro-level, around individual homes, as opposed to other water systems like reservoirs, dams and water treatment plants.

### ***Recommend portions***

Since I have advocated appropriate access to basic needs in my thesis proposition, I paid some attention to recommended portions of daily water consumption by an individual, by science and society. Science recommends every person to drink between 2-3 litres of water everyday. The observed daily water consumption per person in the developed regions around the world is about 300 litres, whereas the same in underdeveloped regions is often as little as 10 litres. To determine a precise number can be rather difficult given the differences in personalities and societies. If we look at the space industry though, there is a clear definition on how much water a crew member can consume daily. Crew on board the International Space Station use about 1/10 the quantity of water we use on earth. By comparing the circumstances on board the space station with the conditions in underprivileged regions, I intended to approximate an appropriate amount of water, available per person, for daily consumption. As an indicator, I noted that the *Human Development Report* by the United Nations Development Programme (UNDP) defines water-poverty threshold at 50 litres<sup>6</sup> per person, per day.

### ***Role of water in sanitation***

Sanitation uses about 30% of the water consumed in a modern household. Due to the extreme scarcity of water available for consumption in the underprivileged regions, sanitation systems are not adequately developed and maintained. I thus saw an opportunity for optimising the use of water for sanitation, or for employing water-free sanitation systems, such as **composting toilets**. Composting toilets can produce biogas and natural fertiliser, which can be utilised to provide fuel for cooking, or electricity generation, and for growing food respectively, without any added environmental cost. Also, they are easy to implement and maintain locally.

A COMPOSTING TOILET IS AN AEROBIC PROCESSING SYSTEM THAT TREATS EXCRETA, TYPICALLY WITH NO WATER OR SMALL VOLUMES OF FLUSH WATER, VIA COMPOSTING OR MANAGED AEROBIC DECOMPOSITION. (WIKIPEDIA)

### ***Prevention of diseases***

It is obvious to a curious mind that the remedies to the common, prevalent diseases and infections, particularly in underprivileged regions, are dependent on the quality of sanitation available to the people. By making sure that the water that is distributed to the people is as close to purity as possible, and that sanitation systems are properly functioning and regularly maintained, majority of the diseases - which are waterborne - can be prevented from spreading. I

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<sup>6</sup> *Human Development Report 2006*, United Nations Development Programme (UNDP), MacMillan: New York, 2006.

believe, if such implements are integrated into a home, the overall health of the community can be safeguarded to a higher degree than at the present.

### 1.3.2 Agriculture and food production

Majority of the initiatives created for benefiting the underprivileged regions have their focus on water, healthcare, education, social equality, or humanitarian aid. Neither of these initiatives are futile. But from a survival point of view, along with water, the production and supply of food are the two most important needs. Yet, very few western funded endeavours are actively looking into developing farming methods and food supply management in these regions, with an intent to propagate the farming traditions of the local people. Moreover, since free trade reforms have been introduced in most African nations, to radically increase the markets for multinational corporations, agriculture and food production on the local level has suffered a major setback. Bringing back the agrarian economy and redefining the conditions for subsistence agriculture can promote food self-reliance and then, perhaps, help in uplifting the poverty which has engulfed the regions at present.

#### *Historical importance of subsistence farming*

Before colonisation gripped Africa, most of the indigenous populations scattered around the African subcontinent relied on subsistence farming, for survival, as well as for the delegation of their society. Tribal laws insured the land belonging to a family, and thus, made sure that all families in the settlement had a land of their own for cultivation. Also, Africa was, and is, extremely rich in natural resources like oil, metal ores, precious stones and consumables like timber, cocoa, coffee, etc. Since the late nineteenth century, colonial powers began scrambling for Africa, in search of such raw materials and cheap labour, for fuelling the industrial revolution and their subsequent world dominance. With this, the indigenous populations were forced into slavery and relocated to create industry driven urban areas. Those who chose to remain as subsistence farmers were severely taxed, or outcast. Thus, over the course of the twentieth century, the sole binder of the traditional African society - *subsistence farming* - was ruthlessly taken away from its people, thereby leading them into living lives of hardship, civil turmoil, war, slavery, and ultimately, poverty.

The history brought into perspective two important points. First, the people of the African subcontinent were self-reliant when it came to the basic necessities like water, food and shelter, before colonisation. The agrarian economy, and the barter system for trading worked efficiently. Second, these people had developed local solutions to their problems including that of water and food management, and housing and sanitation, laws to govern their kingdoms, and means to carry out trade with societies far and beyond. This has had two profound implications on how I designed and developed solutions during the thesis. First, I had to make sure to facilitate and to **promote means for subsistence farming** to the people under consideration. Second, I had to learn from, and subsequently empower these people to take matters into their own hands, and provide means to solve their problems. I did not want to fall into the trap of design imperialism.

SUBSISTENCE AGRICULTURE IS SELF-SUFFICIENCY FARMING IN WHICH THE FARMERS FOCUS ON GROWING ENOUGH FOOD TO FEED THEIR FAMILIES. THE TYPICAL SUBSISTENCE FARM HAS A RANGE OF CROPS AND ANIMALS NEEDED BY THE FAMILY TO EAT AND CLOTHE THEMSELVES DURING THE YEAR. (WIKIPEDIA)

### ***Food culture***

Food is as distinct as the people of a place are, and I planned on making a note of the factors that local food culture can affect in a society, and vice versa, when I undertake the trip later on. In hindsight, I realise how valuable this was - what people eat and drink says a lot about the land, climate, and culture.

### **1.3.3 Society**

Along with natural geographical boundaries, humankind has subjected itself to numerous societal boundaries - for better or for worse. Some of these boundaries have manifested themselves into critical components of contemporary society - the institutions. Some of these institutions have had a detrimental affect the sustained and unbiased development around the world.

#### ***Race and religion***

Historically, societies have been dominated by the institutions of race and religion. When racial traits such as skin colour and lineage are used as an institution to differentiate people, it has inherently led to rigorous prejudice, through design or otherwise. In contemporary society, though racial discrimination has been substantially marginalised, it is nevertheless, still, coupled with social class to segregate humans. This has led to the proliferation of the so called *low-cost* design, and *design for the other 90%*. One of the major challenges to developing unbiased design solutions, then, is to remain immune to institutions of race and social class whilst staying aware of the contextual differences that these institutions bring in. Religion has been pivotal in shaping of the last two thousand odd years of human history. So much so, that majority of institutions even today, are offshoots of the institution of religion. The impact this institution has had on the development of quality of life has somewhat remained ambiguous and often subsumed by political and legal institutions. But it will be rather fool hardy to underestimate the power wielded by religion when working on design solutions that can benefit underprivileged regions, which often have been governed by overtly religious institutions.

#### ***Monetary institutions and politics***

The political and monetary institutions of the world today are the obvious culprits of the detrimental state of affairs around the world. Politics has often been a motivation for power mongering individuals and affiliations, which have distorted and pulverised opinions on sustained and unbiased development of underprivileged regions, as doing so, would have inadvertently affected their power structures. Political institutions rely on monetary institutions for their survival, and the monetary institutions in turn make sure that the preferred political systems stay in power. Moreover, political institutions benefit massively by preserving the segregation of humans in the society, and by all means oppose any efforts to minimise or reduce the segregation. Thus, design solutions intended for uplifting underprivileged regions essentially need to be politically immune - no political institution (or any corporation, for that matter) should be able to ascertain its rights over the solutions, to prevent them from exploiting its subjects. To **remain politically immune**, the key issue that needs to be addressed is utilisation of in-situ resources to improve local production

capabilities. This also led me to look into **microeconomics** and the **role of women** in these regions.

### ***International aid***

What international aid has achieved so far is a subject of controversy and debate. Though I am no expert in geopolitics and international affairs of trade, I abide by my common sense which sees understandable logic in teaching a person to fish, rather than providing him with a fish everyday. Many online forums and comments, often by Africans themselves, voice similar opinion. The outcome of this project had to be so, that it cannot be deemed as an act of charity or aid by the people it is meant for, but rather be perceived as a means to build their own fishing rod. Not a fishing net though!

### ***Attitude towards foreign involvement***

Due to the ugly nature of the international aid and pretentious policies of global powers, it appears to a watchful observer that any attempt by the West to propagate new development in the underprivileged regions, is often met with skepticism and indifference. The white man, for these people, is one with the money, or the one who takes away their money. The white man, on the other hand, looks upon Africa as the hungry continent, the one which sucks in their aid money, with little or no outcomes ascertaining improvement of life and society. These perceptions have to evolve to invoke true progress at the grassroots level. Whether the locals perceive a brown man like me, as a harbinger of new ideas and an aid to improve their life, or just another western design imperialist, is a thing of interest to me. A lot will be achieved just by gaining the trust of these people, especially the patriarchs and the elderly women. These were some of the points highlighted by the documentaries.

### ***Perceived needs and wants***

The attitude of many western designers, which ultimately reflects in their solutions, is that of a *design imperialist* - knowing what is best for the people in underprivileged regions, to promote their own self-interests, and for fame. I am openly critical of this approach. The circumstances or constraints that these designers limit themselves to are not only cost and material ones, but also the underlying design quality and the end experience. To a certain extent, I am ashamed about our arrogance to think it is acceptable to produce solutions of a mediocre quality for the people who have a very little say in what they get to choose and use. I am ashamed of our intelligence when we define what their needs and wants should be. Though there is plenty of compassion and dedication in projects initiated for the underprivileged regions, they do not reflect in the outcome. Nor in the aesthetics. One of my goals with the trip was to mix with the local population, to an utmost extent as possible, to try to understand what their needs and wants are, without the aid of any fancy *questionnaires* and *workshops*.

### ***Microeconomics and open source design***

Every capable person around the world has a right to a livelihood. Once a person has safeguarded the access to basic needs, he or she is free to invest in

a livelihood of their choice. Keeping the design intent and the design process open for public access can serve three objectives. First, constant evolution by creative experts from all over the world, which will ensure optimality of the design, its function and quality. Second, it can provide incentives for the local people to take active part in the design and development process, as subsistence, or vocational livelihood. Third, it can thus create conditions necessary for localised microeconomics to evolve and sustain.

### ***Current local and international initiatives***

The architecture and design community in the West is awash with projects dealing with humanitarian design and *neo-do-goodism* endeavours. The *Millennium Village Projects*, *Architecture for Humanity*, the *Cradle-to-Cradle* initiative, the *Design for the other 90%*, etc., are just some of the popularised projects with seemingly good intentions. There has been very little substantiated evidence about the status and progress of these projects from external sources, which often down plays the do-gooder approach. On the other end of the spectrum, local, self-reliant efforts by the people in underprivileged regions, particularly in Africa, are seldom publicised or promoted. If we are to see any real, measurable improvement in these regions, this stark differences may need to be neutralised, and seeds for fertile environments for independent local initiatives to flourish need to be sown.

### **1.3.4 Energy**

Energy today, is the boon and bane of civilisation. Modern day civilisations have become synonymous with the word *energy*, so much so that their very existence, prosperity or downfall, is defined by use and misuse of it. With an ever increasing fear of dramatic climate change, science and technology is being pushed to its limits to try to mitigate new, alternative ways of harnessing energy for the development of society. But like with agriculture, the need for creating an infrastructure for improving the access to energy in underprivileged regions is either preconditioned to electricity, oil and gas, or completely overlooked.

Without energy, it is believed to be extremely difficult to achieve a western standard of living. I wanted to investigate this belief, as I am of the opinion that, although access to man-made energy helps alleviate the society, the basic needs of life can be attained just by harnessing the direct energy of the sun. Nevertheless, modern day amenities, including advanced healthcare, technical education, and global communication require a constant supply of energy to function. I realised that there were more incentives to harnessing various sources of energy, than by completely ignoring them, and hence I wanted to employ energy as the *invisible hand* in this project.

#### ***The need for energy***

To understand how people value energy, I wanted to understand the need for energy. At first, unlike water and food, the access to energy may not seem life critical. But there is more to it than it seems. A simple study of nomadic and rural lifestyles around the underprivileged regions will reveal that apart from

ENERGY HERE, MEANS THE ABILITY OF A PHYSICAL SYSTEM TO DO WORK. ACCORDING TO THE LAW OF CONSERVATION OF ENERGY, ENERGY CAN NEITHER BE CREATED OR DESTROYED, BUT RATHER, CONVERTED FROM ONE FORM TO ANOTHER.

being able to generate heat (either for cooking or warmth, or for craftsmanship such as blacksmithing, pottery, etc.), the people there require no other active source of energy. Heat energy is almost often generated by burning a fuel of sorts, *wood* and *charcoal* being the most common ones. Despite being renewable, the rate of use of these fuels usually exceeds the rate of natural regeneration, leading to accelerated deforestation. They are also not very efficient of all fuels, and pose a health risk - as carbon monoxide pollutants and as a fire hazard. Thus, I realised there was an opportunity to investigate alternative sources of energy, which could satisfy these peoples modest energy needs. Moreover, I also decided on trying my best to make my design solutions as independent of electricity, oil or wood, as I can.

### **Energy self-reliance**

Being quite nerdy about machines and aeroplanes, it was hard not to be inspired by the concept of *perpetual machines*. Existence of such machines may be limited to the paper, but in reality I am positive about achieving energy self-reliance in physical systems. I was aware of the near limitless availability of sunshine in most of the underprivileged regions, as majority of them are located around the earth's equator. This had increased my faith in the **potential of solar energy**, to develop an implement of a *cyclic (or near perpetual) nature*, and had decided to look out for all possible opportunities to realise this in a practical application, when I undertake the trip. Since heat was the only form of energy most useful to the people in these regions, I also wanted to circumvent the need for generating electricity for the heat applications, thereby improving the overall efficiency of the system.

Moreover, to drive grassroots development and to elevate the quality of life, a high level of self-reliance and self-sufficiency of resources is necessary. By creating intelligent techniques to harness energy locally, along with methods to access water and grow food, the project can try to lay the foundations for this self-reliance and self-sufficiency.

### **Solar energy**

As aforementioned, most of the underprivileged regions around the world are located in the vicinity of the earth's equator. Consequently, the average *insolation* at a given location in these regions is very high all year round. I began studying some relevant technical literature to understand the pros and cons of using solar energy, to be better equipped to conceptualise new ways of harnessing this energy for improving the quality of life in the underprivileged regions.

### **1.3.5 Shelter**

Confucius, the Chinese philosopher is quoted to have said, "*The strength of a nation derives from the integrity of the home.*" I align with his school of thought, and cherish the value in investing time and energy to build a home. I envisioned the nature of the outcome of this project to be as much of an architectural one, as an industrial design one. To this effect, I invested time in learning and understanding the basics of architecture and community planning.

A PHYSICAL SYSTEM IS ENERGY SELF-RELIANT IF IT USES THE WORK IT PERFORMS TO GENERATE THE ENERGY IT REQUIRES.

INSOLATION IS A MEASURE OF SOLAR RADIATION ENERGY RECEIVED ON A GIVEN SURFACE AREA IN A GIVEN TIME. (WIKIPEDIA)

### ***Housing and shelter***

There is art and science in architecture, and it is ever more evident in the ways humankind has designed a home - a shelter - since the *Neolithic* period. The concept of a home is as old as the concept of civilisation. A home has always been the one place where all our basic needs can be fulfilled. It is this very faith in the home, that encouraged me to define shelter as one of the parameters of the expected outcome of this project.

Among the vast number of architectural projects in the area of housing and shelter, I looked into the history of architecture in Africa, nomadic shelters, and western initiatives like *Drop City*, *Earthship*, *Millennium Villages*, *Futuro*, and the *Venus Project*. Describing each one in detail is beyond the scope of this report. Nevertheless, I have introduced the nuances of these projects in the following sections, wherever deemed important. The interior design of the shelter is a vital part of the overall experience that defines a home. I did not overlook the interior aspects of traditional African homes, and I intended to design the interiors, albeit on a conceptual level, during the thesis project.

### ***Design and construction***

An overview study of architecture in underprivileged regions, particularly that in Africa, shows a tradition of community and symbiosis closely integrated within the home itself. An individual home unit is the projection of the community, as opposed to the individual personalities of the owners. In permanent settlements, a property is passed on to the same family for generations. Apart from the post modern housing settlements and urban-slums, most homes include a patch of land for subsistence farming and herding. I had a keen interest in developing the shelter concept based on a *dome* for the following reasons. After briefly studying native African and Asian architecture (homes and shelters), I realised that many of the traditional constructions principles were based the variations of a dome. A dome, or any other derivation of a spherical volume, requires the least of amount of material for construction and provides the maximum spatial volume. These structures can be easily constructed using naturally available materials like twigs and branches, animal hide, ropes, stones, clay and mud. The dome is the most stable structure and durable of all polyhedron structures. So besides the obvious structural advantages a dome can provide as a shelter, the familiarity of the shape and volume could imply that the resulting structure will be well accepted by the end users and their communities.

I continued to study **geodesic domes**. When constructed using triangular faces, icosahedrons to be precise, geodesic domes form incredibly stable, durable and lightweight structures, which can be scaled to any size, without losing the inherent stability. A triangle is the most rigid of all polygons, and hence the enhanced stability of the geodesic dome. Moreover, the exoskeleton of a geodesic dome is tessellated, and therefore modular in nature. This can prove to be a valuable advantage in many different situations, such as during fabrication, transportation, assembly, maintenance and replacement, and even disassembly. Each tessellation-tile, or brick as I call it, can be a prefabricated composite, or a locally casted unit. Creating such a *brick* will be a challenge

A GEODESIC DOME IS A SPHERICAL OR PARTIAL-SPHERICAL SHELL STRUCTURE OR LATTICE SHELL BASED ON A NETWORK OF GREAT CIRCLES (GEODESICS) LYING ON THE SURFACE OF A SPHERE. (WIKIPEDIA)

since the underlying mathematics of geodesic domes requires thorough understanding, to be able to conceptualise new methods of construction.

### ***Community planning***

Most communities across the underprivileged regions around the world are *patriarchal*. Many of these are also *pastoral* in nature. Hierarchy and power are fundamentally interlinked, and rigorously reflected in the way these communities are planned and built. Interestingly, the aerial photographs of such settlements show a high degree of conformity to *fractal patterns*. Fractals, which can be viewed as mathematical representations of hierarchy, undoubtedly aid in the design of such socially structured communities, where the size of the property represents the position and power of the owner in the community. Contemporary western architecture tries to promote equality, and thus, often has difficulty in coming to terms with the local customs and traditions. Though I plan to promote equality through the outcome of this project, I wanted to ensure that there is a possibility to integrate a hierarchal and pastoral system, if the need be.

### ***Resource management***

A home can be viewed as a *hub*, and as such, it presents a remarkable opportunity to manage the scarce resources, namely, water and food. One of the objectives of the project is to facilitate access to appropriate amounts of water, food and energy through the home, which, in others words, can be described as resource management. When multiple homes are connected to form a networked community, the significance of resource management is amplified. If such a system is efficiently developed, it can aid in symbiotic sharing of excess resources, and thereby reduce the dependence of the community on public, or private infrastructure, which is usually ill managed in underprivileged regions.

Resource management is also crucial during the planning, development and evolution of this project. Since I intended to promote local industries, for the manufacture, as well as for the maintenance, supply chain management cannot be overlooked. The **in-situ resource utilisation** techniques developed by space agencies, provide clues for maximising the local resources when creating and building new infrastructure.

IN SPACE EXPLORATION, IN-SITU RESOURCE UTILISATION (ISRU) DESCRIBES THE PROPOSED USE OF RESOURCES FOUND OR MANUFACTURED ON OTHER ASTRONOMICAL OBJECTS TO FURTHER THE GOALS OF A SPACE MISSION. (WIKIPEDIA)

## Chapter II

### Den ständiga resan

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The big trip. I had decided. I was going there as a *traveller*, and not a designer. As a human being, I wanted to understand my own transition across timezones and cultures, to see if the four years in Sweden had rubbed off on me, to see if the design education had changed the way I look at the world around me. I did not know where I would end up. This did not seem to matter, as long as I got to cherish the moments - the journey. But when one journey ends, another one begins. I wanted this project to be a collection of journeys - *the eternal journey*.

Despite an eager desire to go out there and experience for myself, the lives in an underprivileged region, I had a tough time making it happen. Some of the reasons were my inexperience with undertaking a large scale project, not having an adequate network of professionals with the right contacts in and on the field, and being severely constrained financially. The fact that I am not a Swedish (or EU) citizen made me ineligible to apply to several scholarships and field study funds. I got my first respite in this regards when I was awarded the *Ulla Fröberg-Cramér* scholarship of SEK 14.000, by Konstfack. With about 90% of the budget for the trip secured, I went ahead and started planning for it. Although many nations around the world are currently in the state of sublime hardship and poverty, I tried to list down a few which I felt were excellent candidates for my investigation. Likewise, I revised the study-trip budget on the mean expenses that could be incurred while travelling in these nations. I also realised that the most impoverished nations were the ones that suffered perpetually from civil and political unrest, which was another reason why it had become difficult to choose a destination.

Africa is one of the most resource-rich continents on our planet. Yet it constitutes many of the world's most impoverished and under developed regions and nations. This made Africa a prime target for my study. **Ethiopia** has more than adequate water and food resources. But due to the lack of support infrastructure, majority of the population has no direct access to fresh water and food. **Malawi** suffers from similar problems in spite of its proximity to the Great Lakes of Africa. So do **Sierra Leone, Central African Republic, Eritrea, Democratic Republic of Congo, Niger, Zimbabwe** and **Somalia**. Being a native of **India**, I am particularly fascinated by the diversity and disparity in growth across various regions within the nation itself. The same can said about **Bangladesh** and **Pakistan**. But since I am familiar with the situation and conditions prevalent in these regions, to some extent, I preferred to experience the state of things in other regions, namely in Africa.

## 2.1 Why Ethiopia

It was almost two months into the project and I was running out of time. I had been trying to get help to be able to decide on a prospective destination for the trip with no avail. Malawi was the first choice, followed by Ethiopia. Getting to Malawi seemed bureaucratically impossible in the stipulated time. To put an end to all the procrastination, I went ahead and booked the air tickets Ethiopia. Next on the list was finding a place to stay, and after a quick search for hostels around Ethiopia, I came across the **Strawberry Fields Eco-Lodge**, in **Konso**, in southern Ethiopia. It was a *permaculture* initiative started by an Irish guy. Language problem solved, I thought. After some email correspondence with *Alex McCausland*, the founder of the lodge, I had a confirmed roof over the head. I had read about Konso's water problems few months earlier in a National Geographic issue, so I had some idea regarding the task at hand. Next, a trip to the Ethiopian embassy in Stockholm, and my visa was done. In a matter of days, everything fell into place. Now looking back, when I ask myself, why Ethiopia - I retort - *serendipity*. It always has been.

PERMACULTURE IS AN APPROACH TO DESIGNING HUMAN SETTLEMENTS AND AGRICULTURAL SYSTEMS THAT ARE MODELLED ON THE RELATIONSHIPS FOUND IN NATURAL ECOLOGIES. (WIKIPEDIA)

## 2.2 Preparations

The documentaries and films had provided some pointers on what preparations (logistics) I should make before I depart. A worthwhile investment was the *Bradt's Guide to Ethiopia*<sup>7</sup> by *Philip Briggs*, and few detailed maps of the region. From a design (and hence the thesis) point of view, I had decided not to indulge into extensive preparations. No questionnaires, no workshop procedures, and no agendas - the only design aids I carried along were a *DSLR camera*, a *diary*, a *pocket notebook* and two *permanent-ink pens*, along with my six senses. Nor did I restrict myself to predefined areas such as water or food. Everything in the real world is connected, and I wanted to discover these connections, and invent some new ones along the way. I wanted to keep my *designer* observations and interactions concealed from the locals. To test the people's faith in geodesic domes, I carried a *football* and a *pump*, as a present.

## 2.3 The journey

I left for Ethiopia on 31 January 2011 and returned on 9 February 2011, spending seven nights in Karat-Konso and two in Addis Ababa - all in all, nine days travelling around in the land with thirteen months of sunshine. Covering the journey in its entirety will be a task in itself. To stick to the point, I have tried to capture some of it in the illustration Ethiopian utopia [next page]. To view the photo journal covering the trip with detailed side notes, please browse through <http://dreamspace.rohanjaguste.com/ethiopia/>. For those interested, here is a quick travel summary. I covered around 1300 km by a four-wheel drive - from Addis Ababa - Awasa - Shashemene - Agere Maryam - Yvebello - Konso, and on the way back from Konso - Ārba Minch - Sodo - Hossaina - Butajira - Addis Ababa. In the region of Karat-Konso, I visited the villages of Konso, Upper Docatu, Lower Docatu, Busso, Mecheke, Sewgame and Fasha, a total of around 25 km on foot, and then a motorbike ride 25 km back to Konso.

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<sup>7</sup> Unlike many of the travel guides available in book shops, *Bradt's* guides provide a novel, narrative experience rather than an impersonal descriptions of places around the world, with comprehensive and up to date content.

## Chapter III

### Patterns in the ivy

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After spending eight days in Ethiopia, I realised something significant. People were not poor because they had very little money. People were poor because they did not have basic amenities.

Patterns like these began to emerge as I slowly started dissecting my observations and insights after returning to Sweden. After a while, my original ideas about home and dome architecture gave way to the new ones, and I narrowed the scope of the thesis to addressing three issues - water availability, sanitation and minimising the dependence on firewood. In retrospect, these issues are indeed a part and parcel of a home, and perhaps in the near future, I shall revisit my ideas about dome architecture to try to integrate the current solutions. The following section briefly discusses the observations and insights surrounding these three areas.

#### 3.1 Water availability

Regardless of what the media portrays, especially ever since the famine of 1984, Ethiopia has adequate water resources to quench the thirst of its people, along with providing sufficient water for agricultural purposes. The real concern is the severe shortage of infrastructure for making the available water resources accessible to the people. Apart from the capital and the wealthy areas of northern Ethiopia, water systems are almost non-existent. Moreover, the purity of the available water is questionable. With lack of adequate potable drinking water for more than 80% of population, waterborne diseases are prevalent everywhere. The situation worsens in the wet seasons. Most regions of Ethiopia experience two heavy wet seasons, which replenish the massive Rift Valley Lakes and other reservoirs. They also give birth to hundreds of seasonal rivers. But due to the proximity to the equator, and the widespread porous volcanic soil with high water retention capacity, the surface water soon dries out, leaving very little potable water for the growing rural population. Women and little girls have to walk several kilometres to fetch turbid water from these seasonal rivers and reservoirs, usually in 20-25 litre PVC jerry cans. In Karat-Konso, the women climb up and down the mountain slopes, at least twice daily, to collect water from the seasonal River Sagan. Some people, including the Strawberry Fields Eco-Lodge, depend on the government funded *bore-well* project to meet their daily water needs. Locals have even resorted to creating their own little reservoirs, to collect the surface runoff and rain water. But they lack the infrastructure to pump and purify this water for daily use. This prompted me to contemplate on feasible *system-design* solutions which can address this particular problem.

### 3.2 Sanitation

Proper sanitation is almost non-existent throughout rural Ethiopia. This does not seem to bother the local people, except during the wet seasons, when they have to bear the brunt of exorbitant medical expenses to remedy the prevalent waterborne and malarial diseases. Just by creating and spreading awareness alone, I am afraid, cannot solve the problem. I began looking for contextual solutions to this effect.

The composting toilets at the Strawberry Fields Eco-Lodge (SFEL) were a pleasant surprise after seeing some disturbing restrooms along the way. They were clean and uncannily fresh. The toilet is a rich environment for enforcing proper sanitation, educating people about hygiene and for creating a social hub of sorts. Also I understood that wood has natural antibacterial properties, and is more effective than say, plastics and metals in controlling the growth of bacterial cultures. The entire water system at SFEL was quite segregated for several reasons. Yet, to make this system a cyclic and closed loop one, the water system, among others needed a rethink, and probably a redesign. Cost was obviously a hindrance. But often, good design solutions are good, because they circumvent financial constraints.

I was also looking for alternative cleaning agents, like *neem leaves*, *juniper berries*, *moringa* (local, poor man's spinach), local *alcohol*, for substituting the need for manufactured soaps and detergents to wash hands. Such ingredients can be used to line the commonly touched surfaces, to minimise the growth of bacterial and viral cultures. I shook hands with about a hundred kids and adults while travelling, and honestly, I doubted if they had ever washed them. In the dry seasons, the situation resulting from lack of hygiene was not so obvious, as it would have been in the wet seasons. So I went along shaking hands, making friends with people and germs alike. Now, even though I had assumed that these peoples hands were supposed to be a breeding ground for bacteria, and perhaps resourcefulness, I have had evidence of neither. Nevertheless, I realised that whatever I choose to do with sanitation, it has to be a built-in, abstract mechanism.

The other alternative to natural cleaning agents is the use of ultraviolet light. Given the abundance of insolation in this region, even during the wet seasons, I saw an opportunity for laying out a sterility system which can irradiated calibrated ultraviolet light on commonly interfaced surfaces inside a toilet. I became interested in finding if this can be achieved without the need for converting the incident solar energy into electrical energy, perhaps through the use of filters.

Adding complexity to the simple concept of a composting toilet can greatly enhance the efficiency of the system, thereby improving sanitation. But care should be taken to not overdo it, to make the solution logistically plausible. At the same time, seemingly complex designs can pass off as *western designs*, something which the local people had an affinity for. I wanted to incorporate this in my solution(s).

### 3.3 Independence from firewood

The plight of women, and especially young girls, in the underprivileged regions is appalling. The reasons are numerous and debatable, and I shall refrain from discussing those at this moment. Nevertheless, I do wish to bring forth some key observations and insights concerning women and girls. The tribes of Ethiopia, essentially from whom the modern Ethiopian communities have evolved, were predominantly patriarchal in nature, and this has had its consequences on the lives of women, like anywhere else in the world. It is an unquestioned doctrine that household chores and upbringing of children are the sole responsibilities of the women (mothers) here. In a sense, the big picture says, like father, like son; like mother, like daughter - the typical master-apprentice model.

Incessant use of firewood has become a major cause for concern. Not only does it lead to deforestation, it also increases the risks of cardiovascular diseases among the women and children, who inadvertently spend most of their time around stoves. Moreover, young girls and women spend hours daily collecting and hauling firewood from vast distances. Since this, along with other chores, is seen as the duty of a woman, teenage girls often skip school and other social activities to help their mothers with the chores. Find an alternative for firewood then, may enliven the routines of girls and women alike, and may even empower them to attend schools and other communal activities.

All along the way, I noticed *apiculture* is a big time vocation in Ethiopia. I later learnt that this region has one of the highest bee populations of any nation in Africa. It did not surprise me then, when I also witnessed the drunken frenzy among locals of all ages and sex, due to the over indulgence of *tej*, a mead-like alcoholic beverage made from honey. I thus foresaw a prospect for employing beeswax, which was hardly being utilised anyway, as an alternative fuel for cooking. I knew beeswax has a very high calorific value, making it an excellent source of heat. To maximise the efficiency of beeswax as a fuel for cooking, several design issues needed to be addressed, and I started making notes as I began my journey back to Sweden.

BEEKEEPING OR APICULTURE, IS THE MAINTENANCE OF HONEY BEE COLONIES, COMMONLY IN HIVES, BY HUMANS. A BEEKEEPER KEEPS BEES TO COLLECT HONEY AND BEESWAX, TO POLLINATE CROPS, OR TO PRODUCE BEES FOR SALE TO OTHER BEEKEEPERS. (WIKIPEDIA)

After observing what was being done at the Strawberry Fields Eco-Lodge, permaculture made a great deal of impact on my design thinking. Not only it promoted local ecologies and economies, it also preserved the cultural heritage of the peoples of the region. Unfortunately they had not realised its potential and I saw an opportunity to do so through design. Alex introduced me to its basic principles through a permaculture design manual by *Bill Mollison*<sup>8</sup>. Fortunately, the book was also available at the Konstfack library.

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<sup>8</sup> *Bruce Charles 'Bill' Mollison* is a researcher, author, scientist, teacher and naturalist. He is considered to be the *father of permaculture*, an integrated system of design, codeveloped with *David Holmgren*, that encompasses not only agriculture, horticulture, architecture and ecology, but also economic systems, land access strategies and legal systems for businesses and communities. (Wikipedia)

## Chapter IV

### Deliverance

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“The road to hell is paved with good intentions.”

- Old Irish proverb

“I have always thought the actions of men the best interpreters of their thoughts.”

- John Locke

“There are no answers, only choices.”

- Stanisław Lem (*Solaris*)

The three quotes above capture my state of mind after returning from Ethiopia. I knew that my great expectations will all circle the drain if I do not act upon my beliefs and experiences culminating from twelve weeks of contemplation. I had already limited the scope of the thesis to addressing the three issues brought forth in the previous chapter. During the mid-term presentations at Konstfack, I was recommended to pick just one among the three, to work upon further. I could not let go of any as, firstly, I was sure that the three which I had chosen, were justified and required immediate deliberation, and secondly, that they were all inherently connected to each other through the fabric of society. Furthermore, each of the three issues demanded varying expertise and skills - from purely conceptual industrial design to hardcore system engineering. This appealed to me the most, as I believe design to be an amalgamation of the art of science and the science of art, and any task demanding such, is bound to test my credibility, patience and perseverance - a test of a true student. I took up the challenge. So, without further ado, I shall begin describing each of the three prospective solutions to the three issues. These concepts span multiple dimensions, with an intent to subscribe to several issues at once, without overwhelming the end user experience. This intention aligns with my research process, which too, spanned multiple dimensions, thereby laying a firm foundation for the prospective solutions to stand upon.

#### 4.1 Composting toilet

Simplest of all the three solutions, the composting toilet is a modest improvement over the current design used by the Strawberry Fields Eco-Lodge. The key focus areas were enforcing sanitation through behavioural abstraction, improving the portability of the unit, and hence enhancing its role in permaculture, and overcoming the logistical fallacies observed in an underprivileged region. Since there are no credible studies showing the superiority of western-style sitting toilets over squatting ones, or vice versa, I decided to leave this as a choice for the locals to make. What I have tried not to leave a choice for, is the sanitation. As discussed earlier, I envisioned two possible scenarios to integrate sanitary measures into the unit - antibacterial

surfaces and ultraviolet irradiation. Neither are particularly complex. Although ultraviolet irradiation is more effective than the other, it presents severe health risks if implemented without rigorous precision. Finding the best alternative then, is still a matter of debate for me, as it would require a thoughtful insight of more than a designer. Also, just by increasing the number of composting toilet units available to a community can significantly reduce the spread of contagious diseases. Ease of fabrication, assembly and maintenance was the next important issue. With this particular solution, I wanted to push for in-situ resource utilisation for production and maintenance. I soon realised that, due to mediocre raw materials and manufacturing infrastructure, I would need to compromise this constraint to standardise the quality of design. To strike a balance, care was taken to keep the prefabricated parts to a minimum. At the same time, I wanted to add a western feel to the whole experience, as it was something actively desired by the locals. Having finely produced prefabricated parts could perhaps incite this feel. To make the unit portable, the entire unit was built upon a stable and sturdy tripod frame structure. The choice of materials was governed by the available in-situ resources to overcome the logistical shortcomings. Certain species of *Acacia* and *Juniper* wood are plentiful in Ethiopia, are being farmed actively, and are naturally resistant to the severity of the local climatic conditions. These can make for an excellent raw material for the unit. To keep the structure lightweight, woven bamboo cane, or rattan can be used for the unit walls and door. The rear-side of the door presents a potential surface to be exploited through behavioural probing.

## 4.2 Cooking stove

The second product concept is a cooking stove assembly utilising alternative fuel, beeswax in this case, to cook food. The key focus while designing this concept was on computer aided design, engineering and manufacturing, to create a highly functional, durable and aesthetically approvable product. The underlying desire to do so was to drastically improve the lives of the young girls and women in underprivileged regions, by reducing their workload gathering firewood, thereby also keeping a check on deforestation in these regions; to provide commercially viable opportunities for locals to indulge in, and to bring about a dignified and uncondescending product experience to these peoples. The design tries to keep the part count to minimum, promotes symmetry for ease of manufacturing and maintenance, and provides room for employing other alternative fuels such as paraffin wax, vegetable oil, clarified butter, animal lard, etc., in place of beeswax. The construction and assembly tries to ensure a constant, steady draft of air to fuel the flames, and to minimise the formation of soot. Along with the design of the stove, the design of the fuel pellets (beeswax candles) too, requires careful attention. The wick height and thickness needs to fit within the given tolerances to ensure a laminar flame, thereby maximising the heat transfer and minimising the soot.

## 4.3 Water pump and purifier

The third product concept - a water pump and purifier - was a challenge for the engineer in me. The premise of this concept lies in utilising solar energy to pump turbid water from natural or man-made reservoirs, and then distilling it to provide potable drinking water to the people. Standalone solar water pumps

and solar water distillers already exist. But an efficient combination of the two is yet to be developed. The focus here was system design, rather than the precise design details which would make no sense without a formidable collaboration with power system engineers and machinists. Nevertheless, I spent considerable time studying the basics of thermodynamics, solar energy systems, and steam engines. One of the high points of this phase of the project was when I discovered original works of *William Rankine*<sup>9</sup>, published in 1859, in Konstfack's library archive. It was of significant help in defining the system concept. Rather than employing electrical energy to drive the pump, I opted to utilise the incident solar energy, to convert available water into superheated steam, which in turn drives the steam engine that powers the pump to draw out more water from a reservoir. Obviously, this system would need a supply of water to begin with, but this need can be mitigated by using synthetic oils in place of water. The tradeoff here would be the lower achievable steam pressure, and thus, no superheated steam, which would mean a less efficient system. The steam, whether superheated or not, is then condensed to obtain distilled water at close to purity. To improve the effectiveness of the system as a water purifier, filters will be deployed at three stages to counter impurities of various dimensions and types. The distilled water is then pumped into overhead or inflatable water tanks for distribution to the local populace. It is empirical that the design of these storage systems and other distribution channels synthesise with the solar water pump and purifier, to maintain a standard in water purity. As a means for distributing the water, a portable storage unit made of earthenware or clay, with support braces can be developed. Earthenware vessels act as natural coolants and maintain the water temperature at a level not conducive to bacterial growth. These vessels will provide a better alternative for water storage as compared to the plastic cans used by the locals today.

Unlike the majority of standalone solutions developed for making potable water accessible to the people in underprivileged regions today, the proposed solution takes a step in the direction of infrastructural system-design. With added complexity, and perhaps added costs, such a solution may seem impractical in the real world. But I would argue that systems which provide us fresh water, electricity, sanitation, and even food, in the developed world, are seldom standalone and straightforward in layperson's terms. Why then, is it incomprehensible to envision similar systems in underprivileged regions?

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<sup>9</sup> The *Rankine cycle*, formulated by *William Rankine*, a Scottish engineer and physicist, describes a model of steam-operated heat engine, and builds on the foundations laid by *James Watt*.

## Chapter V

### A fair judgement

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The ability to be your own worst critic, is probably the most important thing I have learnt during my design education. The moment of satisfaction should not be a long lasting one, if I am to grow as a professional. In the series of moments that this project has been, satisfaction has come far and apart, and I must say, I'm satisfied the way it has.

After watching many design students graduate over the last four, both at Umeå Institute of Design and at Konstfack, I was inspired to create something valuable and radical to give back to the people and the design community. But more importantly, I wanted to use it as an opportunity to out do myself, and to test my worth in this field. With the thesis nearing its end and the outcomes defined, I now want to reflect upon what was learnt and unlearnt along the way. My biggest concern was identifying whether I had created something that I despised in the first place - a mere interpretation of a design imperialist. The following section deals with these fears and some others, and my reflection on the three outcomes.

#### 5.1 Revisiting the thesis proposition

I had set out to study the possibility of introducing a sustained and unbiased improvement of the quality of life of people in the underprivileged regions around the world. As I begin to evaluate my proposals against this hypothesis, I am confronted with the harsh reality that I am no where even close. For this evaluation to continue any further, I have to create full functioning prototypes and try them out in the real world, which is a long shot at the moment. In my defence, what I can conclude with the certainty of an open mind is that I have identified some crucial areas that need to be addressed through design or otherwise, and that I have outlined a unique process of research, analysis and execution as an aid for attempting so. Judging whether the proposals are sustainable or not, will require prototyping and field testing. On the other hand, I was actively unbiased throughout the process, and I do want to believe that the outcomes reflect this.

#### 5.2 Feasibility as complexity versus time

The three proposals, with varying degrees of complexity, are all technically feasible today. I resort to think of complexity as the measure of the number of variables that completely define a system. That said, the inherent complexity of a system does not necessarily determine the time it will take to build and deploy the system. However, it does define the time it will take to design it. The composting toilet is a fairly simple concept, apart from the unknowns regarding both preferred sanitation implements - antibacterial surfaces and ultraviolet

irradiation. These need to be deliberated and verified before the system can be completely designed and deployed in the real world. The cooking stove has a well laid out design with very few unknowns, the likely ones being the availability and efficiency of a wax based fuel. Consequently, this proposal is the most prototype ready of all the three. At the other end of the spectrum, the water pump and purifier proposal is entirely conceptual, with very little scientific and technical data to support its significance. It is also the most complex of all the three, and will effectively require hundreds of work hours and a range of experts to merely design it.

I would like to bring forth one important consideration necessary while designing a system. A relatively simple system, such as the composting toilet, may in fact be harder to build in the real world, as compared to, say, the water pump and purifier. This disparity is due to the **bicycle shed argument**<sup>10</sup>, as pointed out by *C. Northcote Parkinson*, and later by *FreeBSD*<sup>11</sup> developer, *Poul-Henning Kamp*. Here is an excerpt from an email correspondence between Poul-Henning and other programmers on a forum, where he explains the disparity.

[...]

In the specific example involving the bike shed, the other vital component is an atomic power-plant, I guess that illustrates the age of the book.

Parkinson shows how you can go in to the board of directors and get approval for building a multimillion or even billion dollar atomic power plant, but if you want to build a bike shed you will be tangled up in endless discussions. Parkinson explains that this is because an atomic plant is so vast, so expensive and so complicated that people cannot grasp it, and rather than try, they fall back on the assumption that somebody else checked all the details before it got this far.

A bike shed on the other hand, anyone can build one of those over a weekend, and still have time to watch the game on TV. So no matter how well prepared, no matter how reasonable you are with your proposal, somebody will seize the chance to show that he is doing his job, that he is paying attention, that he is \*here\*.

In Denmark we call it "setting your fingerprint." It is about personal pride and prestige, it is about being able to point somewhere and say "There! \*I\* did that." It is a strong trait in politicians, but present in most people given the chance. Just think about footsteps in wet cement.

[...]

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<sup>10</sup> *Parkinson's Law of Triviality*, also known as *bikesbedding* or the *bicycle shed* example, is *C. Northcote Parkinson's* 1957 argument that organisations give disproportionate weight to trivial issues. Later, *Poul-Henning Kamp* applied the law to software development and introduced the *colour of the bike shed* as the proverbial trivial detail receiving disproportionate attention. (*Wikipedia*)

<sup>11</sup> *FreeBSD* is a free UNIX-like operating system and much of its code has become an integral part of other operating systems such as Mac OS X.

I am quite certain that I will face a similar situation with my *composting shed*, or cooking stove, and get away with the water pump and purifier, during the school presentation, and perhaps even beyond. To alleviate this issue at this particular moment, I have refrained from including any renders or illustrations of the product concepts in this report. As it is, I will be spending most of the time during the presentation visually describing the design details.

### 5.3 Imperial judgement

The fear of being the one who you despise the most is tantalising. When I began to reflect on the outcome, I was afraid I was going to see the same attitude in it like all other *humanitarian* designs. Each of the three proposals appear to be western interpretations of a solution for issues in the underprivileged regions. But I hope that the appearance is deceptive in this case - for my own sake, and more importantly, for the local inhabitants of these regions, who have shown a desire to possess western amenities. The design intent on the other hand, is neither western, nor local, but rather human. I had no agenda beyond being able to provide appropriate access to potable water, food and shelter, during the entire project. I want this to reflect in the outcome. Despite the appearance, considerable effort was made to integrate local means of being and living, without enforcing western ideologies regarding water management, sanitation and cooking. Each of the proposals showcase alternative ways of satisfying daily needs, without focusing on the dexterity or ingenuity of the design itself. Whether I have succeed or not, is a matter for discourse during the presentation, and beyond. Nevertheless, I do believe that having a diverse and robust research background, coupled with a first hand experience in an underprivileged region, and no imperial agenda to fog my mind, has helped me refrain from **cargo cult design**<sup>12</sup>.

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<sup>12</sup> Derived from *cargo cult science*, *cargo cult design* implies any design or design process, which imitates the superficial exterior of a process or system without having any understanding of the underlying substance. The term cargo cult science was first used by physicist *Richard Feynman* during his commencement address at the California Institute of Technology, United States, in 1974, to negatively characterise research in the soft sciences - arguing that they have the semblance of being scientific, but are missing "a kind of scientific integrity, a principle of scientific thought that corresponds to a kind of utter honesty." Cargo cult science, in turn, is derived from *cargo cult*, a religious practice that has appeared in many traditional pre-industrial tribal societies in the wake of interaction with technologically advanced cultures. The cults focus on obtaining the material wealth - *the "cargo"* - of the advanced culture through magic and religious rituals and practices.

## Chapter VI

### Closure

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“I do not think there is any thrill that can go through the human heart like that felt by the inventor as he sees some creation of the brain unfolding to success... Such emotions make a man forget food, sleep, friends, love, everything.”

- Nikola Tesla

Even though I admire the beauty in Tesla's thought, I know I have a thousand miles to go before I share similar enthusiasm. The closure of the thesis is the beginning of a new chapter of an open book. I have cherished every moment of past twenty weeks, whether good or bad, high or low. From where I stand today, sooner or later, I will have to make a choice between continuing the thesis project and or giving it up in the pursuit of a dependable livelihood, as I am not certain if one can combine the two.

#### **Staying hungry and foolish**

The thesis project exposed me to a number of different disciplines, techniques, media and people. From the design of the product concepts to the typography of the reports and book, from text-doodles to CAD and parametric solid modelling, from people skills to cross-cultural interactions, from process scheduling to budget planning, and many more, I touched them all. To begin with, I knew very little about any of these things. But I was forever hungry, never dependent on others, and never gave up. My biggest strength was that I knew my weaknesses. I was quick to realise that the pursuit of knowledge is never ending one, and that, the more I know, the more I will know how little I know. At the same time, knowing too much can cloud up the vision and prevent me from making radical connections between the research, observations and insights. So it became crucial that I keep unlearning things from time to time.

#### **Down to earth**

The influence of space technology has been minimal on the outcome, as opposed to what was envisioned during the initiation of the thesis. In hindsight, all the three product proposals can benefit from space materials and technologies, in some way or other. But I am glad that I chose to focus on making the proposals people centric rather than technology centric. The hunger for working with extreme environments (such as ones in space, and in underprivileged regions) is still there, and I will be devoting the coming months for developing the necessary skills. Perhaps then, I may be able to better address the prospects for space technologies in these proposals myself.

***Some final thoughts on the Ethiopia trip***

The trip to Ethiopia was definitely one of the best moments of the entire project. I am glad I could make it happen. The best research is often first hand experience. Throughout the project, I wanted to understand my own transition as a professional and as a person, and to see if the four years in Sweden had rubbed off on me. In some ways they have, and it was obvious when I was amongst the locals in Ethiopia, trying to mingle. I was more Swedish to them than an Indian. Had I never been living in Sweden, I believe the people would have had a better time with me. Moreover, they would have been well chuffed if I had been a Bollywood loving lad. I despise any nationalistic association, and so I saw them as the very people as I would have even if I never had lived in Sweden. The only difference was in the way I perceived design, and the opportunities for design.

***A note on field documentation***

The pocket notebook and pen I carried was priceless. It was small enough to be conveniently concealed, and big enough to take down pointers, which I then elaborated upon in my diary, at the end of the day. Most of the documenting, thus, was in a text-doodle form. Regarding photography - I was not there as a photographer, nor a clothing designer nor an anthropologist. I used the camera to document interesting moments, and many a times they had people in them. But I tried to avoid bringing them into the frame, unless it was absolutely necessary. Almost all the locals I met were very modest people, with humble attires and bare minimum belongings. Photographing them, especially the kids, would have served no purpose other than provoking pity, which I cannot stand. Many kids, and even some adults wanted me to photograph them, for a price, to make a quick buck. This is what most tourists do - they take pictures of people and then pay them a scanty sum. I could not do it. Not only I had no money left, I had no intention of promoting addiction to a farce of resource called money.

## Epilogue

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Ideas are just borrowed thoughts. A vast number of resources have helped me develop my ideas. Very few of them have been books per se. The most valuable resources were people and the real life interactions with them, documentaries and films and few articles in periodicals. During the later stages of concept development, a few technical books helped me map out the engineering side of things. Inspirations too, seldom came from the world of design, or designers. Rather, it were the common people that I met along the way, the countless hours of music that got me through the days and nights while working, and the occasional pub debates, that sparked revolutionary changes during the project. Below is a brief list of the major influential resources that benefited the project in some way or another. Others have been referred to in the footnotes.

**Konstfack's bibliotek** - Next door friendly neighbour, with access to rich variety of resources, on most subjects and topics. If something is not available in the library, they will order it for you.

**New Scientist** - Weekly science magazine with updates from all areas of science and technology in layperson's terms. Published in the UK.

**Wikipedia** - A good starting point for most subjects and topics. Always follow up on the referred sources, as they are often very insightful and lead to other resources. Sometimes, it is worthwhile to check the article's entry in other languages, especially the ones in German or French - they may provide additional information. Be skeptical about all the information though. And be wary about getting lost in the seas of information - not everything is useful, given the circumstances - know beforehand what you would like to know.

**Youtube** - An unlikely resource for research, but as it happens, a great aid for profiling people's reactions to almost all arguments conceivable (both, the videos, and their comments).

**BBC documentaries** - Some of the best in the business, narrated with eloquence, and covering the matter in depth and with diligence.

**cadjunkie.com** - Straightforward video tutorials covering nuances of 3d parametric and surface modelling tools, along with some handy tips and tricks.

**Online forums** - As with Youtube videos, every conceivable topic has a forum, or is covered in some forum. Such forums present a conversation, a dialogue, which is more than a static disclosure in a book. Even if you do not take part in the conversation yourself, you can still get a lot out of reading relevant posts.

**Stand-up comedians** - As weird as it may sound, good standup-comedians are excellent observers, constantly people-watching. Some of their jokes are in fact fantastic ideas for products. Designers can learn a thing or two about observational skills from these professionals.

**Late night, pub debates** - Absolutely insightful, provided your counterpart(s) and you have just the right quantity of everything offered in there.

**Hobbies** - They not only help you relax and find inspiration, but also certain insights into human mind and the way we behave and interact in the real world.

**Non-designer friends** - They are the dark horse when it comes to real world underpinnings of human behaviour and thinking. A valuable resources for validating your design concepts.

## Ending credits

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Words will never be able to adequately express gratitude, and so I will keep it simple. I dedicate the master thesis project, my progress as a professional, and as a human being in the past few years, to the following people and places.

To my parents - for my being and believing, and for letting me be. To Shruti Agarwal, for being there without being here. To Teo Enlund, for his faith in my abilities and for forgiving my intelligence, or lack thereof. To Konstfack, for giving me a taste of creative freedom. To Cecilia Hertz, for bringing me down to earth. To all my classmates - Anders Johansson, Bengt Brümmer, Cristine Sundbom, John Astbury, Karin Wallenbäck, Li Xiaokang, Lisa Minogue, Marie Gullander Koch, Mohammed Reza Mansouri, Olof Einarsson and Tove Thambert - for their friendship and wisdom. To Nils-Johan Eriksson, for all the 'burgare och öl' for thought. To David Erhensträhle, for helping me map out the book. To Katja Pettersson and Malin Orebäck for their timely comments. To Anna Celsing and Jon Bergqvist, for lending me their solemn apartment with a wall of knowledge. To Alex Abdurahman McCausland and his team, for giving me a taste of Ethiopia. To Umeå Institute of Design, for helping me design my ambitions. To Industrial Design Centre, IIT Bombay, for making me realise I had ambitions. And last but not least, to humanity, for making me be.

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