A Micro Inhaler for South Africa
Mechanical Engineering 310 Fall Document 2014

Team Merck
Danny Concha, Sri Sibi, and Jade Fernandez

Mechanical Engineering Design Group
416 Escondido Mall
Stanford University
Stanford, CA 94305-2203
http://me310.stanford.edu
December 1, 2014
1 Executive Summary

In a rapidly growing black middle class in South Africa, it becomes more and more difficult to define exactly who they are. Being constantly in flux, the black middle class grows more diverse each day. However, they have one thing in common and that is the goal of being more Westernized. There are common goals amongst the black middle class such as aspiration in life, education for children, investment into children’s future, and an aspiration to be like their Western counterparts. Merck has approached our team of seven to redesign the current solution of an inhaler and help these people breathe more easily. South Africa would be the ideal market to target because it tends to be the most technologically advanced in all of Africa and has set the trends for the rest of the nations. We have chosen the redesign of a micro inhaler because it is a common device used among many people with diverse backgrounds and will allow us the space to innovate and think beyond the current products.

Our vision is to create a discreet product that is highly Westernized, as well as technologically advanced. We have decided to explore the wearable technology space since it is a growing trend in the US. Our goal is to invent a device that is “cool”, effective, cheap, and is a natural extension of the user’s everyday behavior. It is important that the device is associated with Western technology, yet is affordable to the average black middle class family. Through a series of surveys, we have found that there is a general stigma associated with inhalers. We intend to find a solution that will reduce the stigma of inhalers and be more subtle than the current solution.

In the Fall of 2014, our focus was mainly on research and need finding. We delved into extensive research on South African society and the emerging middle class. We also found a breadth of research on existing technologies and products in the market today. After we developed a good grasp for the context of our project, we began prototyping different forms and functions of inhalers. After conducting numerous interviews, we gained important insights that will inform our final product.

In order to best design a Western inhaler for the South African market, we will be taking our prototypes into the market itself this holiday season. While there, we will not only be observing the black middle class, but also conducting user testing. We will also be gaining key insights on the market itself. Once we return from our trip, Maia will hopefully evolve into a more refined product that is both aesthetically pleasing, as well as functional.
Table of Contents

1 Executive Summary ............................................................................................................ 2
2 Glossary .............................................................................................................................. 7
3 Context .............................................................................................................................. 9
  3.1 Need Statement ............................................................................................................. 9
  3.2 Problem Statement ...................................................................................................... 9
  3.3 Corporate partner: Merck KGaA/Partner School: University of St. Gallen .... 10
    3.3.1 Corporate Liaison .................................................................................................... 10
    3.3.2 ME 310 Coach ....................................................................................................... 11
  3.4 The Design Team ......................................................................................................... 11
    3.4.1 Stanford Teaching Team ....................................................................................... 15
4 Design Requirements ......................................................................................................... 17
  4.1 Assumptions ................................................................................................................ 17
  4.2 Functional Requirements ............................................................................................ 17
    4.2.1 Functional Constraints ....................................................................................... 19
    4.2.2 Functional Opportunities .................................................................................. 19
  4.3 Physical Requirements ............................................................................................... 20
    4.3.1 Physical Constraints .......................................................................................... 22
    4.3.2 Physical Opportunities ..................................................................................... 22
  4.4 Business Requirements .............................................................................................. 22
    4.4.1 Business Constraints ....................................................................................... 23
    4.4.2 Business Opportunities .................................................................................... 23
5 Design Development ....................................................................................................... 24
  5.1 Brainstorming ............................................................................................................. 24
  5.2 Technology Benchmarking .......................................................................................... 26
    5.2.1 Online Research .................................................................................................. 26
    5.2.2 Interviews .......................................................................................................... 36
    5.2.3 Purchase and Dissection of Existing products ..................................................... 37
    5.2.4 Unmet Needs/Opportunities and Interests Moving Forward ......................... 39
  5.3 Need Finding ............................................................................................................... 39
    5.3.1 Online Research ................................................................................................ 40
    5.3.2 Interviews .......................................................................................................... 41
    5.3.3 Our Biggest Takeaways .................................................................................... 43
  5.4 Persona Development ................................................................................................ 45
  5.5 Critical Experience Prototype .................................................................................... 46
    5.5.1 What We Hoped to Learn .................................................................................. 46
    5.5.2 Experience Description ....................................................................................... 47
    5.5.3 Study Results ...................................................................................................... 48
    5.5.4 CEP Insights ....................................................................................................... 50
    5.5.5 Long-Term Study ............................................................................................... 51
    5.5.6 Overall CEP Conclusions .................................................................................. 51
6 Design Vision ................................................................................................................... 52
7 Project Planning and Management .................................................................................... 54
  7.1 Deliverables and Milestones ........................................................................................ 54
  7.2 Project Timeline ........................................................................................................... 55
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.3</td>
<td>Project Budget</td>
<td>57</td>
</tr>
<tr>
<td>7.4</td>
<td>Distributed Time Management</td>
<td>58</td>
</tr>
<tr>
<td>7.5</td>
<td>Reflections and Goals</td>
<td>59</td>
</tr>
<tr>
<td>7.5.1</td>
<td>Danny Concha</td>
<td>59</td>
</tr>
<tr>
<td>7.5.2</td>
<td>Jade Fernandez</td>
<td>59</td>
</tr>
<tr>
<td>7.5.3</td>
<td>Sri Sibi</td>
<td>60</td>
</tr>
<tr>
<td>7.5.4</td>
<td>Philipp Elbel</td>
<td>60</td>
</tr>
<tr>
<td>7.5.5</td>
<td>Jasmine Bissig</td>
<td>62</td>
</tr>
<tr>
<td>7.5.6</td>
<td>Carolyn Ragaz</td>
<td>62</td>
</tr>
<tr>
<td>7.5.7</td>
<td>Rouven Gruenig</td>
<td>63</td>
</tr>
</tbody>
</table>

8 References

8.1 Bibliography

8.2 Image Sources

3.3 Video Sources

9 Appendix
List of Figures

Figure 3.1: Merck KGaA Logo.................................................................10
Figure 3.2: University of St. Gallen Logo..............................................10
Figure 4.1: Graphical Illustration of Functional Requirement.................18
Figure 4.2: Early Design Requirements and Metrics..........................19
Figure 4.3: Graphical Illustration of Physical Requirements..................20
Figure 4.4: Design Requirements and Metrics.....................................22
Figure 4.5: Business Requirement Chart.............................................23
Figure 5.1: Our Team's Design Development Process..........................24
Figure 5.2: Understanding Fears of Western Technology and Medicine.....25
Figure 5.3: Important Considerations of Inhalers.................................26
Figure 5.4: Organizational Chart of Benchmarking.................................26
Figure 5.5: Example of Wet, Active Inhaler.......................................27
Figure 5.6: Example of Dry, Passive Inhaler.....................................27
Figure 5.7: Comparison of Wet and Dry Inhalers.................................28
Figure 5.8: Pros and Cons of Nasal Sprays..........................................29
Figure 5.9: Illustration of the Intrusive Nature of a Respirator................30
Figure 5.10: Illustration of the Intrusive Nature of Nasal Cannula..........30
Figure 5.11: A View Inside a Modern E-Cigarette...............................31
Figure 5.12: A View Inside a Nicotine Plug Nicotine Inhaler..................32
Figure 5.13: A Standard Nebulizer.....................................................32
Figure 5.14: Occoris Inhaler Engine....................................................33
Figure 5.15: Description of how a Metered-Dose Inhaler Functions..........34
Figure 5.16: Schematic of Respimat Inhaler.......................................35
Figure 5.17: Interviewee Description and Important Interview Findings.....37
Figure 5.18: a.) Neti Pot b.) Vicks Portable Steam Inhaler c.) Gasmask d.) Nebulizer tubing/mouthpiece e.) Full-face Steam Inhaler.............................................38
Figure 5.19: Pugh Matrix of Advantages and Disadvantages of Inhalation Products……39
Figure 5.20: Organizational Chart of Need Finding……………………………………40
Figure 5.21: Population Categorization of South African People……………………40
Figure 5.22: Table of Need Finding Interviewees……………………………………41
Figure 5.23: Jade skyping Trudy………………………………………………….42
Figure 5.24: Daniel skyping Jean Fourie…………………………………………..43
Figure 5.25: Advantages of Designing for South African Miners…………………44
Figure 5.26: Design Consideration for Middle Class…………………………….44
Figure 5.27: Middle Class South African Woman, Ayanda………………….45
Figure 5.28: Typical Metered Dose Inhaler………………………………………..47
Figure 5.29: Inhaler Design Selection……………………………………………..48
Figure 5.30: Interviewee "most liked" Inhalers…………………………………….49
Figure 5.31: Interviewee "most disliked" Inhalers…………………………………49

Figure 6.1: A combination of two ideas showing the design path we are currently following…………………………………………………………….52
Figure 6.2: CAD Model for our Vision of an Inhaler……………………………..52
Figure 6.3: Cut Section showing the Functioning of the Inhaler…………………53
Figure 7.1: Deliverables and Milestones…………………………………………55
Figure 7.2: Gantt Chart for the end for the fall quarter and the winter quarter……56
Figure 7.3: Project Spending in the Fall Quarter…………………………………..58
Figure 7.4: Proposed Spending for Winter Quarter…………………………….58
2 Glossary

**Active inhaler**: Inhaler that propels the medicine into the user’s mouth.

**Asthma**: a respiratory condition marked by spasms in the bronchi of the lungs, causing difficulty breathing.

**Benchmarking**: The process of discovering information on existing products/systems and their relevance to our project.

**Breath Actuated Mechanism (BAM)**: Mechanism which is used to deliver medication into the user and is triggered and actuated by the user’s breath.

**Cannula tube**: tube that can be inserted into the body for the delivery or removal of fluid or for the gathering of data.

**Chronic Obstructive Pulmonary Disease (COPD)**: Chronic obstructive pulmonary disease (COPD) is one of the most common lung diseases. It makes it difficult to breathe. There are two main forms of COPD: Chronic bronchitis, which involves a long-term cough with mucus; Emphysema, which involves destruction of the lungs over time.

**Critical Experience Prototype (CEP)**: A prototype used to observe an important experience that the user of a device will undergo. This prototype helps gain insight on how to best design the product based off of the user experience.

**Critical Function Prototype (CFP)**: A prototype used to observe an important function that a device must include in order to operate properly.

**Dry inhaler**: Inhaler that disperses medicine in the form of a powder.

**e-cigarette**: electronic cigarette which usually uses a heated coil to atomize liquid nicotine.

**KGaA**: Kommanditgesellschaft auf Aktien – abbreviated KGaA – is a German corporate designation standing for 'partnership limited by shares', a form of corporate organization roughly equivalent to a master limited partnership.

**Nasivin**: Nasal spray created by Merck for treating congestion from the common cold

**Respirator**: Personal air filtration device worn around the mouth, usually in the form of a mask.

**Nebulizer**: a device for producing a fine spray of liquid, used for example for inhaling a medicine drug.

**Need finding**: the process of investigating the potential users of a device and understanding what needs these users need addressed by the device’s function.
**Neti Pot:** container which is filled with saline water and is used to rinse your nasal cavity.

**Obstructiveness:** the degree to which a device covers a significant portion of a user’s face.

**Passive inhaler:** Inhaler that requires user’s inhalation to intake medicine.

**Pugh Matrix:** tool for weighing the relative strength of various objects versus a baseline object as defined by various categories.

**Silicosis:** lung fibrosis caused by the inhalation of dust containing silica. Silicosis is currently incurable.

**Traditional Healer:** a figure in South African culture who employs non-Western techniques to cure physically, emotionally and spiritually sick people by means of herbs, rituals and other natural remedies.

**Throat/mouth deposition:** residual medication that is left on the user’s mouth and throat upon inhalation of a medication.

**Tuberculosis:** an infectious bacterial disease characterized by the growth of nodules (tubercles) in the tissues, especially the lungs.

**Unnaturalness:** how “strange” it feels to use the device, first hand (as used from our team’s benchmarking process).

**Wet inhaler:** Inhaler that disperses medicine in the form of a gas.
3 Context

3.1 Need Statement

Merck KGaA is the oldest operating pharmaceutical and chemical company in the world, being founded in 1668 in Darmstadt, Germany. Merck has established a positive public image as through their innovative and diverse products. They maintain an active role in developing modern technology and life science discoveries in order to better their product for the well-being of millions of lives. Merck aims to continuously improve the quality of their products and develop a customer relationship with the brand in order to continue to grow and develop their business. With these goals in mind, Merck has asked our team to introduce a new product into the market to help people breath easier by redesigning a micro-inhaler for the South African market.

South Africa is the ideal location to introduce this new product because South Africa tends to set the trends for the rest of the African nations. They are, historically, the most Western leaning country and they have a desire to become more like their Western counterparts. Merck has decided that in order to enter the African market, they first must penetrate a more targeted customer base and that is the black middle class in South Africa. Currently, the black middle class is in a transitional phase. They are entering a new role in society and are growing more technologically sophisticated. Aspiring to have products of the West, the black middle class is embracing a new mindset of ambition, health, and success. With this in mind, we are intending to design an affordable, yet highly Westernized product that will emphasize health, well-being, and success.

We have selected a micro-inhaler as our product that we will be dissecting and redesigning. This is a common product used for people that have difficulty breathing for one reason or another. Our intention is to develop a product that will allow you to interchange the medicine you are inhaling to allow the opportunity for one product to help several issues through the same solution. Our design challenge is an exciting opportunity for us to not only explore an entirely foreign user group, but also allows us the freedom to push the limits of what an inhaler is.

3.2 Problem Statement

The goal of our team is to create an inhaler that is affordable, sleek, Westernized, and discrete. Many people associate inhalers with an unhealthy stigma. We are determined to reverse this mindset by creating something that this market has not yet seen. We are taking the micro inhaler into the wearable technology space and developing a sleek, discrete design that will improve the perception of inhalers. The product should also be capable of working with a variety of remedies, in order to allow for a much larger user group. Most importantly, it should accurately deliver the medicine to the patient and be easy to use and understand.
3.3 Corporate partner: Merck KGaA/ Partner School: University of St. Gallen

The corporate partner for this project is Merck KGaA, based in Germany. Merck’s headquarters are located in Darmstadt, Germany and is the oldest operational pharmaceutical and chemical company. They are expected to close in on $1 billion by the end of 2014 in sales. Our partner school is the University of St. Gallen in Switzerland. We are working with Philipp Elbel, Rouven Grunig, Carolyn Ragaz, and Jasmine Bissig, who are all Master’s in Business and Innovation students.

![Merck KGaA Logo](image1.png)

*Figure 3.1: Merck KGaA Logo*

![University of St. Gallen Logo](image2.png)

*Figure 3.2: University of St. Gallen Logo*

3.3.1 Corporate Liaison

Luc Van-Der-Heyden  
Head of Innovation Management  
Merck, Darmstadt, Germany  
Contact: Luc.Van-Der-Heyden@merckgroup.com
3.3.2 ME 310 Coach

Annika Matta  
ME 310 Coach  
Contact: annikamatta@gmail.com

3.4 The Design Team

The design team consists of three members from the Mechanical Engineering Department at Stanford University and four members from the program of Master’s of Business and Innovation at St. Gallen University, a prestigious business school in Switzerland. We have great advantages because of our diverse educations, personal interests, and cultural backgrounds and thinking styles. This design challenge was developed with the help of Merck and coordinated through the ME 310 class. ME 310: Project-Based Engineering Design, Innovation, and Development teaches us how to work with international, as well as corporate teams in order to innovate and design a inspiring solution for the design challenge.

Daniel Concha  
Status: 1st Year ME Graduate Student  
Contact: dconcha@stanford.edu  
Skills: Rapid prototyping, SolidWorks modeling, Medical Device Development

I was born in Cali, Colombia but moved to the United States at the age of one. I grew up partially in Boca Raton, Florida but now live in Sammamish, Washington. I completed my undergraduate studies in Mechanical Engineering at Duke University in Durham, North Carolina earning a Bachelor's Degree. I am greatly interested in design, particularly within the medical device field and on my free time I enjoy playing guitar and recording my own songs.
Jade Fernandez  
Status: 1st Year ME Graduate Student  
Contact: jadef1@stanford.edu  

I was born and raised in Honolulu, Hawaii. I completed my undergraduate degree at Stanford University in Product Design Engineering. I am heavily interested in design and manufacturing and hope to continue to study my interests in depth while completing my Master’s degree in Mechanical Engineering at Stanford University. I enjoy playing soccer, going to the beach, and practicing my crafts in studio art.

Srinath Sibi  
Status: 2nd year ME graduate student  
Contact: ssibi@stanford.edu  
Skills: CAD, Human Factors Experiment Design, Finite Element Modeling, Mechatronics, General Machining

I was born and raised in Chennai, India. I completed my undergraduate at Indian Institute of Technology Madras in Engineering Design and Automotive Design. I am very interested in Automotive Design and Human Factors for drivers. I enjoy movies, good food and my research.
Philipp Elbel
Status: 1st Year Business Innovation Master Student
Contact: philipp.elbel@student.unisg.ch
Skills: web-programing (php/mysql), STATA, Microsoft Office
I come from Zug, Switzerland. After my military service as Electronic Warfare Officer, I completed my Bachelor's degree in Business Administration at University of St. Gallen (HSG) including an exchange semester in Sweden. After a gap year for internships I've started the Master's in Business Innovation at HSG due to my strong interest in innovation regarding business models and technology, and am accepted for the CEMS Master's in International Management. I like running, road cycling, hiking and hold a private pilot license for single-engine aircrafts.

Rouven Grunig
Status: 2nd Year Master in Business Innovation student
Contact: rouven.gruenig@student.unisg.ch
Skills: Microsoft Office, Java Programming (Eclipse), Languages: English, German, French, Italian
I was born and raised in Switzerland. I completed my undergraduate degree at Zurich University of Applied Sciences in Business Administration with a Major in General Management. I am highly interested in business models, technology and innovations and thus hope to continue to study my interests whilst completing my Master's degree in Business Innovation at the University of St. Gallen. I like playing tennis, going for a run and travelling through the world.
Carolyn Ragaz  
Status: 1st year Business Innovation Graduate Student  
Contact: carolyn.ragaz@student.unisg.ch  
Skills: Microsoft Office, Google Sites, speaks German, English and French

I was born in Virginia, USA and I grew up in Lucerne, Switzerland. I completed my Bachelor's degree in Business Administration at the University of St. Gallen. During my studies I spent a semester in the US and I worked at two multinational companies in Germany and Ireland for 10 months. I’m interested in working on innovative projects within an international setting and learning from different cultures. I hope to pursue my interests in completing my Master's in Business Innovation at the University of St. Gallen and with a second exchange semester in Asia. I enjoy hiking and skiing in the Alps and traveling to different countries.

Jasmin Bissig  
Status: 2nd Year MOK (Master in Management, Organization and Cultural Studies) Student  
Contact: jasmin.bissig@student.unisg.ch  
Skills: Microsoft Word, Excel, Powerpoint, Adobe Photoshop, Illustrator and InDesign

After finishing my Bachelors degree in communication studies (University of Lucerne) I am now working on my Masters degree in Management, Organization and Cultural Studies. When not studying I like to spend time outdoors, meet friends and sometimes read a books.
3.4.1 Stanford Teaching Team

Mark Cutkosky
Status: Stanford Professor
Contact: mcutkosky@gmail.com

Larry Leifer
Status: Stanford Professor
Contact: larry.leifer@stanford.edu

George Toye
Status: Stanford Professor
Contact: toye@withinc.com

Katie Zhou
Status: ME 310 Teaching Assistant
Contact: ktzhou@stanford.edu
Shiquan Wang
Status: ME 310 Teaching Assistant
Contact: shiquan@stanford.edu

Andrew Hudak
Status: ME 310 Teaching Assistant
Contact: ahudak@stanford.edu
4 Design Requirements

At this stage in our design process, it is not feasible to list in detail our design requirements. However, from our benchmarking, need finding, and CEP results, we are able to identify (at least from a broader perspective) some important components that our device must have. These requirements are roughly broken into the categories of functional (Fig. 4.1) and physical (Fig. 4.2) requirements, and tentative metrics have been assigned.

4.1 Assumptions

The assumptions made in making these tentative decisions are based on designing for a middle class Western-leaning South African user (as depicted in our Design Development section). This middle class demographic has been quickly growing (since the end of apartheid in South Africa), therefore leading these new middle class members to desire a quick integration into the “Western” lifestyle, as a way of establishing their status. Typically, this demographic consists of very hard working people who are extremely busy and work challenging jobs to earn enough money to live lavishly. These people desire an inhaler, which is very sleek, quick to operate, concealable, and economical, as they tend to live on tight budgets. Additional assumptions are listed as follow:

- Users have a mild respiratory condition such as asthma (rather than say, silicosis) that requires treatment about 2-3 times per day or less
- Users are willing to spend approximately $3-$5 per week on managing their asthma
- Our user fits within the majority of the South African middle class demographic which embraces (and does not fear) Western innovation and medicine
- Our user fits within the majority of the South African middle class demographic which wants to promote an image of healthiness
- Our user has a high school to college level education

4.2 Functional Requirements

Considering we are still in the early stages of development, we are still uncertain as to how exactly our device should function. Through our research depicted in the Design Development section of this document, we found that our inhaler functions will likely be modeled after a typical pocket inhaler in that it incorporates the functions shown in Fig. 4.1.
Figure 4.1: Graphical Illustration of Functional Requirement

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Metric</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contains doses of medicine</td>
<td>Holds about 21 doses inhalation medicine</td>
<td>Mild asthmatics use an inhaler about three times a day, thus this reusable device could use one canister of medication per week, allowing users to pay on a weekly basis for more. This is preferable for our user group which typically lives on a very tight budget</td>
</tr>
<tr>
<td>Provide respiratory relief to user</td>
<td>User should feel relief within 30 seconds</td>
<td>A typical aerosol asthma inhaler (such as an Albuterol inhaler) requires 30 seconds between puffs, thus a</td>
</tr>
</tbody>
</table>
The rationale for the listed functions is that they describe from a very broad perspective how an inhaler works; namely that a personal inhaler holds medication in the form of doses, which is then delivered to the user’s mouth (either through a mechanism, or passively through the user's inhalation), after which the user experiences respiratory relief. The details regarding the active vs. passive nature of the device, the specific medicine used (dry powder vs. wet medication), how many doses the inhaler must hold, and how these doses are triggered have yet to be finalized, and will be more solidified in the Winter quarter. Regardless, above in Fig. 4.2 we have listed our tentative thoughts regarding these requirements along with some temporary metrics.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>User should intake only one dose per triggering of the inhaler</th>
<th>The medicine needs to be transferred from the inhaler into the user’s body, or else the device is effectively useless. However, we also do not want the user to accidentally intake too much medicine upon triggering the inhaler (more than one dose, as is intended).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allow for user inhalation of medicine</td>
<td>User should intake only one dose per triggering of the inhaler</td>
<td>The medicine needs to be transferred from the inhaler into the user’s body, or else the device is effectively useless. However, we also do not want the user to accidentally intake too much medicine upon triggering the inhaler (more than one dose, as is intended).</td>
</tr>
<tr>
<td>Be reusable (reloadable medicine)</td>
<td>Inhaler can be reloaded in no longer than 1 minute</td>
<td>Despite being Western leaning, most of our users don’t have excess disposable income, or spare time. They would prefer to reuse a medical device (simply replacing the cartridge) rather than needing to repurchase an entire device.</td>
</tr>
</tbody>
</table>

**Figure 4.2: Early Design Requirements and Metrics**

The rationale for the listed functions is that they describe from a very broad perspective how an inhaler works; namely that a personal inhaler holds medication in the form of doses, which is then delivered to the user’s mouth (either through a mechanism, or passively through the user's inhalation), after which the user experiences respiratory relief. The details regarding the active vs. passive nature of the device, the specific medicine used (dry powder vs. wet medication), how many doses the inhaler must hold, and how these doses are triggered have yet to be finalized, and will be more solidified in the Winter quarter. Regardless, above in Fig. 4.2 we have listed our tentative thoughts regarding these requirements along with some temporary metrics.

### 4.2.1 Functional Constraints

- Device must be able to function in hot South African climate
- Reusable device must not experience failure from fatigue and repeated use
- Medication must not be excreted when inhaler is not “operating”

### 4.2.2 Functional Opportunities

- Medication can be stored in a variety of forms (dry powder, aerosol, etc.)
- Dosage delivery is possible through a variety of techniques (electrically, mechanically and through human inspiration) used in existing inhalers
• Dose release can be triggered by various means (electrically and mechanically) as identified in existing inhalers
• Less complexity—overall design of current pocket inhalers are basic in nature

4.3 Physical Requirements

Fig. 4.3 illustrates some of the important physical requirements we believe our inhaler must have. These were derived from our benchmarking, need finding, and CEP results discussed in later sections. We believe these factors to be critical in order for our product to integrate well into the lives of the South African middle class.
<table>
<thead>
<tr>
<th>Requirement</th>
<th>Metric</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy to access from “rest” position</td>
<td>Inhaler can be brought from concealed “rest” position to “operable” position and back in under five seconds</td>
<td>Users desire an inhaler that can be used quickly, without priming, in such a way that it’s use is only a mild interruption of social interactions</td>
</tr>
<tr>
<td>Device must be easy to hold</td>
<td>User should feel comfortable gripping the inhaler for one minute continuously in one hand</td>
<td>Users want to only rely on one hand to administer a dose very quickly, while leaving their other hand free to continue social interactions or other tasks in a natural way</td>
</tr>
<tr>
<td>Inhalation nozzle and trigger easily identifiable</td>
<td>User should take no more than one second to identify the inhalation nozzle and trigger (if any)</td>
<td>Users do not want to fumble around with their inhaler, and instead want quick and discrete operation of the device.</td>
</tr>
<tr>
<td>Can be easily concealed</td>
<td>Largest face of Inhaler should be smaller than 2.5in²</td>
<td>Users would prefer to keep inhalers tucked away and concealed when not in use, as to not draw too much unwanted attention when in a social setting. This is crucial to our target customer as South Africans want to present an image of healthiness—an image which is damaged by the use or display of an inhaler in public</td>
</tr>
</tbody>
</table>
| Operable with low dexterity                     | Dosage administration can be triggered by anyone between the ages of 10 and 80 | Many current inhaler-users complain that it is hard to trigger their
inhalers with one hand. We want to make sure anyone who purchases our product is physically capable of operating it. Considering the familial nature of South African culture, this is also preferable as it is likely that these inhalers may be shared within a family (including older, less dexterous relatives).

Figure 4.4: Design Requirements and Metrics

4.3.1 Physical Constraints

• Design should be small such that it can be easily “concealed” and discreet when in use. The exact dimensions are yet to be determined.
• Material construction must withstand the hot South African climate
• Inhaler shape and physical construction must not harm the user or damage clothing (if concealed as a wearable)

4.3.2 Physical Opportunities

• Possibility to incorporate inhalers into wearables
• Possibility of altering form factor to one which people are less reluctant to use
• Possibility of using materials which are very cost effective
• Possibility of altering inhaler color scheme/material construction for better “camouflaged” design

4.4 Business Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Metric</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhaler must be very affordable</td>
<td>Inhaler must cost under $10</td>
<td>As previously mentioned, our users don’t have much excess income, and what they have</td>
</tr>
<tr>
<td>If made reloadable, inhaler “refills” must be affordable</td>
<td>Inhaler refills must cost under $2</td>
<td>Considering our users live on a tight budget, they would like to purchase medicine as needed (for example, on a weekly basis). This medicine must also be extremely cheap.</td>
</tr>
</tbody>
</table>

*Figure 4.5: Business Requirement Chart*

### 4.4.1 Business Constraints

- Device and cartridges must be available for purchase at a pharmacy (as all of Merck’s products are)

### 4.4.2 Business Opportunities

- Opportunity to implement a “pay-as-you-go” system for asthma treatment
5 Design Development

Our project presented a very unique set of challenges from the get-go considering that it required us to not only get a grasp on the design space and our potential users and their needs, but also a completely unfamiliar culture. Tackling this immense task of understanding the lifestyle of a middle class person in South Africa proved to be tough, but we were able to draw important conclusions through benchmarking, need finding, persona development, and a critical experience prototype. Our design development can be seen in Fig. 5.1.

5.1 Brainstorming

![Diagram showing the Design Development Process]

*Figure 5.1: Our Team's Design Development Process*
Our team’s approach to the brainstorming phase of our project changed drastically throughout the Fall quarter. Merck originally presented the project as a way of introducing inhalers to a culture that shies away from Western technology. With this mindset, our team was forced to initially think about why South Africans might shy away from Western technology (and especially Western medicine). Our team reached some of the following conclusions (Fig. 5.2):

After speaking with multiple South African interviewees, we learned that our findings contradicted those of Merck. The middle class South African demographic is one which does not oppose Western culture. Instead, they embrace it, and desire Western products as a way of establishing their status within society. These findings are better explained in our need finding section, and forced our team to change our brainstorming class as a Western-leaning demographic, it makes sense to understand inhalers from our point of view (a Western view). Fig. 5.3 shows our first brainstorming map demonstrating the important considerations when designing an inhaler.

Figure 5.2: Understanding Fears of Western Technology and Medicine
5.2 Technology Benchmarking

5.2.1 Online Research

The first step to our design development was to explore the design space and conduct some benchmarking. In order to diversify our approach to this step, we conducted our design space exploration and benchmarking by researching existing products online, conducting interviews, and dissecting existing inhalers and other relevant technologies (Fig 5.4). In order to gather some fundamental knowledge about inhaler types, functions and advantages/disadvantages, we first conducted some online research.
5.2.1.1 Basic Pocket Inhalers

Through this research we learned that inhalers are most commonly used for treatment of Asthma and Chronic Obstructive Pulmonary Disease (COPD). We also learned that inhalers are typically categorized by the form of the medicine they disperse (wet vs. dry inhalers) as well as the method in which the medicine is delivered to the user (active vs. passive inhalers). Wet inhalers refer to a medicine, which is stored as an aerosol such as most Albuterol inhalers, which exist today (Fig. 5.5). These wet inhalers are referred to as “active” or “metered” because upon pressing a trigger, the aerosol medicine is released into the user’s mouth. The alternative dry inhalers use dry powders and are passive because there is no medicine delivery mechanism. Instead the user uses the force of their inhalation to intake the medicine. One of the most common dry inhalers on the market today is called Advair (Fig. 5.6). We found very distinct advantages and disadvantages with each type of inhaler, as illustrated in Fig 5.7.

Figure 5.5: Example of Wet, Active Inhaler

Figure 5.6: Example of Dry, Passive Inhaler
Figure 5.6: Comparison of Wet and Dry Inhalers
5.2.1.2 Alternative Inhalation Devices

In addition to researching inhalers specifically, our team conducted online research investigating other inhalation devices or potential methods of delivering medicine. Topics of focus included nasal sprays, nebulizers, respirators, e-cigarettes, humidifiers, and even cannula tubes. Considering that Merck currently makes a nasal spray product called Nasivin, we conducted much research on nasal sprays. Our research however very quickly pointed us away from nasal sprays, for the many unwanted side-effects illustrated in the chart below (Fig. 5.8) and the fact that administering respiratory medicine through one’s nose is very inefficient. After speaking with several doctors (see Need Finding section), they informed us that respiratory conditions are best treated through the mouth directly. While nasal sprays are effective at decongesting a nose (as experienced during a common cold), our team was more interested in designing for more prevalent South African respiratory problems such as asthma or COPD. As demonstrated in the Need Finding section, we found there was a greater need for treatment of these conditions within our South African context.

Figure 5.8: Pros and Cons of Nasal Sprays
After researching respirators (Fig. 5.9) and understanding their functions, we quickly learned that they are a very effective filtration tool in which air is fed through a filter that absorbs undesirable toxins. However, when considering the acceptance of these products into a South African culture, which historically shies away from Western medicine, options such as regulators and cannula tubes (Fig. 5.10) were not further pursued as they were very intrusive and unnatural. As can be seen in the images below, these options cover sections of the user’s face, and project the notion of “unhealthiness” in a very public way—something we learned is looked down upon amongst South Africans due to their history with disease.

Figure 5.9: Illustration of the Intrusive Nature of a Respirator

Figure 5.10: Illustration of the Intrusive Nature of Nasal Cannula
One alternative benchmark which proved to be fairly promising was the concept of an e-cigarette. E-cigarettes are extremely compact, sell for as little as $3, and deliver a liquid nicotine (which we can analogously think of as medicine) to the user’s lungs through a simple atomization process with a heated coil. The interesting thing about these e-cigarettes and other nicotine inhalers, is that there are various patents on very distinct nicotine delivery methods, all of which are very basic. Two notable designs are the modern electric atomization cigarettes (Fig. 5.11), and a different system which passes air through a porous nicotine infused plug (Fig. 5.12). This concept was particularly appealing to us until our CEP during which we found that a cigarette-shaped inhaler was actually very polarizing with users (see CEP section). While the cigarette shape was abandoned, the unique nicotine delivery methods were not, as the porous plug idea was incorporated into our current design vision as a medicine delivery method.

*Figure 5.11: A View Inside a Modern E-Cigarette*
In addition to e-cigarettes, the concept of a nebulizer proved to be promising but limited by its difficulty of operation and lack of portability. Although it is much bulkier than an inhaler, a nebulizer functions in a similar way, delivering a very fine mist of medicine (but over a treatment of about 5-10 minutes). However the devices are very large, complex to use and require electricity. The sheer size, technical complexity and high cost (starting around $60) made the nebulizer a poor choice for our target South African demographic as we later explain that our users have very little excess income that they would like to use on medical devices.

Figure 5.12: A View Inside a Nicotine Plug Nicotine Inhaler

Figure 5.13: A Standard Nebulizer
Perhaps some of the most important findings from our online research were the facts that there does exist the potential to make extremely cheap and portable inhalers (which we found to be a vital consideration when designing for Africa) and that there are many unique mechanisms used to deliver medicine through inhalers. One of our biggest findings was an inhaler by the name of Occoris (Fig. 5.14). The inhaler is called an inhaler “engine” as it is an active device which propels the powder medicine into the user’s mouth using a unique and undisclosed breath actuation mechanism (BAM). Thus, this is a unique example of an active inhaler that uses dry powder! Through testing, the throat/mouth deposition has been found to be only about 20% versus the usual 40-70% for typical active inhalers, meaning that users experience much more relief per dosage. The most remarkable thing about this single-use inhaler, is that it is made of extremely cheap materials (with a cost of manufacturing of about 20 cents). This finding served as an important indicator to us that it was indeed possible to create an extremely cheap and effective inhaler.

![Image](image_url)

*Figure 5.14: Occoris Inhaler Engine*

In addition to the Occoris inhaler engine, our online research showed that inhalers use various methods to administer the medicine to the user, some of which are complex electrically-controlled mechanisms, and others which are very basic and clever mechanical mechanisms. The basic metered active inhaler functions in a way shown in Fig. 5.15, where the drug particles are mixed with a propellant that is stored as a liquefied compressed gas that is gaseous at atmospheric pressure (allowing for the gaseous spray of medicine into the user’s mouth) but a liquid when compressed.
Figure 5.15: Description of how a Metered-Dose Inhaler Functions
One example of an especially clever design for an active inhaler is the Respimat (Fig. 5.16) which utilizes the mechanical force of a compressed spring (which is twisted each time to load the spring) to load the proper dosage into a capillary tube which is then released by a trigger.

![Schematic of Respimat Inhaler](image)

*Figure 5.16: Schematic of Respimat Inhaler*

The plethora of these medicine delivery methods presented many options for the delivery method in our device. The fact that so many of these methods are basic in nature and use mechanical components implies that they could also be highly cost efficient (compared to electrical alternatives).

### 5.2.1.3 Home Remedies

In order to approach the problem of respiratory troubles from a very different and more traditional vantage point, we also researched some “home remedies” typically used to treat a cough or a cold. We learned that the treatments are extremely varied in form (and often inconsistent). For example, steeping some thyme to make a tea is very common as the leaves have compounds, which relax the cough-causing muscles. Rather than drinking a tea, some people opt to consume a gooey gel made of boiled flax, honey and lemon to soothe the throat. Others rely on aromatherapy or vaporized eucalyptus oils to clear the nostrils and respiratory tract and some even insist (believe it or not) that
sucking a lemon is the best way to restrain a cough. It is clear that when it comes to a cough or cold, there are very many supposed remedies with unique forms and applications. However, none of these options present a practical and portable method to address a chronic respiratory condition such as asthma quickly and easily.

### 5.2.2 Interviews

In the hopes of learning more about existing products related to our project, we interviewed four people with very different backgrounds. The significant findings (related to benchmarking) from these interviews are outlined through the following points:

<table>
<thead>
<tr>
<th>Interviewee Name and relation to South Africa/Background</th>
<th>Significant Benchmarking Findings from Interview</th>
</tr>
</thead>
</table>
| Margaret Irving-South African native connected to one of our team members through Stanford research group | • Public healthcare is very poorly run/organized, but pharmacies are stocked with many westernized drugs  
  • There are certain cure-all medications at the pharmacy (think Tylenol in the US)  
  • Everyone in South Africa has a cell phone, rich or poor  
    o It is free to receive text messages |
| *Stanford firefighters and paramedics*-Familiarity with respiratory devices. No relation to South Africa | • Safety is emphasized with respiratory devices  
  o Oxygen tanks used when entering dangerous environments  
  o Respirators can be plugged into tank of other firefighter when running low on personal oxygen  
  o Many signals (both audible and visual) on equipment used to indicate low oxygen or dangerous respiratory situations |
| *Dr. Van Wert and Dr. Ruoss*-Stanford Hospital Pulmonary Care division. No relation to South Africa | • The design of an inhaler has not been radically altered for many years  
  • The basic wet aerosol inhaler and dry powder disk inhalers have become the |
staple—they accomplish their goals

- Dry powder inhalers are especially simple and could make for a cheap design
- Suggest that we consider the economic constraints of our demographic and which inhalers are cheaper to make/sell
- Modern inhalers are sold with the medicine included—you cannot simply refill an inhaler
- There are no inhalers which use atomization of a liquid medicine (like e-cigarettes)
- There are no portable “pocket” inhalers which are continuously operating
- It is important to consider the form of the medicine including how it holds up in the environment/climate we will work in
- It is important to consider if certain forms of medicine can be more easily transported to Africa—transport can become a big cost
- HIV, Tuberculosis and other transferable diseases make sharing inhalers very dangerous in South Africa.
- Coughing in general is not always bad. For certain diseases like Tuberculosis, it is encouraged to clear the lungs of fluid
- Many South African miners inhale excessive silica and acquire Silicosis which is not curable, but detectable through x-rays

**Figure 5.17: Interviewee Description and Important Interview Findings**

After speaking with Dr. Van Wert and Dr. Ruoss and for the sake of our research, we conducted a quick search on the prices of different inhalation therapy devices and found that an Albuterol (wet active) inhaler costs approximately $30-60, while a nebulizer can cost upwards of about $60.

### 5.2.3 Purchase and Dissection of Existing products

In order to investigate and learn more about existing products, our team purchased a variety of products online. Luckily we already had a basic active metered Albuterol inhaler on hand from one of our team members. Using this as a baseline, we investigated
a Neti Pot for nostril cleansing, a full-face steam inhaler, a gas mask, a nebulizer cable and a Vicks portable inhaler (Fig. 5.18).

After playing with these devices, learning how they worked and observing their advantages and disadvantages, we found that they were all very basic in the way they functioned but that they were all obstructive, unnatural, or unappealing in their individual ways. We believe it is critical to consider these unappealing factors and the implications

Figure 5.18: a.) Neti Pot b.) Vicks Portable Steam Inhaler c.) Gasmask d.) Nebulizer tubing/mouthpiece e.) Full-face Steam Inhaler
they may have on our particular South African demographic (as confirmed through our need finding). These immediate concerns are voiced in the following Pugh matrix (Fig. 5.19). As we were not able to obtain a full nebulizer, the corresponding values are computed for the nebulizer system as a whole. The terms obstructiveness and unnaturalness are used as described in the Glossary.

### Criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Active Metered Inhaler (Baseline)</th>
<th>Neti Pot</th>
<th>Vicks Portable Steam Inhaler</th>
<th>Gasmask</th>
<th>Nebulizer</th>
<th>Full-face steam inhaler</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstructiveness</td>
<td>0</td>
<td>0</td>
<td>-1</td>
<td>-3</td>
<td>0</td>
<td>-2</td>
</tr>
<tr>
<td>Unnaturalness</td>
<td>0</td>
<td>-2</td>
<td>2</td>
<td>-3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Portability</td>
<td>0</td>
<td>0</td>
<td>-2</td>
<td>-3</td>
<td>-3</td>
<td>-3</td>
</tr>
<tr>
<td>Ease of use</td>
<td>0</td>
<td>-1</td>
<td>1</td>
<td>2</td>
<td>-2</td>
<td>-2</td>
</tr>
<tr>
<td>Cost</td>
<td>0</td>
<td>1</td>
<td>-1</td>
<td>-2</td>
<td>-3</td>
<td>-2</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>0</strong></td>
<td><strong>-2</strong></td>
<td><strong>-1</strong></td>
<td><strong>-9</strong></td>
<td><strong>-7</strong></td>
<td><strong>-7</strong></td>
</tr>
</tbody>
</table>

*Figure 5.19: Pugh Matrix of Advantages and Disadvantages of Inhalation Products*

As revealed in this matrix, we found that the active metered inhaler perhaps serves as the best solution for these categories, which we designated. Based off of our initial understanding of the South African demographic, and the results of this matrix, this suggested to us that we should think about moving forward with a modification of the existing portable pocket inhaler form.

#### 5.2.4 Unmet Needs/Opportunities and Interests Moving Forward

From our benchmarking our team became interested in several important concepts, which could be further pursued and are listed below:

- Continuously-operating inhalers/breathing apparatuses
- Familial pocket inhalers with interchangeable and sterilized mouthpieces
- Integration of inhalers to mobile phone texting service for managing treatment
- Inhalers for severely affected miners using central nebulizer and personal masks
- Rechargeable inhalers--use of tablets or liquid medicine
- Extremely cheap inhalers
- Redesign of the pocket inhaler form for portability and easy concealment.

#### 5.3 Need Finding

In order to best understand the South African culture (and particularly the middle class) and due to a lack of South African contacts in our close proximity, we conducted our need finding through both online research and interviews (mostly through Skype) (Fig. 5.20).
5.3.1 Online Research

Through our online research, we gained a lot of insights regarding the South African culture as a whole, which we learned is very diverse and fairly fragmented. There are eleven official languages in South Africa, with a population of approximately 52 million. The population can be broken into the following categories:

<table>
<thead>
<tr>
<th>Population group</th>
<th>Number</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>African</td>
<td>41,000,938</td>
<td>79.2</td>
</tr>
<tr>
<td>White</td>
<td>4,586,838</td>
<td>8.9</td>
</tr>
<tr>
<td>Coloured</td>
<td>4,615,401</td>
<td>8.9</td>
</tr>
<tr>
<td>Indian/Asian</td>
<td>1,286,930</td>
<td>2.5</td>
</tr>
<tr>
<td>Other</td>
<td>289,454</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>51,770,560</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

We learned that the majority of the population lives within or very near to the three main cities of Durban, Cape Town or Johannesburg, and that the majority of the population is between the ages of 25-54 years old (38.2%). We discovered many troublesome signs regarding the state of healthcare in South Africa. The physician density is about 0.76 physicians/1000 people with an average of 13,718 people per clinic which exceeds the World Health Organization’s guidelines of 10,000 people per clinic. This is disheartening to begin with, but what is even more saddening is that since approximately 73% of general practitioners work in the private health sector, there is only about one practicing doctor for every 4,219 people. Perhaps another staggering statistic is
that South Africa has reported the fifth highest asthma case fatality rate (18.5 people per every 1000 asthmatics die). Understanding the role of traditional medicine in South Africa was a particularly difficult task due to a lack of statistical data, however one rough figure computed that there are about 200,000 healers compared to 25,000 western doctors. We learned more details regarding the role of traditional medicine through our interviews.

### 5.3.2 Interviews

Our interviews were conducted with the following interviewees (Fig. 5.22):

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Relation to S. Africa</th>
<th>Medium for interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Margaret Irving</td>
<td>PhD Sociology</td>
<td>Born in South Africa</td>
<td>Skype</td>
</tr>
<tr>
<td>Stephen Reid</td>
<td>PhD Statistics</td>
<td>Born and raised in South Africa</td>
<td>In Person</td>
</tr>
<tr>
<td>Mike Blum</td>
<td>President of Materials and Technology Inc.</td>
<td>Born in South Africa</td>
<td>In Person</td>
</tr>
<tr>
<td>Trudy Meehan</td>
<td>Director of Bing Overseas Studies in Cape Town</td>
<td>Works in South Africa</td>
<td>Skype</td>
</tr>
<tr>
<td>Sean MacDonald</td>
<td>Palo Alto Fire Fighter</td>
<td>None. Asthmatic</td>
<td>In Person</td>
</tr>
<tr>
<td>Jean Fourie</td>
<td>Microsoft Employee</td>
<td>Born in South Africa</td>
<td>Skype</td>
</tr>
</tbody>
</table>

*Figure 5.22: Table of Need Finding Interviewees*

Below we list some of the most significant findings from our interviews. Note that important quotes from our interviewees regarding each category listed below can be found in the Appendix.

#### 5.3.2.1 Racial Divisions and the Role of Race in Society

- Before 1994, segregation effectively separated the different economic classes, with white South Africans occupying almost all of the middle and high class while also holding most of the jobs, which drove the economy.
- With the end of segregation, many of these jobs become available to people in previously lower classes (traditionally black South Africans)—since this time, the “middle class” has been in flux and is still growing today.
For these same reasons, the middle class has become hard to define
● These newcomers to the “middle class” largely aspire to embrace Western ideals, culture, and technology (and they are often willing to spend nearly all the money they have to do this) as they attempt to speed their assimilation into their new societal roles.
● These middle class newcomers are often not sufficiently educated and technologically savvy for the jobs they hold.

5.3.2.2 Healthcare
● Private healthcare/insurance is largely reserved for the upper class (almost exclusively white South Africans), but offers excellent treatment
● The public healthcare system is very poorly managed and even corrupt. There are insufficient doctors/facilities to treat everyone, and people must wait very long to receive treatment if they are lucky enough to even get a hospital bed
● These public health clinics are mostly located by the larger cities and are very inaccessible to anyone who lives in rural areas
● Many people opt to visit traditional healers simply because they are more readily available (no long wait necessary) and are cheaper than Western medicine. Many people use both traditional medicine and public healthcare, turning to traditional medicine when they can’t receive treatment quick enough from a clinic
● Traditional healers play a more prominent role in rural areas--here health is thought to be a function of your relationship with the community and ancestors
● Nowadays, to bypass the delays in a clinic, most people rely on the pharmacist for medical advice

5.3.2.3 Technology as a Whole and the Perception of Inhalers
● Technology is embraced in South Africa, especially cell phones which almost everyone has (some are even solar powered!). Everyone is free to receive text messages.
● Functional, “intuitive,” easy to use products are highly valued (such as ones that don’t require extensive user manuals). Communicating complex information is further complicated by the 11 national languages.
Even in Western countries, inhalers have a stigma for unhealthiness.

Many people, even in Westernized countries would rather choose a healthier option than inhaling chemicals to treat respiratory conditions.

The image of “appearing healthy” is especially critical in South Africa, where disease is so rampant. It is important to present oneself as healthy, and therefore (supposedly) of a higher class.

5.3.3 Our Biggest Takeaways

After synthesizing the knowledge gained from our interviews, we found that our findings contradicted the ideas proposed by Merck in their project abstract. Contrary to what was originally stated, most of the South African middle class does not shy away from Western medicine. In fact, most people attend both a public healthcare facility and a traditional healer in parallel, opting for traditional healing when constrained by time and money. Although they do embrace this Western lifestyle and often purchase expensive things, these people live on very tight budgets, barely scraping by to live this way. The fluctuating middle class strives to use sleek-looking Western products to establish their status, thus it seems logical to create a product that invokes this look while still being very economical and promoting the image of strength and good health.

One interview with Mike Blum was particularly insightful as he encouraged us to target the mining industry, as South African miners have some of the highest rates of occupational lung disease in the world. Mike informed us that miners are almost unanimously men, who leave their families (almost as a rite of passage) to go work the mines and send money back home. They live on very little money themselves, and often acquire lung diseases such as silicosis. Historically, mining companies have opted to pay off the families of workers diagnosed with silicosis or other mining-induced diseases if they can prove the cause of death through an autopsy. Mike saw this as a great field to make a big impact and together we formulated the following chart to outline the advantages to designing for South African miners (Fig. 5.25).
We entertained the idea of designing our inhalers for these miners, as there were evident advantages to doing so. We even proposed our first persona as a South African miner. However, after some reconsideration, we (at least temporarily) turned away from the miners for the reason that these miners are considered part of the working class, not the middle class (the particular demographic which Merck asked us to target). We also decided that designing for the middle class would allow us to potentially have a much broader influence, seeing as the middle class is in such flux and continues to grow. With the established mindset of designing for this group, and from the information in our interviews the important design considerations were laid out as follows (Fig. 5.26):

**Figure 5.25:** Advantages of Designing for South African Miners

**Figure 5.26:** Design Consideration for Middle Class
5.4 Persona Development

Developing a persona is critical to our project, as it allows us to fully identify a potential user. It forces us to understand how this user lives, and the typical experiences they undergo each day. By thinking on this personal level, it allows us to develop a product which is well suited for their particular needs, and therefore integrates more naturally into their life. This persona serves as a good indicator of how we can expect (at least roughly) the rest of our target users to act and accept our product. Based off of our need finding, we decided to create a persona who is young and aspires to become more westernized in order to cement her social and economic status.

![Image](image.png)

Figure 5.27: Middle Class South African Woman, Ayanda

Our persona is a 30 year old female from Johannesburg named Ayanda. Ayanda grew up in Johannesburg, and was a young child during the time when apartheid ended and integration began. She watched her father struggle to earn enough money to support her, her mother and her two little sisters. Her father had a hard time integrating into his new job as a teller at a department store, as he often got confused on how to use the cash register. Ayanda acquired a better education than her parents, going to school until the 10th grade, after which she began working at a small restaurant to support her now-sick father. During her adolescence, she (along with all of her friends) became captivated by Western culture. They often listened to popular music from America and she loved to watch American action films. Shortly after obtaining her restaurant job, she and her sisters were making sufficient money to support the family, while also being able to indulge in new things. She soon began buying Western clothes, technology, and even jewelry to fit in with her friends (who were also doing the same) and the white South Africans she would see around town.

Having now worked at the restaurant for a long time, Ayanda has acquired a passion for cooking and wants to open her own high-end restaurant in order to keep
making sufficient money to support her growing lavish lifestyle. It is important to note that while Ayanda does live this lavish lifestyle, she lives on a very tight budget, sometimes on the brink of going into debt, just to establish her upper status. Unfortunately, Ayanda has always suffered from moderate asthma. She spends much of her time coughing, and frequently gets strange looks from strangers who see her as sick and unhealthy like her father. She really wants to end this coughing, because she needs to uphold her image of success in order to attract the clientele she is looking for. However, she does not want to use an inhaler as they are too obvious, bulky, and would invoke the same concerns from strangers. Ayanda is looking for a sleek, discreet and effective solution which she can use about five times per day to help her halt her coughing and succeed as a businesswoman.

5.5 Critical Experience Prototype

After conducting our need finding and learning very interestingly that most people within the South African middle class tend to embrace Western culture, we decided to plan our CEP accordingly. Our team figured that since these South African people are Western-leaning, we wanted to learn what influences Western people to hesitate using an inhaler. It is no secret that people who use inhalers (including one of our team members) don’t always feel completely comfortable using them in public, and we wanted to understand why. In particular, we wanted to understand the effect of shape factor and inhaler placement on a user’s comfort using an inhaler. Our team decided to conduct a CEP rather than an CFP, as we deemed it very important to first understand the psychological implications of using an inhaler—a very important consideration for our project. A CEP is important as a method of understanding a vital experiential component of our project, and what a user should experience if our product is designed effectively.

Our Goal: We aim to analyze human perceptions of inhalers and detect any patterns in their rankings of different inhaler forms.

Why?: Our need finding showed that the South African middle class is very Western-leaning, and therefore may have the same psychological reservations about using inhalers as people in our close vicinity.

5.5.1 What We Hoped to Learn

- Is there a preferred inhaler shape amongst the interviewees?
- Is there a preferred inhaler size amongst the interviewees?
- Do interviewees prefer wearable or pocket inhalers? Why?
- Does material construction affect perception?
- Any additional insights regarding inhaler uses and stigmas against inhaler users.
5.5.2 Experience Description

In order to best address the questions listed above, our study consisted of a basic interview process with 16 interviewees. The interview was structured as follows:
1. After showing the interviewees a typical metered active inhaler (Fig. 5.28), they were asked whether there is a stigma associated with these inhalers and people who use them.
2. Interviewees were asked if they would use an inhaler like this in a social setting like a party.
3. Users were asked to rank their three favorite inhaler designs from Fig. 5.29.
4. Users were asked to state their least favorite inhaler design.
5. Elaboration on any of these points was encouraged.

Figure 5.28: Typical Metered Dose Inhaler
5.5.3 Study Results

The different inhalers illustrated in Fig. 5.29 were machined from either wood or 3D printed out of plastic. The intent was to create a variety of unique shapes and forms, from distinct materials to allow interviewees to compare the inhalers. The inhalers were also modified with air channels, such that the interviewees could actually breathe through the device to simulate inhalation. Results from our study were quantified in the following way: for the question in which participants were asked to rank the different inhalers in terms of preference, their first rank was awarded three points, their second rank was awarded two points and their third rank was awarded one point (Fig. 5.30). For the question in which the participants were asked to state which inhaler they most disliked, their vote was counted as one point (Fig. 5.31). The results are shown below.
**Figure 5.30:** Interviewee "most liked" Inhalers

**Figure 5.31:** Interviewee "most disliked" Inhalers
5.5.4 CEP Insights

The following are insights gained from the first portion of questioning during each interview:

- Most people who do not use an inhaler (a majority of our interviewees) believe that there is not a stigma against inhalers and people who use them.
- Most people who do use inhalers believe there is a stigma against inhalers, as it makes the user look unhealthy and it is disruptive.
- Unanimously, people would opt not to use a typical inhaler at a large social gathering such as a party.
- Many interviewees mentioned the role of inhalers during their childhood or their friends’ childhood, and “fitting in” during these childhood years.
- Many interviewees mentioned how inhaler users in movies and TV shows are portrayed as weak or nerdy.

**Our Conclusion:** Although most people claim that there is no stigma against inhalers, they are forced into a contradiction by saying that they themselves wouldn’t use them in a social context. This tells us that there is a conscious, as well as unconscious stigma against inhalers. From our interviewees, it seems much of this perception stems from one’s childhood when it is not “cool” to have to pull out an inhaler during recess and from pop culture which paints inhaler users as inferior.

The following are insights gained from the form of our prototypes:

- Small inhalers are preferable.
- Many people commented on the fact that a watch/inhaler is too noticeable, as you move your hands around throughout the day.
- Various people commented on the fact that they wouldn’t want to occupy even more space on their wrist (in addition to watches, smart bands, etc.)
- The e-cigarette design was very polarizing. The overall size was desirable, but many people disliked the association with smoking.
- Wearables are only preferred if inhaler use is very frequent. They were usually preferred by women over men.
- If a pocket inhaler is pursued, people generally like something that does not look the slightest bit like a typical metered dose inhaler, but is instead sleek and easy to hold (such as 2).
- Necklaces are good because they can be concealed (such as 9).
  - Necklaces must be small (a reason why various people disliked option 8) and “stylish,” to look fashionable like jewelry.

**Our Conclusion:** Through the preferences, we found that people generally all seemed to appreciate discreet inhalers. Whether for pocket use, purse use, or as a wearable, the overall conclusion is that smaller is better. Regarding the overall form, people generally tried to stray as far as possible from a typical inhaler shape (we believe, as a way of dissociating from the typical perception of an inhaler). We were surprised to find that
most people did not want inhalers on their wrist, as we figured it was natural to cover one’s mouth while coughing, and thus bringing your wrist close to your face seemed practical. Instead, people wanted an even less noticeable solution that can be tucked away when not in use, and discreetly used when needed. No one commented on the different materials of the inhalers, although the top results were made of plastic, leading us to believe people prefer a sleek modern finish over a traditional wooden finish.

5.5.5 Long-Term Study

As a way of gathering more varied data, our team also gave four of our highest ranking inhaler prototypes to four people to test for an entire day. They were encouraged to “use” them at regular intervals (about every hour) in both private and social settings, and to report back any important findings. From this, our team learned that the pocket inhalers seemed to get the most “funny looks” and questions from friends, despite their abstract shapes (as people simply wanted to know what they were). The e-cigarette design remained well camouflaged and did not lead to any questions, although perhaps some strange looks when “smoking” indoors. The necklace design (9) was found to attract very little attention. The user mentioned she thought it was because people tend to naturally chew on their necklaces and jewelry.

5.5.6 Overall CEP Conclusions

Overall, the results from our study point to a discreet necklace design or alternative concealable wearable as a good route for our project. This design should be sleek, look very little like a traditional inhaler, and be very quick and easy to use, such that it does not inhibit social interactions. It is also crucial that this device be very inexpensive, as our need finding demonstrated that middle class South Africans still live on tight budgets. Keeping our persona in mind, such a device would be great, as it would not lead people to think of her as “unhealthy.” Rather, they would probably not see the device at all (tucked under her shirt) and if they do, they would see it as a new Western technology. The idea is to make the inhaler “cool,” by hiding it, simplifying it, and completely changing its shape. It is believed that such a wearable (if basic enough), could also be given to children, in the hopes of remedying the root of the stigma at a young age.
6 Design Vision

Based on the CFP and the CEP, we chose the inhaler concealed in a necklace design. The CAD model is shown below. The figures shown below are our design vision for the winter quarter. The core idea behind the approach to the problem statement right now is to integrate an inhaler into a popular wearable device such that there is no stigma with carrying such a device without compromising on the availability of the device during dire need. The concealed design should allow the user to freely use the device in a social setting. This approach is shown succinctly in the figure below.

![Figure 6.1: A combination of two ideas showing the design path we are currently following](image)

A number of physical models were made and the most popular shape and functionality was chosen. The CAD model below depicts our current design vision of the product for the next quarter.

![Figure 6.2: CAD Model for our Vision of an Inhaler](image)
The figure above shows the pendant that can be worn on a necklace as a piece of jewelry. The pendant-like shape conceals the medicinal nature of the necklace and can be worn by the user without facing the stigma of being sick or weak. The blue cartridge on top is composed of a porous material that contains the medicine to be delivered. The working of the inhaler is demonstrated by Figure 6.3.

The user inhales through the hole in the pendant on the chamfered side. Air passes through the pores in the surface of the cartridge and picks up vapors of the medicine from the cartridge. This air mixed with medicine is then inhaled by the user as per requirement.

The feature of this design that we wish to emphasize is the reusability and modularity. The cartridge can be replaced with one containing the medicine that the user needs and the necklace itself can be reused. The lack of moving parts aids simplicity of use and might result in a low cost inhaler that would be ideal for our user.
7 Project Planning and Management

The direction of our project and the solution is currently undergoing change and will be changing in the near future. Due to the lack of contacts in the Black South-African Middle Class and the in-depth need-finding that will be conducted during the team’s visit to South Africa over the winter break, we expect that the direction of the design solution and the approach will change. At present, we plan to stick to the established timelines and expect no deviation yet.

7.1 Deliverables and Milestones

<table>
<thead>
<tr>
<th>Deliverable/Milestone</th>
<th>Duration</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1. Travel (Jade and Srinath to South Africa)     | 26\textsuperscript{th} Dec to 6\textsuperscript{th} Jan | In-Depth Need-finding of the South African Middle Class at three Major Cities of Johannesburg, Durban and Cape Town though:  
1. Meeting with Merck officials in South Africa and analyzing their marker research as well.  
2. Establishing contact with other contacts that we developed through networking.  
3. Visiting the Chris Hani Baragwanath Academic Hospital at Johannesburg.  
At the end of this trip, we will meet and debrief the St. Gallen team that will be travelling to SA immediately after we leave. This way they will continue the work we would have been doing and can explore any possible missed areas of interest. |
| 2. Dark Horse Prototype and Funk-tional Prototype| 18\textsuperscript{th} Jan to 14\textsuperscript{th} Feb | Exploring alternate and natural remedies as a possible solution to the problem statement. Exploring perception of people towards natural remedies. We will also delve into the delivery of the drug and user perception of developing resistance to the drug after a few times of use. |
| 3. Travel (Daniel to St. Gallen)                 | 13\textsuperscript{th} February to 18\textsuperscript{th} February | Converging with the international team. Before this can happen, we need to finish the dark horse |
prototype and the FUNK-tional prototype exercise. At this point we will confer and reach a common direction that we will pursue for the remainder of the academic year.

Possibly, meet with Merck corporate team and liaison at Darmstadt and present our idea to them and establish a direction for the rest of winter and spring quarter.

<table>
<thead>
<tr>
<th>4. Functional System (Two Iterations)</th>
<th>15&lt;sup&gt;th&lt;/sup&gt; Feb to 3&lt;sup&gt;rd&lt;/sup&gt; March</th>
<th>Complete two iterations of a complete model of the product and begin building a testable prototype</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Winter Documentation</td>
<td>Due on 19&lt;sup&gt;th&lt;/sup&gt; March</td>
<td>Since the activities during winter will be substantial, we will be doing the documentation simultaneously with the design process</td>
</tr>
<tr>
<td>6. Build Model for testing at South Africa</td>
<td>6&lt;sup&gt;th&lt;/sup&gt; March to 28&lt;sup&gt;th&lt;/sup&gt; March</td>
<td>During this period we will try and build a first pass of the final product and send it to the Merck headquarters in Johannesburg for testing to get user feedback for the prototype. Since our users are quite far away, it might be our last chance to make any change in the direction of the project.</td>
</tr>
</tbody>
</table>

*Figure 7.1: Deliverables and Milestones*

### 7.2 Project Timeline

The list of activities is better indicated by the Gantt chart below. The pink indicates that the activity will transpire for the duration of the quarter and will be done incrementally every week.
Figure 7.2: Gantt Chart for the end for the fall quarter and the winter quarter

<table>
<thead>
<tr>
<th>Activity</th>
<th>December</th>
<th>January</th>
<th>February</th>
<th>March</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel (Smath and Associates to South Africa)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Documentation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Functional Systems (2 Iterations)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel (Daniel to St. Gallen)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dark Horse and Funky Functional Prototyping</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SL. Callan Team and Members</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combine data from St. Mathias and the team</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Build Model for Pilot Test in South Africa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Make prototype</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combine data from Srinath, Jade and the St. Gallen Team and Brainstorm Dark Horse and Funky Functional Prototyping exercise</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel (Srinath and Jade to South Africa)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Activity: 56
## 7.3 Project Budget

The spreadsheet below shows the spending for the fall quarter.

<table>
<thead>
<tr>
<th>Reference*</th>
<th>Purchaser</th>
<th>Date</th>
<th>Vendor Name</th>
<th>Description of Expense</th>
<th>Pre-tax Amount</th>
<th>Shipping &amp; Handling (if any)</th>
<th>Amount Incl Sales Tax</th>
</tr>
</thead>
<tbody>
<tr>
<td>116-5328059-2037812 (order #)</td>
<td>Srinath Sibi</td>
<td>11/4/2014</td>
<td>Amazon</td>
<td>Vicks Vapo inhaler 0.007 Oz for benchmarking</td>
<td>$7.14</td>
<td>N/A</td>
<td>$7.14</td>
</tr>
<tr>
<td>116-7487367-5453800 (order #)</td>
<td>Srinath Sibi</td>
<td>11/4/2014</td>
<td>Amazon</td>
<td>Vicks Sleepytime Waterless Vaporizer Scent Pads for benchmarking</td>
<td>$7.99</td>
<td>(all included in shipping/handling for Veridian 1-525)</td>
<td>$7.99</td>
</tr>
<tr>
<td>116-7487367-5453800 (order #)</td>
<td>Srinath Sibi</td>
<td>11/4/2014</td>
<td>Amazon</td>
<td>Vicks V1300 Portable Steam Therapy for benchmarking</td>
<td>$9.25</td>
<td>(all included in shipping/handling for Veridian 1-525)</td>
<td>$9.25</td>
</tr>
<tr>
<td>116-7487367-5453800 (order #)</td>
<td>Srinath Sibi</td>
<td>11/4/2014</td>
<td>Amazon</td>
<td>Traveller's Neti Pot for Nasal Cleansing for benchmarking</td>
<td>$6.95</td>
<td>(all included in shipping/handling for Veridian 1-525)</td>
<td>$6.95</td>
</tr>
<tr>
<td>116-7487367-5453800 (order #)</td>
<td>Srinath Sibi</td>
<td>11/4/2014</td>
<td>Amazon</td>
<td>Veridian 11-525 Steam Inhaler and Beauty Mask for benchmarking</td>
<td>$39.35</td>
<td>$5.99</td>
<td>$50.10</td>
</tr>
<tr>
<td>N/A</td>
<td>Daniel Concha</td>
<td>11/16/2014</td>
<td>Room 36</td>
<td>3D printed parts from room 36 for CEP</td>
<td>$30.06</td>
<td>N/A</td>
<td>$30.06</td>
</tr>
<tr>
<td>N/A</td>
<td>Srinath Sibi</td>
<td>11/16/2014</td>
<td>PRL Woods hop</td>
<td>Modulant for machining prototypes for CEP</td>
<td>$20.25</td>
<td>N/A</td>
<td>$20.25</td>
</tr>
</tbody>
</table>
Figure 7.3: Project Spending in the Fall Quarter

For the winter quarter, the proposed spending is shown below.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Money Spent on</th>
<th>Proposed Spending Date</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dark Horse Prototype</td>
<td>Materials and Manufacturing</td>
<td>18\textsuperscript{th} Jan to 31\textsuperscript{st} Jan</td>
<td>$500</td>
</tr>
<tr>
<td>FUNK-tional Prototype</td>
<td>Materials and Manufacturing</td>
<td>1\textsuperscript{st} Feb to 14\textsuperscript{th} Feb</td>
<td>$500</td>
</tr>
<tr>
<td>Functional Systems ( 2 iterations )</td>
<td>Materials and Manufacturing</td>
<td>14\textsuperscript{th} Feb to 5\textsuperscript{th} Feb</td>
<td>2 x $500</td>
</tr>
<tr>
<td>Build model for pilot tests</td>
<td>Materials and Manufacturing</td>
<td>6\textsuperscript{th} Feb to 21\textsuperscript{st} Feb</td>
<td>$1000</td>
</tr>
<tr>
<td>Send Model to SA</td>
<td>Shipping</td>
<td>22\textsuperscript{nd} March</td>
<td>$500</td>
</tr>
</tbody>
</table>

Figure 7.4: Proposed Spending for Winter Quarter

7.4 Distributed Time Management

In order to better manage the time, we planned during the fall quarter to split the team into two parts, so that each part could travel to the two places that were vital to the project. We decided that Srinath and Jade would travel to the regions of interest for need-finding and Daniel would travel to the University of St. Gallen to meet with the global team during the middle of the winter quarter and possibly the Merck corporate team in Darmstadt. The St. Gallen team would also be traveling to South Africa but at a different time and they would more time than Srinath and Jade in Johannesburg.

For the purposes of considering multiple solutions, we decided that the St. Gallen Teams and the Stanford Teams would consider different solution paths to the problem statement. For the initial need-finding and CFP and CEP exercises, the Stanford Team worked on the Inhaler design as shown in previous sections. The St. Gallen worked on an
inhaler that provides the user nasal decongestion and has a concealer attachment that can be used to conceal cold sores and red noses.

7.5 Reflections and Goals

7.5.1 Danny Concha

Since beginning our ME310 project I have already experienced that inevitable “roller coaster” feeling of designing a product. Our project has had unexpected twists and turns already. Throughout the quarter, our team often found ourselves somewhat confused about the goals and target of our project. Due to some struggles in communicating with our corporate liaison and with Merck, our team had to make knowledgeable decisions about which direction to take our project. For example, our need finding research indicated to us that our target demographic is not Western-fearing as Merck had suggested, but rather embraces Western technology and innovation. In order to make such a claim and to feel justified in pursuing this route (without being able to discuss our findings with Merck), our team had to gather many concrete resources (such as first hand interviews) to support our conclusion. By placing this added responsibility on ourselves, I found that our team was therefore forced to conduct very detailed research—something I am very proud of.

One of the most important lessons I have learned from this quarter, is that change is not bad, and that adapting to a new approach does not imply that all of your previous work is wasted. In just the past couple of days, Merck has asked us to revamp our initial design ideas for the next quarter and to approach the solution from a new angle. At first, this was very frustrating, as our team felt that all of our work would be lost. But we very quickly found that very much of it could be directly transferable—everything from functional components of the device to the need finding background and info we learned about South African culture as a whole. I am starting to understand how these minor setbacks can actually serve to propel our ideas forward, leading to an even better product which both satisfies Merck’s goals, and our team’s personal goal of making a big difference in South African healthcare.

7.5.2 Jade Fernandez

Before taking this course, I considered ME 310 to be too similar to my undergraduate experience as a Product Design Engineer. However, after one quarter of this course, I have learned more than I ever imagined. An immense amount of this came from the people I am working with. The project itself is also a very captivating and insightful topic. I had no idea about medical devices or South Africa for that matter. After doing my due diligence, I discovered so much more about a broad range of topics.
Our efforts began while doing paper robots. I think the roles we took in the final project were first pronounced in this challenge. It was a good experience to learn more about my teammates and how we worked together. Because we are very diverse in background and only a group of three, each of us has established a very different role in the project that will allow us to be more successful.

Initially, we had difficulty determining the scope of our project. It was very open-ended, but we wanted to do something that was totally different than what anyone in the market had put out. We finally decided on wearable technology. Inhalers have an innate stigma that is associated with them. People can sometimes view the user as weak or unhealthy. Our goal is to develop something really cool that people would be excited to use.

We hope to discover more about our project as we travel to South Africa this winter break. Not only will we be doing user interviews, but also user testing. This will hopefully give us insights on how to better determine and develop the direction we want to take with this project.

7.5.3 Sri Sibi

After a quarter of design exercises and product development, I now have a lot of appreciation for team work and the 310 process itself. The project prompt that was given to us was designed for a country whose population, customs and traditions we were unfamiliar with this. Despite this, the team rallied and within a short period of time we were able to get in touch with a lot of South African Nationals who gave us a very good idea of what we were up against.

Initially, we had some communication issues with our global team and our corporate team due to the significant differences in space and time. Also our approaches to the problem were different due to differences in our background. But after going through a lot of design exercises, I have now come to appreciate the ambiguity and the variety in approaches. As evident with market trend of new technology, wearable devices are fast becoming popular and our decision to incorporate this idea into the project solution was truly exciting move.

For the next quarter, I hope that we can converge on an idea that we all like. This project has the potential to affect significant changes in the health care systems in the countries across Africa and we are very excited to to take part in it.

7.5.4 Philipp Elbel

As a trip to South Africa was not possible during the actual needfinding phase our primary goal for interviews, observations, engagements and research activities was to get insights about the causes and symptoms of a cold and the way non-users of nasal sprays treat them in Switzerland.
Apart from other application of chemical medicine, we found that many people use homemade remedies. I find it impressive how diverse and creative the ingredients and applications of these remedies are and how much time some people invest to treat their diseases even if there are quick, easy and convenient solutions as nasal sprays. That made me understand that for some people doing something for their own health has a character of a profound ritual.

Our challenge has the advantage that almost everybody can tell you something about colds and personal treatment experiences. That made it easier for us to find people as partner for longer and shorter interviews but also contributed to a great diversity of (sometimes contradicting) insights. I really like the approach to speak with people instead of doing desk research only as it is common for most of project works at university.

We could obtain first insights about the South African culture by interviewing expats, experts and some South Africa based students by Skype. However, most of the interviewees did not belong to the particular target group as we had hoped at the beginning. Nevertheless, these findings provide us with a good base for further needfinding and prototype testing during our trip to Johannesburg. The goal for this trip is definitely to challenge made assumptions about the target group’s living standard, their values and attitudes and enrich our needfinding results with more target group specific insights. This also means to revise or complete our personas and benchmarks.

What I liked was the process of analyzing our collected needfinding information for patterns and important insights as the first step of the prototyping phase. That process inspired me a lot, as it gave me a broader picture and a new perspective on our findings. I am quite surprised about the amount of prototypes and the diversity of ideas we came up with. The principle of going for quantity instead of quality differs from the concepts we normally learn at our business school. The same is true for the feeling of not knowing of how our final prototype will look like. At other project work, I mostly had a specific final idea in my subconscious mind based on knowledge and feelings. The actual work was then to underlay these ideas with suitable data without having to change the idea too much. In this way, assumptions are not challenged but reinforced what narrows the focus and decreases the plausibility of the work.

Especially at the beginning, our two team parts - Stanford and St. Gallen – had a slight different perspectives on the project and its goals. Probably this is linked to a diverse understanding and teaching of the Design Thinking approach. I think especially for the diverging phase, this issue has a positive impact on our work as it constantly challenges each other’s research focus. On the other hand, it made the coordination and collaborative work between the two parts of our team a bit more difficult. However, I am very confident that we can solve this issue in the next project phase.
7.5.5 Jasmine Bissig

When I signed in for the course design thinking, me310 respectively, I was expecting two things in particular: A lot of hard work and highly interesting experiences. Both not only came true but it showed that this year will even be harder and more interesting than I had imagined. It’s not the actual hours I spend working for me310 that makes it so demanding, it is the fact that the challenge we received from Merck is on my mind day and night. I start to see nasal sprays everywhere. When I talk to people I find myself asking what they do when they have a cold, which was definitely not my topic of choice some weeks ago.

The cooperation with Merck is one of the many things that surprised me in a positive way. I feel like our liaison Luc van der Hayden is as excited about the project as we are. Everyone at Merck we had the chance to see or hear was very open, cooperative and helpful.

I couldn’t be happier about the challenge either. We are given the opportunity to learn a lot about the south african culture not to speak of the chance to actually go there. Another thing I really like is that the challenge is about a product. We as business students are not used to think that tangible and technical.

I can learn a lot out of the remote team work, which I only knew out of theory so far, as well. It is great to get to know the way of working of the engineering students which comes often from another angel than ours in St. Gallen. To rely on Skype and other technical tools for the communication makes it sometimes challenging to exactly know what everyone is doing, thinking, feeling and so forth. That we met in Stanford at the beginning was a big plus.

7.5.6 Carolyn Ragaz

When I signed up for ME310 at the University of St.Gallen, I was expecting to participate in an exciting project and get a glimpse of the real working life due to the collaboration with a corporate partner. I was especially interested in the human-centered Design Thinking approach. Since I was focusing on Marketing during my Bachelor's in Business Administration, I was expecting to talk to a lot of different stakeholders to get a broader understanding about their needs and interests when it came to our challenge.

I would not have expected to work for such a great corporate partner like Merck and get such an interesting challenge. I did not know a lot about the healthcare market and I have never been to South Africa before. This was a big value add to get to know a new industry and a new country which is very different to Switzerland. In fact, I'm excited to do further need finding and prototype testing in South Africa and I cannot wait to get to know the South African market and understand the consumer's needs.
Additionally, I like working in a global team which ME310 made possible. I have learned to communicate over almost 10,000 km and nine hours time difference. It is not always easy to share all our thoughts and ideas within a global team. However, I think it is extremely interesting to get to know various insights about the same challenge, especially when you have different study backgrounds in one global team.

Overall, ME310 exceeded my expectations and I’m happy to get the chance to work within our global team on this unique challenge for the next six months.

7.5.7 Rouven Gruenig

Before starting the Design Thinking course I had numerous expectations since I heard much about it from former students which were all excited and strongly recommended me to take the course. Now having completed the first months I must admit that this enthusiasm has fully caught me. Not only do I appreciate the creative approach on tackling such a challenge but also the great collaboration in an international team.

The challenge we got from Merck is highly fascinating and insightful to me. At the beginning, I did not only have any experience in working on a pharmaceutical project, but also our target market South Africa represented a blank spot on my map of countries that I have already visited. In fact, this project was like a blue ocean to me.

Since blue oceans are the best places to innovate I was highly motivated to start exploring and gathering as much information as possible. What I especially liked in this stage was that we extended the classical desk research with meaningful interviews. This human-centric approach enabled us to identify the true needs of people.

The next phase was ideation. The brainstorming techniques we learned from our teaching assistants seemed to be truly helpful. Within a short time we were able to collect a vast amount of ideas which I would have never expected to happen. As most of the ideas were truly great it was then difficult for us to decide on which ideas we are going to prototype.

Prototyping was something completely new to me. As a business student I have never physically built anything. However, it made a lot of fun and enabled me to be highly creative. Also, I am well aware of the unique advantages that a prototype has.

Overall, these months were very instructive to me. Especially, I got to know various methods and techniques of how to tackle a challenge that seems to be a blue ocean. In addition, I learned how to work in a global team in which people have diverse backgrounds. Hence, I look forward to the next months which will be even more thrilling!
8 References

8.1 Bibliography


8.2 Image Sources

1.) http://nokautimg2.pl/p-e3-c0-e3c01ed8ab41c46cf8b41594e7093cde500x500/nasivin-soft-0-025-aerozol-do-nosa-z-glicerolem-dla-dzieci-od-1-do-6lat-220dawek-10ml.jpg

2.) http://nokautimg2.pl/p-e3-c0-e3c01ed8ab41c46cf8b41594e7093cde500x500/nasivin-soft-0-025-aerozol-do-nosa-z-glicerolem-dla-dzieci-od-1-do-6lat-220dawek-10ml.jpg
3.3 Video Sources


9 Appendix

Valuable Quotes Regarding Racial Division and Race in Society

“The black middle class in South Africa is fast growing and quickly expanding”—Stephen Reid

“Market [the inhaler] as a way to become better, stronger, more Westernized, and people will want it”—Stephen Reid

“The black middle class often aspires to what the white middle and upper class have”—Mike Blum

Valuable Quotes Regarding Healthcare

“The quality of care is very poor in the local health clinics…sometimes people have to bring their own blankets and sheets”—Mike Blum

“In rural areas, it is easier for people to visit the traditional healer than local health clinics”—Margaret Irving

“Given the average household income, to many, medicine is simply not affordable”—Margaret Irving

“People in South Africa have really come to rely a lot on the pharmacist behind the counter to serve as their main source of medical advice”—Jean Fourie

Valuable Quotes Regarding Technology and the Perception of Inhalers

“Everyone in South Africa has a phone. They may not have food, or a house, but they have a phone”—Margaret Irving

“People often use their phones for banking. It’s a system that’s been in use for a long time, even before apps like Venmo existed”—Stephen Reid

“I’d rather do an open water swim than inhale chemicals. I’m tired of putting crap into my body, I guess I’m just stubborn”—Sean MacDonald.
“Things like inhalers or devices which require instructions are very difficult to package in South Africa—you need to account for the 11 languages which increases the complexity of getting an idea across.” - Jean Fourie