DEVELOPMENT OF NOVEL BREATHING PROTECTION FOR URBAN CHINA

Preliminary Report
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Degree 2014
AIR POLLUTION IN CHINA

Scope
The scope for this project will be to explore, define and satisfy the current need for protection devices against air pollution. The outline for the project will be to explore the matter from an entrepreneurial perspective where the level of feasibility will be of great importance. Cost efficiency, branding and market are all important factors that should align with the product design process and outcome.
Problems Identified

In 2012, the president of the China Medical Association warned that air pollution could become the biggest health threat to the Chinese population. Lung cancer and cardiovascular disease were increasing because of factory and vehicle air pollution. Air quality is measured through the Air Quality Index (AQI) that runs from a level of 0-500, the higher AQI value, the greater the level of air pollution.

As a comparison, in 2010 spike tires got prohibited at Hornsgatan in Stockholm since AQI levels reached 40. Meanwhile, there have been occasions where levels as high as 500 have been measured in Beijing. This has forced the population to wear military gas masks on a daily basis to prevent the polluted air from causing significant medical conditions.

The Product

In order to challenge the problems associated with wearing filter masks, a holistic research of the available solutions has to be initiated initially. This process will identify the flaws and problems with today’s products. The main problems associated with wearing today’s solutions are based on comfort, bad filtering and intimidating appearance.

Therefore a major part of the research process will be aimed towards ergonomics, alternative filtering solutions and materials/aesthetics. Nevertheless, the ultimate goal of the product should be to prevent medical conditions associated from everyday exposure to polluted air, therefore a filter mask might not be the only or ultimate solution. Moreover, due to the set desire of incorporating feasibility and business opportunities, the general product outline must be defined early on in the process.

Another important aspect to deal with is the social context. Can a product like this become fashionable? Is this just a piece of wearable technology or is it a product stating human failure? Analyzing the outcome from what an impact on our views and discussions around the environmental issue is another vital part to this project.

PROJECT SCOPE

Dealing with air pollution in emerging markets from a business & design perspective.

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The Entrepreneurial Angle

As the project scope description states the project would be conducted from a business perspective. The initial goal was that the project would be executed in two steps. The first step was to create a design concept through the methods and techniques commonly used by designers today. The second part will focus on creating a brand, find out production methods and costs and to target a viable market. Therefore in the first step, the “desired” product will be tailored and changed in the later step for various reasons such as; prioritizing cost, using, cost efficient materials, fit the market and work from a technical standpoint.

As a summary, the desired final outcome of this degree project was to have a branded prototype along with a project report that a business plan can be based on. Moreover to have an idea of the possibilities of production and a deeper understanding of the market the product is targeted towards.

All of this should be part of a foundation for a continuation of this project, where the work made in the degree project can either be a basis for seeking money to realize the project, or discard it if the figures does not match.

Social Relevance

Air pollution is a problem of great significance in many parts of the world. In 2010 the World Health Organization (WHO) estimated that 223,000 people around the world died from lung cancer caused by air pollution. The need in the matter is that people living in polluted areas need breathing protection when commuting to work, doing outdoor activities, shopping etc. There are many solutions out on the market already, but the lack of human centred focus is evident since a major part of the solutions are masks intended for industrial and medical use in extreme environments. The consequences of the matter are that some masks are not intended for daily exposure to PM2.5 (particles with an aerodynamic diameter less than 2.5 μm), does not have the comfort required for daily use, are hard to breathe in during use and does not offer perfect seal which is crucial.

Attempts have been made by different stakeholders to fit the product into a context of friendly appearance and familiarization by choosing patterns and prints to take away the intimidating appearance.

This project will not focus on fighting the root of the problem, in other words the cause of air pollution itself (coal burning, heavy traffic). This project should rather function as a reaction to the human mistakes made and fight the symptoms of the matter from a social context. Therefore, the main reason why the project is relevant to society is to save people from developing medical conditions. In the meantime, an interesting aspect is whether the idea of making filter masks fashionable and desirable could raise a debate around the root of the problem and more importantly, how to deal with it? Another aspect could also lie within the question whether the outcome will make air pollution acceptable and part of our social culture? Nevertheless the situation is critical and will probably not change over the next couple of decades to come since radical changes moving into clean, renewable energy supply must be initiated and will take time to implement.
General Perspective

China’s rapid economical growth is based on utilizing fossil fuel. Coal is the main energy source in China providing energy to 1.3 billion people. This has led to that 70% of all Chinese cities can not meet their air quality standards. Burning coal is the main cause of air pollution, in 2012 China alone consumed as much coal as the world combined. Increase in transport and construction are also significant reasons to the problem.

A study from the Asian Development Bank and Beijing’s Tsinghua University suggests that China is home to seven of the world’s 10 most polluted cities. Various studies show that illness, premature deaths and loss in productivity cost the Chinese government approximately $100 billion a year.

Individual Perspective

Face masks are an everyday product in China and serve a broad range of needs ranging from self protection to health etiquette.

Protecting the airways from polluted air, cold weather, sun or viruses is a common behavior in countries like China, Japan, South Korea and Japan.

Business Perspective

Ever since the Chinese government decided to address the undeniable issue, masks have sold out within days. Applications and services monitoring air pollution have boomed. According to BBC, masks have become the new fashion on Beijing’s streets.

The number of online searches for the word “mask” jumped by 53040 percent in January 2013. According to figures released by Taobao, the biggest online shopping site in China. There are more than 100,000 masks being sold every day in Beijing alone during the worst days of air pollution.
Atmospheric particulate matter – also known as particulates or particulate matter (PM) – are tiny pieces of solid or liquid matter associated with the Earth’s atmosphere. They are suspended in the atmosphere as atmospheric aerosol, a term which refers to the particulate/air mixture, as opposed to the particulate matter alone.

Some particulates occur naturally, originating from volcanoes, dust storms, forest and grassland fires, living vegetation, and sea spray. Human activities, such as the burning of fossil fuels in vehicles, power plants and various industrial processes also generate significant amounts of particulates. Coal combustion in developing countries is the primary method for heating homes and supplying energy.

The effects of inhaling particulate matter that have been widely studied in humans and animals now include asthma, lung cancer, cardiovascular issues, respiratory diseases, birth defects, and premature death. The size of the particle is a main determinant of where in the respiratory tract the particle will come to rest when inhaled. Because of their small size, particles on the order of ~10 micrometers or less (PM10) can penetrate the deepest part of the lungs such as the bronchioles or alveoli. Larger particles are generally filtered in the nose and throat via cilia and mucus, but particulate matter smaller than about 10 micrometers, referred to as PM2.5, can settle in the bronchi and lungs and cause health problems. The 10 micrometer size does not represent a strict boundary between respirable and non-respirable particles, but has been agreed upon for monitoring of airborne particulate matter by most regulatory agencies.

Similarly, particles smaller than 2.5 micrometers, PM2.5, tend to penetrate into the gas exchange regions of the lung, and very small particles (< 100 nanometers) may pass through the lungs to affect other organs. Penetration of particles is not wholly dependent on their size; shape and chemical composition also play a part. To avoid this complication, simple nomenclature is used to indicate the different degrees of relative penetration of a PM particle into the cardiovascular system. Inhaleable particles penetrate no further than the bronchi as they are filtered out by the cilia. Thoracic particles can penetrate right into terminal bronchioles whereas PM which can penetrate to alveoli and hence the circulatory system are termed respirable particles.
Sulfur oxides (SOx)
Partially sulfur dioxide, a chemical compound with the formula SO2. SO2 is produced by volcanoes and in various industrial processes. Coal and petroleum often contain sulfur compounds, and their combustion generates sulfur dioxide.

Nitrogen oxides (NOx)
Nitrogen oxides, particularly nitrogen dioxide, are expelled from high temperature combustion and are also produced during thunderstorms by electric discharge. They can be seen as a brown haze dome above or a plume downwind of cities. Nitrogen dioxide is a chemical compound with the formula NO2. It is one of several nitrogen oxides. One of the most prominent air pollutants, this reddish-brown toxic gas has a characteristic sharp, biting odor.

Carbon monoxide (CO)
CO is a colourless, odourless, toxic yet non-irritating gas. It is a product by incomplete combustion of fuel such as natural gas, coal or wood. Vehicular exhaust is a major source of carbon monoxide.

Volatile organic compounds - VOCs
They are categorized as either methane (CH4) or non-methane (NMVOCs). Methane is an extremely efficient greenhouse gas which contributes to enhanced global warming. Other hydrocarbon VOCs are also significant greenhouse gases because of their role in creating ozone and prolonging the life of methane in the atmosphere. This effect varies depending on local air quality. The aromatic NMVOCs benzene, toluene and xylene are suspected carcinogens and may lead to leukemia with prolonged exposure. 1,3-butadiene is another dangerous compound often associated with industrial use.

Particulates
Alternatively referred to as particulate matter (PM), atmospheric particulate matter, or fine particles, are tiny particles of solid or liquid suspended in a gas. In contrast, aerosol refers to combined particles and gas. Some particulates occur naturally, originating from volcanoes, dust storms, forest and grassland fires, living vegetation and sea spray. Human activities, such as the burning of fossil fuels in vehicles, power plants and various industrial processes also generate significant amounts of aerosols. Averaged worldwide, anthropogenic aerosols—those made by human activities—currently account for approximately 10 percent of our atmosphere. Increased levels of fine particles in the air are linked to health hazards such as heart disease, altered lung function and lung cancer.
The soluable part of PM2.5 directly enters the bloodstream and the insoluable part accumulates at the alveolus of the lungs, causing inflammation.

**Respiratory System**
PM2.5 causes cardio-toxicity and also causes severe irritation to the autonomic nervous system, which regulates the activity of the heart muscle.

**Cardiovascular System**
Various types of pollutants such as heavy metal and PAHs, causing placental blood toxicity that leads to direct harm to fetus, intrauterine growth retardation, and low birth weight of babies.

**Reproductive System**
PM2.5 causes blood toxicity, blood coagulation abnormalities and can trigger heart disease.

**Blood System**
PM2.5 causes blood toxicity, blood coagulation abnormalities and can trigger heart disease.

Wearing N95 masks can provide effective protection against PM2.5 when worn correctly with a tight seal around the face.

**Time of Day**
Reduced outdoor physical activity is advised, especially from dawn till dusk.

**Air Purifier**
For indoor purposes the population is advised to use air conditioners or air cleaner set to inner-circulation.

**AQI**
Having updated information about the Air Quality Index is a good way of knowing when to avoid the outdoors.

Image courtesy of Greenpeace
General Overview

A respirator is a device designed to protect the wearer from inhaling harmful dusts, fumes, vapors, or gases. Respirators come in a wide range of types and sizes used by the military, private industry, and the public. Respirators range from cheaper, single-use, disposable masks to reusable models with replaceable cartridges.

There are two main categories: the air-purifying respirator, which forces contaminated air through a filtering element, and the air-supplied respirator, in which an alternate supply of fresh air is delivered. Within each category, different techniques are employed to reduce or eliminate noxious airborne contents.

Modern Respirator Technology

All respirators have some type of facepiece held to the wearer’s head with straps, a cloth harness, or some other method. The facepiece of the respirator covers either the entire face or the bottom half of the face including the nose and mouth. Half-face respirators can only be worn in environments where the contaminants are not toxic to the eyes or facial area. For example, someone who is painting an object with spray paint could wear a half-face respirator, but someone who works with chlorine gas would have to wear a full-face respirator. Facepieces come in many different styles and sizes, to accommodate all types of face shapes, and there are many books and references available for determining which kind of hazard requires what type of respirator.
Air Purifying Respirators

Air-purifying respirators are used against particulates (such as smoke or fumes), gases, and vapors that are at atmospheric concentrations less than immediately dangerous to life and health. The air-purifying respirator class includes:

- Negative-pressure respirators, using mechanical filters and chemical media
- Positive-pressure units such as powered air-purifying respirators (PAPRs)
- Escape Only respirators or hoods such as Air-Purifying Escape Respirators (APER) for use by the general public for chemical, biological, radiological, and nuclear (CBRN) terrorism incidents.

Full hood, half- or full-facepiece designs of this type are marketed in many varieties depending on the hazard of concern. They use a filter which acts passively on air inhaled by the wearer. Some common examples of this type of respirator are single-use escape hoods and filter masks. The latter are typically simple, light, single-piece, half-face masks and employ the first three mechanical mechanisms in the list below to remove particulates from the air stream. The most common of these is the disposable white N95 variety. The entire unit is discarded after some extended period or a single use, depending on the contaminant. Filter masks also come in replaceable-cartridge, multiple-use models. Typically one or two cartridges attach securely to a mask which has built into it a corresponding number of valves for inhalation and one for exhalation.

### Penetration of commercially available filters: 3 M Dust Respirator 8812, Dust Respirators A and B, Cyclist Masks A to D. The Teflon filter is an industry standard filter for aerosol studies included as a control. Cotton handkerchiefs and surgical masks are often seen worn in public areas in parts of Asia.

**Research study by:** Centre for Cardiovascular Sciences, Edinburgh University, Edinburgh, UK.
PRODUCT STUDY

3M Mask 3M™ Aura™ Particulate Respirator
9211+

Being the current market leader in particulate respirators, 3M was found to be a great product to examine for inspiration and for solutions. The reason for being market leading 3M states is because the following information:

- N95 Approved filtering facepiece particulate respirator
- Designed to direct exhaled air away from the nose panel, helping reduce eyewear fogging
- 3M™ CoolFlow™ Valve keeps wearer cool
- Comfortable braided headbands help keep respirator securely in place and minimizes pulling of hair
- Curved low profile design conforms well to nose and eye contours, allowing more room for eyewear
- Individual packaging and flat fold design provides convenient storage and portability
- Soft inner materials
- Compatible with a variety of eyewear
- Adjustable noseclip helps provide a custom secure seal

As an attempt to create respirators more for everyday commuting compared to the industrial appearances found today, the Singaporean company Totobobo developed a mask that is claimed to ensure perfect fit, reusability and transparency showing the face. The mask can be washed and filters are exchangeable. The filters get a gray color absorbing particles during use, working as a guide for the user to ensure when filters need to be changed. According to Totobobo their mask is unique due to the following features:

- World’s first customizable mask
- Transparent, seal check is easy and accurate
- Very flexible and comfortable to the skin, superior fit due to the SoftTech material
- By far the lightest reusable respirator. Weight only 20 grams
- Super elastic strap, most comfortable and durable
- Reproduction of bacteria or virus is prohibited on the surface of the mask, thanks to the anti-virus additive.
The respirator market is flooded with different solutions mainly intended for industrial use. Listed is an overview of the most popular solutions adaptable and/or made for daily use protecting from urban air pollution. The products listed are featured with high ratings on popular e-shops such as taobao.cn, amazon.cn, jd.com and dangdang.com.

3M AURA 10 pack $25
3M™ Aura™ Particulate Respirator 9211+/37193(AAD) N95

MOLDEX 2300 10 pack $25
Moldex 2300N95 Disposable Particulate Respirator N95 Dust Mask

RZ Mask $30
RZ Mask Active Carbon Filters, Black, Regular

3M AURA 10 pack $25
3M™ Aura™ Particulate Respirator 9211+/37193(AAD) N95

3M HEPA Mask $30
3M® HEPA Mask

3M HEPA Mask

3M 8210 20 pack $26
3M 8210 N95 Respirator, 20-Pack

Colorful Paws $14
Colorful Paws Mask - (Child Size) By Breathe Healthy® Masks

VOGMA$20
Classic Microfiber Vogmask (8bit)

VOGMA$30
N95 Filter Active Carbon Exhale Valve (Black)

TOTOBOBO $30
Totobobo Classic Anti Pollution Cyclist and Motorcyclist Mask

NEOMASK $40
NeoMask - Neoprene Carbon Mask - Multi-Purpose Dust Mask

BLACK CARBON Mask $8
Basic Black Carbon Filter Face Mask

BLACK CARBON Mask $8
Basic Black Carbon Filter Face Mask

ICB Honeycomb Mask with Classic Filter

ATV TEK PRO $23
ATV TEK Pro Series Rider Dust Mask # PSRD1

VOGMA$30
N95 Filter Active Carbon Exhale Valve (Black)

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NeoMask - Neoprene Carbon Mask - Multi-Purpose Dust Mask

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Basic Black Carbon Filter Face Mask

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Basic Black Carbon Filter Face Mask

ICB Honeycomb Mask with Classic Filter
An air quality index (AQI) is a number used by government agencies to communicate to the public how polluted the air is currently or how polluted it is forecasted to become. As the AQI increases, an increasingly large percentage of the population is likely to experience increasingly severe adverse health effects. Different countries have their own air quality indices which are not all consistent. Different countries also use different names for their indices such as Air Quality Health Index, Air Pollution Index and Pollutant Standards Index.

Air quality is defined as a measure of the condition of air relative to the requirements of one or more biotic species or to any human need or purpose. To compute the AQI requires an air pollutant concentration from a monitor or model. The function used to convert from air pollutant concentration to AQI varies by pollutant, and is different in different countries. Air quality index values are divided into ranges, and each range is assigned a descriptor and a color code. Standardized public health advisories are associated with each AQI range.

The AQI can go up (meaning worse air quality) due to a lack of dilution of air pollutants. Stagnant air, often caused by an anticyclone, temperature inversion, or low wind speeds lets air pollution remain in a local area, leading to high concentrations of pollutants and hazy conditions. An agency might encourage members of the public to take public transportation or work from home when AQI levels are high. Most air contaminants do not have an associated AQI. Many countries monitor ground-level ozone, particulates, sulfur dioxide, carbon monoxide and nitrogen dioxide and calculate air quality indices for these pollutants.

**AQI Scale:**

<table>
<thead>
<tr>
<th>AQI Value</th>
<th>Description</th>
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<tbody>
<tr>
<td>0 - 50</td>
<td>Good</td>
</tr>
<tr>
<td>50 - 100</td>
<td>Moderate</td>
</tr>
<tr>
<td>100 - 150</td>
<td>Unhealthy (Sensitive Groups)</td>
</tr>
<tr>
<td>150 - 200</td>
<td>Unhealthy</td>
</tr>
<tr>
<td>200 - 300</td>
<td>Very Unhealthy</td>
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<tr>
<td>300+</td>
<td>Hazardous</td>
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</table>
I went to China in order to see for myself how air pollution affects the daily lives of people. The first stop was Beijing where I met up with regular people for interviews followed by a visit to Volvo Design China in Shanghai to investigate trends. Ethnographic research for 10 days, 14 people interviewed, 12 masks bought.
In order to gain a clearer insight regarding the product, the users and their daily life being surrounded with polluted air, I traveled to Beijing, China and met up with regular people to see how air pollution protection could be improved.

**Ask - User Interviews**
Find people who use versus does not use air pollution protection, obtain trust in order to evaluate their decisions and experiences using the product. Find out about their daily habits dealing with air pollution and ask what kind of improvements the users would like to gain. Ask what they look for when buying the product and what drives their decisions to pick a certain brand or product type.

**Look - User Observations**
Participate in the users daily lives and spend time with them in order to look for and find certain patterns when using the product. Are there any particular repetitive rituals or activities that occur while using the product, or obtaining information about air pollution or choosing a product from the shelf.

**Try - Self Evaluation**
Use the product or prototype I am designing. What are the constrains, flaws and immediate problems I experience. What is good about the existing product and its features?

**Ask - Dealer Interviews**
Interview the people that provide the product. Which type of product is the most popular and why? Are there certain styles, patterns, technical solutions that are more lucrative for the business than others?

**USER RESEARCH**

**Method**

Where does the pm2.5 in Beijing come from?

**ETHNOGRAPHIC RESEARCH BEIJING**

**AIR QUALITY INDEX (AQI) BEIJING CHINA**

January 2013

- Good
- Moderate
- Unhealthy Sensitive Groups
- Unhealthy
- Very Unhealthy
- Hazardous

<table>
<thead>
<tr>
<th>Pollutant Type</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Industrial emissions</td>
<td>4.5%</td>
</tr>
<tr>
<td>Coal pollution</td>
<td>16.3%</td>
</tr>
<tr>
<td>Urban fugitive dust pollution</td>
<td>16%</td>
</tr>
<tr>
<td>Rural straw burning</td>
<td>16.7%</td>
</tr>
<tr>
<td>Pollutions from districts around Beijing</td>
<td>22%</td>
</tr>
<tr>
<td>Direct and Indirect vehicle emissions</td>
<td>24.5%</td>
</tr>
</tbody>
</table>
Chang He
Chang is a business student. She is worried about how the air affects her health in general but wears her masks as little as possible, mainly for comfort and esthetical reasons.

"Soon after I’ve put on the mask it gets warm and soggy inside, and when I take it off I have this red border around the lower part of my face, unfortunately you’re willing to sacrifice health for comfort sometimes”

Chang describes that the air quality is disastrous in Beijing, she comes from Shanghai where the air quality is slightly better.

"Since the bad air is part of everyday life, it’s easy to get used to and therefore disregard”

The biggest inconvenience for Chang is the fact she can not wear the mask at all times, for her the optimal solution would be something comfortable that she could wear on i.e the train while often transiting from outdoor to indoor environments.

"You keep the mask on in the train or while strolling through a mall because once you have the straps and positioning in order it's so annoying to take off and put on again.”

Jin Xiaoxiao
Jin is an interaction student and is very aware and protective of her health. Her parents remind her frequently from time to time to change her respirator once the filter has lost its filtration capability. Jin uses a mask made out of fabric, she finds this type of mask the most comfortable. Unfortunately it usually does not fit her face.

"I know that when I wear the mask it doesn't give me a perfect fit. Space is created between my nose and cheek and i can smell the fumes upon breathing”.

"I think that frightening propaganda or communication could make people more aware about the situation".

Jin is also concerned about the waste produced from the respirators she is throwing away on monthly basis. She explains that she would pay a much higher price for a reusable solution that can last for a “lifetime”.

"If I’d add up all the respirators I’ve thrown away during a lifetime, I’d wonder how much air pollution the manufacturing of those masks created to protect me in the first place ”.
TAKE AWAYS
BEIJING

HIGH AQI LEVELS

Highest levels of AQI I experienced during my stay in Beijing. It smelled like burnt iron.

501 HAZARDOUS AQI

Masks can be considered as fashionable sometimes. Subcultures where military masks are worn as fashion accessories are growing. This, to proclaim and state the negative effects of air pollution.

MASKS AS FASHION

SHOPPING ONLINE

The users explain that the main way of purchasing masks is via internet. Taobao.com, dangdang.com, amazon.cn etc.

CERTIFICATIONS

Shops rate and display certifications in order to proof quality and authenticity. The users I interviewed explained that this is the main way of trusting a physical retailer.

MASK COMES OFF

It is considered disrespectful when conversing with your mask on, therefore the mask always comes off before talking.

HIGH AQI LEVELS

It is considered disrespectful when conversing with your mask on, therefore the mask always comes off before talking.

GERMS & MASKS

Masks in China come in different designs intended for different areas and are accepted in Chinese culture. The mask that the woman in the photo is wearing is to protect the food she is preparing from saliva.

KELLY

Kelly is a hotel owner and a very aware user of air pollution protection. Before using her 3M™ Aura™ Particulate Respirator 9211+ on a daily basis she tried out many masks in order to ensure that it fitted her needs and ergonomic preferences.

“1 tried many masks before deciding on purchasing big quantities. Since I wear glasses, the valve window comes in handy while exhaling. It’s also light and takes up very little space”.

Kelly lost her husband some years ago. He passed away suffering from lung cancer. This has according to herself made her exceptionally aware of the importance of protecting ones lungs from air pollution. When meeting visitors and tourists at her hotel, she usually advises them to wear masks and keeps them updated regarding air pollution forecasts.
For the sake of obtaining an adequate overview of the demand and available solutions on the physical market, research was performed on-site investigating where masks are bought, cost per unit and how they are promoted in stores. The field research showed three main buying spots for masks: Outdoor markets and smaller shops, Bike shops and pharmacies.

The main goal of the retail investigation was to find different segments of retailers. Some more high-end and some on the lower end of the scale. The majority of the shops were found in the lower segments where the most advanced masks were found in bike shops.

The Outdoor Market
A paradise for counterfeit masks. Here masks intended for keeping the face warm are mixed with counterfeit N95 masks. All masks are marketed as protecting from air pollution but when investigating the selection further on the web, it was found that all of these were counterfeit and did not work for filtration at all.

The Bike Shop
This was the most high-end retail spot found during my retail investigation in Beijing. The bike shop had a wide selection of Respro Masks, currently market leading in the sports segment, but the bike shop girl explained that all kinds of people use them for regular commuting. The brand comes from the UK and is considered very trustworthy. The average mask retails for 548 Yuan (550 SEK) and two add on filters are bought for 169 Yuan (170 SEK).

The Pharmacy
Sells medical masks and carbon filter respirators.
In order to investigate market segments, trends and information that could be valuable from a strategic point of view, I met up with Lars Falk, Vice President Product Design, Volvo Cars China. I got in contact with Volvos trend and marketing departments to further research trends in China, customer values, colors, patterns and how to market and design Scandinavian products aimed for China.

Salaries grow by 8-9% annually.

The people of Shanghai have the highest standard of living in China.
Lars Falk

As a foreigner from Sweden, living and working in Shanghai, one of the most dense and polluted cities in the world Lars Falk views himself as very aware of air pollution. Having moved to China with his family consisting of him, his wife and two children (one newborn), Lars is facing and tackling air pollution daily. His biggest worry is the long-term health impact on his children’s in the long run.

“We don’t take Linna (3 year old daughter) out more than we need to, only cases where we have to do it, such as doctors appointments or visits to the Swedish Consulate for instance”

“We try too keep 150 AQI as our limit, if it’s above that we don’t let the kids out at all”.

“My wife wants the kids to wear masks, but I don’t like wearing them”.

Furthermore, Lars makes sure to have a home environment as free from air pollution as possible. Upon moving to China he equipped his house with six air purifiers.

“It was the first thing we invested in when moving here”.

Anders Sachs

Anders Sachs works as the Chief Designer Color & Material at Volvo Cars, China. With extensive knowledge in CMF application and trend, Anders was found to be a great tool of understanding the Chinese trend and buying patterns. First and foremost, Anders stated, that the Chinese people cannot be viewed as one homogenous target group.

“China country consists of 1.4 billion people, cultures, rituals and social groups. This makes it hard to target one car for such a huge population”

Out of the 1.4 billion people currently residing in China, about 300 million have a western standard of living. Out of these most live around the Chinese coastline in cities as Hong Kong, Shanghai and Beijing. According to Sachs, the traditional way of displaying wealth among Chinese people have been to use color palettes such as burgundy, gold, bronze and copper. Although, Sachs says this is now slowly fading.

“We see a certain kind of sophistication where our target market is adopting the idea of simplicity and neutral colors in favour of logo scattered fashion and golden details.”
RESEARCH
SYNTHESIS

科研 合成
The aware guy. Only buys the best. Finds pride in his products. Exercises, aware about his health and loves products that are an extension of him. Currently buys the 3M mask or Totobobo, simply because there is nothing better out there.

The average adult looking for something cheap and effective, something easy to carry around and comfortable but still effective. Does not have to be reusable. Buys their masks from taobao in large quantities.

Most Chinese people. Somewhat aware of the problems associated with breathing in polluted air but does not bother to protect himself due to inconvenience.

The children are a sensitive user group benefiting extensively from wearing a mask. The buying target user group are the worried parents, looking to protect their kid, but cannot find masks or the child does not like the ones they have tried. Sometimes the children suffer from staying indoors limiting activity due to the pollution levels.

MR. AWARE

MS. I DON'T KNOW

MS. CHILD

MR. I DON'T BOTHER

4 USER GROUPS

CHALLENGE: TRANSFORM HER INTO MRS. AWARE

CHALLENGE: TRANSFORM HIM INTO MR. I DON'T KNOW
Presented here is an overview of the current buying and information acquiring patterns in terms of air pollution protection based on the insights gathered from the ethnographic research.

**Overview**

**Current means of air pollution protection**

**Disposable masks / Reusable masks + filters**
When choosing an appropriate mask the user groups interviewed usually have two options to choose from. Disposable or reusable masks. The disposable masks cost from 5 to 10 Yuan and need to be replaced every day on average, building up an average monthly cost of 150 Yuan.

The reusable masks such as the Respro models use exchangeable filters that each last for 60 using hours on average and sell for 169 Yuan for a 2-pack.

**Digital Devices**
A major part of the user-product relationship is the bridge consisting of digital devices and services. Before even considering wearing a mask the user checks the Air Quality Index for his/her region. Many of the users buy their products via internet where ratings, reviews and user opinions are driving the ranking and recommendations of products. A clear buying pattern is that masks are (if disposable) bought in larger packs a’ 20-50 units at a time, the same pattern goes for filters.

**Air Purifiers**
Of the 7 million premature deaths caused by air pollution, WHO estimated that there were about 4.3 million deaths in 2012 caused by indoor air pollution. The users interviewed are aware of the importance of clean indoor air and air purifiers are as common in middle class Chinese homes as computers today. Air purifiers have the advantage of giving direct feedback regarding the air quality and filter replacement. Many air purifiers have a basic air-quality sensor built in that estimates the amount of airborne pollutants and adjusts the fan speed accordingly.
Self-evaluation tools
Since air pollution is a long term threat, it is hard for regular users to understand the long term health impact. With a growing sector of applications dealing with self-monitoring and self-evaluation there are ways of monitoring lung health such as “Spiro Smart”.

“A new tool from researchers at the University of Washington, UW Medicine and Seattle Children’s hospital lets people monitor their lung function at home or on the go simply by blowing into their smartphones. A paper presented this month at the Association for Computing Machinery’s International Conference on Ubiquitous Computing, showed results that came within 5 percent of commercial devices, meaning it already meets the medical community’s standards for accuracy.”

In order to deal with the awareness issue, tools such as medical respiratory evaluation technology, smartphone apps, digital information etc. would be researched, evaluated and possibly used in order to create a full user experience eco-system. This in order to trigger not only self-health awareness, but ultimately an understanding of the global impact of air pollution, planting a seed towards a movement or community for a better environment, health and in the short run, which masks that are preferred for best protection and that can be evaluated using these tools.

To the right is an example of how Nike created Nike+, an ecosystem of products and services measuring the users fitness progress.
Current problems associated with personal air pollution protection

Comfort
The biggest direct issue for most users is the lack of comfort in today’s solutions and is of such substantial value that often times the users choose not to protect themselves at all.

Appearance
The users mention that there has been an increase in masks decorated with patterns and colors to create more of a friendly appeal. Since masks are becoming accepted as wearable accessories there is an increased demand for solutions that not only reflect the individual, but also provide the feeling of reliability.

Awareness
Most Chinese people don’t wear masks and risk future health conditions. Creating awareness among these people is not only beneficial for the individual but for the whole society in reducing premature deaths and for fighting the root of the problem.

Engineering
Users demand improved solutions in terms of efficiency and practicality.
MASK PROBLEMS SPECIFIED

**COMFORT**
I want my mask to have perfect seal and be adapted to my face.
If my protection is reusable, how do I keep it hygienic?
I don’t want to use protection when I don’t need it.

**ENGINEERING**
I want my mask to be compact and easy to bring anywhere.
I want my mask to tell me that it actually works.
I want my mask to tell me when it’s expired.

**APPEARANCE**
I don’t want to cover half my face.
People with masks look intimidating to me.
I don’t want to look like a victim of a post-apocalyptic movie.

**AWARENESS**
I want my mask to be smart.
How do I know my protection is effective?
How do I protect my children and my grandparents?
When do I need to wear a mask?
CONCLUSIONS

Goals & Wishes

Primary Project Goals
To obtain the result of presenting a device that protects the user from air pollution. The device should be adapted for wide parts of the adult Asian population. The design process will focus on the four problem areas presented earlier; Comfort, Appearance, Awareness, Engineering. The solution should work in every day use, be practical and effective in its purpose. In order to find the right solution a selection of different working methods will be used to ideate, define and prototype the solution.

Secondary Goals
The secondary goals are set and dependant on the amount of time and complexity that the project requires. The secondary goals may be implemented holistically or partially.

Working Prototype
Ultimately, depending on the amount of technology implemented in the solution, a working prototype is a secondary goal. This, in order to bring further relevance and realism to the project. The advantages of having a working prototype are; direct user testing, production costs and a better way of pitching the solution.

Business Model
As a third step a suitable business model will be applied together with branding, overall identity and some elementary marketing strategies.

Services
Creating a feeling of being “in the know” will be crucial for this project. Letting the user understand the benefit of healthy air and perhaps even monitor the progress made. Therefore, implementing services, campaigns, apps or other technology that explain the health benefits could be a good way of educating the user groups.

The Outcome Should
01 / Create awareness about health conditions caused by air pollution
02 / Protect users from health issues caused by air pollution
03 / Provide info when not be used if not needed
04 / Have a viable business model/strategy
05 / Not be intimidating to wear
06 / Tell user when to be worn
07 / Give useful information
08 / Express/inform trust
09 / Be easy to sanitize
10 / Provide tight seal
11 / Be comfortable
12 / Be Ergonomic
13 / Be lightweight
14 / Be desirable
15 / Be compact
16 / Be hygienic
17 / Be reusable

The Outcome Could
Have a valve / 01
Be affordable / 02
Be collapsible / 03
Be made for urban dwellers / 04
Be made from renewable materials / 05
Provide information about AQI levels / 06
Allow being redesigned to fit children / 07
Have a base (loading station, packaging?) / 08
Provide possibilities of creating a movement / 09
IDEATION
“Red oceans represent all the industries in existence today – the known market space. In the red oceans, industry boundaries are defined and accepted, and the competitive rules of the game are known. Here companies try to outperform their rivals to grab a greater share of product or service demand. As the market space gets crowded, prospects for profits and growth are reduced. Products become commodities or niche, and cutthroat competition turns the ocean bloody; hence, the term red oceans.”

“Blue oceans, in contrast, denote all the industries not in existence today – the unknown market space, untainted by competition. In blue oceans, demand is created rather than fought over. There is ample opportunity for growth that is both profitable and rapid. In blue oceans, competition is irrelevant because the rules of the game are waiting to be set. Blue ocean is an analogy to describe the wider, deeper potential of market space that is not yet explored.”

Source

Image courtesy: http://cdn.theatlanticcities.com
FAMILIARIZATION EXPERIMENT

Quick Visuals Based on Existing Products

Familiarization
As a way of quickly generating ideas, an exercise where taking wearable hard goods and transforming them into air pollution masks. The reasoning behind this type of exercise was to experiment and ultimately defeat the issue of bad association (described earlier) when users interact using traditional air pollution protection. Could well known materials, finishes and shapes in artefacts such as ski-goggles or headphones create more positive, familiarized emotions?
By creating ideation workshops with a diversity of participants, ideas were kick-started. The methods used in both workshops were conducted in two steps where hypothetic questions were asked followed by reflection and ideation. After each question, the participants explained and presented their ideas in order to boost further consideration and solutions. The categories defining the questions were based on the problem findings in the research synthesis section.

**Awareness**

**Problem:** There are lots of counterfeit (fake) masks out there on the market with fake certifications. People also wear surgical masks to a huge extent, which does not help at all.

**Question 1:** How can we create air pollution protection devices that signal trust, reliability and that “this will work”?

**Question 2:** How can we make more people use air pollution protection?

**Question 3:** Come up with services or add-on features to the mask that raise awareness about the user’s health or the situation in general.
Appearance
Problem: Many people are intimidated by the appearance and look of air pollution protection masks. Moreover the idea of something covering half your face is discouraging to some people.

Question 4: How can we create a mask that does not cover the face, or can we create very hidden or even invisible masks?

Comfort
Problem: Masks are hard to breathe in, the temperature inside raises, they are uncomfortable and get unhygienic in the long run from saliva and coughing.

Question 5: Come up with solutions to make the mask more comfortable and hygienic.

Sketch Exercise
Question: Sketch air pollution protection that you would wear.
Question: Pick some ideas from question 4 and try to sketch them out.
WORKSHOP
SKETCH IDEAS

Popular ideas that were considered in the next phase
By implementing business models early on in the design process, another evaluation criteria was added to the concepts generated. Since the project is conducted from an entrepreneurial point of view, asking the question; how will the product be sold?, adds constraints in terms of feasibility and moves the concepts beyond beauty and functionality in the direction of making an experience rather than a product. When generating the business models a lot of focus was aimed towards creating an ecosystem of services and products combined, based on the different buying patterns that were discovered in the ethnographic research phase.

With ideas generated from the workshops together with the business models created, exploration of the core product (mask) was initiated. The functionality and design was steered towards different levels of complexity based on the different setups in the business models. Due to the early market positioning, focusing on blue ocean strategies, it was desired to implement a higher level of innovation to the concept. Having these factors in mind - business models, market positioning, feasibility and problem areas, two clear directions were distinguished.

1. A mask that would be based on the traditional mask designs adding value with add on products and services.

2. A clearly different direction based on the idea of creating something that does not interfere with the face the way a traditional mask does, adding value due to it’s innovative design.
The “Dock” business model is aimed to tie the different means of air pollution protection together in order to create a unified “pure air experience”. The concept consists of a personal protection device for outdoor use (the mask) that can be analyzed if connected to the indoor air purifying device. Due to this setup the “brainpower” is stationary and can analyze and sanitize the mask or filter in order to gather valuable information to the user that can be shared with the community or for future self monitoring in connection with a doctor. The reason for implementing an air purifier is also due to the demand from aware users, that often have a multitude of air purifiers in their homes.

- Cheap mask
- Lightweight mask
- Selling pure air as a package
- Sanitation
- More brainpower by outsourcing it

- Expensive package
- Will it work?
- Is it worth the investment?
- No primary focus
- Mask itself doesn’t add enough value

Gathers & evaluates info
Shares info with community
Orders new filters

Protects from PM2.5
Two exchangeable filters

Purifies air
Analyses filter
Cleans mask filter
Cleans mask

KP
MARKET & AIR PURIFIER MANUFACTURERS
KR
BRAND PATENTS HARDWARE
KA
MARKETING PRODUCTION LOGISTICS
VP
THE PURE AIR EXPERIENCE
CR
COMMUNITY
CS
MANUFACTURE DISTRIBUTION & CHANNELS
CH
EXCLUSIVE WEBSITE
RS
CS
VP
CR
CS
KP
KA
KR
VC
CS
RS
The “Kids” business model aims to create a generation of aware people by implementing means of air pollution protection aimed towards children.

- Obtaining awareness from early life
- Creating desirability amongst children
- Provision from parents
- Understanding pollutants
- Letting children be active

- Limited target group
- Lack of innovation due to continuous new sizes
- May not be desirable at all times
- Children grow fast - new sizes, expensive (?)

Child can gather points when wearing mask/learning about pollutants

When growing, the child reaches a new superhero stage and gets a new mask

Creating a story around superheroes (?) fighting specific pollutants

Child wears the same mask as the superhero - traditional setup

BUSINESS MODEL CONCEPT 2

“Kids”

Description

The “Kids” business model aims to create a generation of aware people by implementing means of air pollution protection aimed towards children.

+ Obtaining awareness from early life
+ Creating desirability amongst children
+ Provision from parents
+ Understanding pollutants
+ Letting children be active

- Limited target group
- Lack of innovation due to continuous new sizes
- May not be desirable at all times
- Children grow fast - new sizes, expensive (?)
“Smart”

Description
The “smart” business model implements intelligence to the mask itself creating valuable information by utilizing dust sensors and a microprocessor. This way the user obtains real-time information regarding the filter status, filtration power, longevity and peer-to-peer information from other users.

+ Measures actual PM2.5 inside mask
+ Dust sensor inside ensures tight seal
+ Dust sensor inside ensures valid filter
+ Gives accurate information

- Battery runs out, still needs a charging station
- Higher price point when implementing technology
- Dust particles from filter - interference?
- Heavier due to battery & sensors

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Two Dust Sensors

Dust Density PM2.5
Outside Mask (mg/m³)
0.6

Dust Density PM2.5
Inside Mask (mg/m³)
0.01

Gathers & evaluates info
Orders new filters
Community

Protects from PM2.5
Dust sensor
Battery
Bluetooth

Charging station
The first ideas were inspired by the germ blocking masks observed in the restaurants during the ethnographical research. Using the simplicity, transparency and lightweight features of this product, the goal was to create a mask with little interference in terms of comfort and where the mouth would be visible. This partly due to the importance of facial expressions during social interactions. The main challenge in this phase was to deal with the issues found in the problem analysis, since the product would have a similar product architecture as today’s solutions.
An early idea in the ideation workshop phase was to create an external “nozzle” that would blow purified air to the nose and mouth. By exploring the possibility outsourcing the filtration unit as a separate part in the same way as a PAPR (Powered Air Purifying Respirator) it was found that space could be freed up around the mouth area. A set up like this would require a battery, a blower or fan motor and a filter. By adding these electrical components, a microprocessor that would handle data acquired by the filter, was considered to be implemented to support the idea of add-on services that would connect to the users smart devices.
When performing the evaluation process I stepped back to the initial axis showing factors such as innovative versus traditional and premium versus low priced. This chart later became a great tool for evaluating which concepts and business models to move ahead with since clear diversifications between red and blue ocean strategies appeared. The ultimate goal was to enter a blue ocean strategy redefining the marketplace by introducing a highly innovative business model and product. Therefore the business models with the two mask design ideas were pinned to the chart and chosen based on the level of blue strategy compatibility.
Before starting the design conceptualization phase, it was of great importance to get an overview of the general technical package and what kind of components could be implemented both to allow for add-on services to the concept and to filter the air. The technical package was found to be similar to the ones that are found in air purifiers today. With smaller processors and sensors being available on the market, this can be scaled down to substantial levels allowing the components to be implemented in wearable solutions. The blower technology and engineering has the same properties as today’s Dyson fan solutions as shown in the image. This setup allows the motor to be silent and the blades to produce maximum efficiency in terms of blow. The fan is the first Dyson machine to include a Helmholtz cavity in the base to eliminate tones of 1,000Hz, similar to the frequency of the noise produced by the wing beat of a mosquito. When air is forced into the Helmholtz, the pressure increases.

Re-engineered airflow paths

Engineered to significantly reduce turbulence throughout the machine. Airlow paths have been streamlined allowing air to pass through the machine with greater efficiency.

Helmholtz cavity

Now housing a Helmholtz cavity, designed to capture and dissipate motor noise. The motor is also calibrated to run slower without affecting cooling performance. And an eccentrically aligned loop allows air to enter with less turbulence, further reducing noise.
To allow the smart device to connect to the protection device and display information, it was found that a microprocessor with a Bluetooth transmitter could be built in to update the user about filtration and filter expiration. The basic idea is that two dust sensors would be implemented. One outside the inlet and one inside. By placing the sensors in that way the processor can calculate the amount of particles coming in and the amount being trapped in the filters by calculating the cleaned air. Once the numbers start being similar, the system knows that a filter needs to be replaced. The benefit for the user is the confirmation that the product works and that filtration replacement is accurate and timed well.

Lapka is a company that produces consumer oriented sensors to monitor radiation, humidity, carbon monoxide etc. The sensors are connected to the phone via the AUX inlet and the interface displays the information gathered in non-intrusive and way that is easy to understand.

“Lapka’s precise sensors respond to the invisible world of particles, ions, molecules and waves. But Lapka does not just quantify what it measures. You get results that are specific to where you are. On the street, at the office, inside a child’s bedroom, or on an airplane: the Lapka app compares its readings to average guidelines for each individual environment.

You can collect snapshots of your comfort throughout the day to create a diary or share with the world around you. Keep the conversation going.”
Testing principles through mock-ups

MOCK-UP A
In this mock-up high pressured air was flowing through a tube positioned on the side of the face for better control and stability of the air nozzle.

Blocking particles: ++
Comfort: ++

MOCK-UP B
Mock-up B had two nozzles, one pointing outwards and one pointing inwards. The nozzle had a cone shaped tip to disperse the air in a triangular formation to create an air wall.

Blocking particles: ++++
Comfort: ++++

MOCK-UP C
Mock-up C created a big airwall but was inefficient in blocking particles. Since the nozzle was located far away it was very comfortable to wear.

Blocking particles: +
Comfort: ++++

MOCK-UP D
By piercing holes along the tube an airwall was created together with a nozzle close to the mouth. Blocking capability was slightly reduced and the comfort level got similar to concept B.

Blocking particles: ++
Comfort: +++
SKETCHES

Exploring product architecture

Sketches
SKETCHES

Exploring product architecture

Sketches
Based on the sketches and physical "air flow" mock-ups made as exploration, 3D modelling around an average sized Chinese head was implemented as further form and ergonomic evaluation. Furthermore in the process of creating 3D mock ups, a variety of concepts ranging from more simplistic solutions to appearances that were more complex and organic were created.

Parallel to this, three solutions were picked out and worked with as concept directions in the first phase.
As a continuation from the 3D mock-ups, three directions, very distinct from each other were moved on with and had materials applied to them. At this stage of the process it was important to create concepts that were distinguishable in terms of gender style and fashion direction. It was stated after this step in the process that revision and heavy refinement was needed in order to meet the goals and wishes regarding ergonomics, improved engineering and comfort.
Since the product is aimed towards a very self aware target group, implementing an identity and a sense of a fashion piece or jewelry rather than a protection device was crucial to build interest and desirability for the product. Hence, research in the field of Chinese fashion design and the general direction that contemporary fashion is moving towards.
MOODBOARD
GENERAL SHAPE

MOODBOARD
DETAILS
Based on the desire of bringing the vision of futuristic fashion forward, utilizing new production techniques and materials enabling the possibility of creating organic shapes that before 3d printing were almost impossible to mass produce. Prominent fashion designers such as Iris van Herpen is considered the initiator of the digitally produced fashion movement. Looking at and combining the possibilities, the digitally generated ergonomic studies, the moodboards and the three different styling directions, a first “air cleaning collar concept” was generated.

**AIR CLEANING COLLAR CONCEPT**

**Air Cleaning Collar**

Polluted air being sucked in. Filtered air being dispursed around the users face.
Before any definitive decisions regarding the product architecture could be fully decided upon, a quick but intense mock up phase was initiated in order to gain real world experience wearing the product.

Two different concepts were generated and tested. One based upon earlier sketches where the aim was to create a product that would be collapsible for the sake of being easy and flexible to bring along or to put in a bag once not needed.

The other concept was created to test a more structural organic pattern where focus was targeted towards the overall feel, ergonomics and whether the product would interfere with the user’s mobility. This concept was later revised and tweaked in 3D based on the mock-up findings before established as the final concept.

**ERGO MOCK UP TESTS**

*First Attempt - Combining two*

Before any definitive decisions regarding the product architecture could be fully decided upon, a quick but intense mock up phase was initiated in order to gain real world experience wearing the product.

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The other concept was created to test a more structural organic pattern where focus was targeted towards the overall feel, ergonomics and whether the product would interfere with the user’s mobility. This concept was later revised and tweaked in 3D based on the mock-up findings before established as the final concept.
FINAL DESIGN

概念
Breathe Couture is a smart breathing protection for urban China that through its exclusivity and novelty creates desirability and awareness to protect oneself from bad air. Due to its appearance as a fashion statement it can be combined with scarves and other accessories to blend in as part of the user's identity.
Breathe Couture is divided into two main parts, one “expressive” part and one that functions as “brain and lungs”. The idea behind this product architecture is that the user should be able to change the expressive part according to the occasion. One type of expressive part might be used for going out to parties while a completely different aesthetic appearance would be used when commuting to work or exercising.

The “expressive” part snaps onto the “brain” through magnets.

Brain and lungs being charged.
In order to enhance the user experience and provide a smooth product experience, the filters needed would be shipped to the user automatically once the mask notices that the filter is worn out. Also, filters would be fragranced lightly to add to the overall experience. This way of offering secondary products tailor made for a specific product is utilized by Nespresso and has turned out to be a very profitable business model.
The scale 1:1 representation of the project was 3D printed in plaster, hardened, sanded primed and painted. The model was divided into 14 individual parts where the snap on function was achieved by building in strong magnets into the structure. In order to achieve a stronger understanding of the functionality behind the air cleaning properties, two 9V batteries and a computer fan were built-in to simulate the air purification process. The aim of the 1:1 representation was to give the viewers of the project a feeling for ergonomic preferences, weight and overall comfort when the product was being worn.
Air Channel
Battery
Secondary Air Channel
Air Nozzles
Dust Sensors
Magnets
Fan
Filter
Air Channel
Microprocessor
Secondary Air Channel
Magnets
Dust Sensors
As mentioned earlier, it was of high importance to generate awareness among the user groups and be able to monitor their surrounding air quality. Furthermore, when researching the need and market of self-evaluation tools connected to smart devices, an integration of an informative application emerged as crucial to place the product in a high status, premium market segment.
Dust Density Levels I
Interface show what the two dust sensors “see”. Breathing zone is the air in the zone around the mouth, while “outside” is referred to as the mid-air.

Dust Density Levels II
If the levels between the breathing zone and the outside start becoming to similar the system will alert the user that a filter change is needed.

Dust Particles
An intuitive way of learning more about the pollutants is the dust particles “floating” around on the screen. The user can “catch” these and read more about them spreading awareness.

Start Loading Screen
A logo and a loading ring appears. The background image will be updated with the newest masks or styles available in the store.

Menu List Option I
List of different sections ranked in the order of most frequently used. In the bottom a battery symbol is visible displaying remaining mask runtime.

Menu List option II
Different overview of icons in menu list option I
The air quality index section is similar to the common weather apps. The user sees his/her current location and swipes between favorites. Below the AQI number is a pre- and forecast that can be looked at further.

**AQI Favorites List**
Here, the user can add his/her favorite regions that would be displayed in a list. If curious, the user can tap the discovery mode to browse more places, or add and search for regions by tapping the + symbol.

**Discover**
When tapping the discover symbol, an interactive globe appears in which the user can discover AQI levels in cities. This insight is based on curiosity of the users interviewed that liked to look at lists of which city has the highest/lowest levels of air pollution.

**Alert Start Screen**
Displaying alerts, messages from the mask to the user, can be filter expiration, highly polluted areas etc.

**Alert Inbox**
Messages displayed. Filter expiration message instructing the user when and how to change filters.

**Breathe Store**
Lets the user browse new products and filters.

**Air Pollution News**
News about air pollution globally or in the users community.
When commencing this project, before even knowing which field to dive into, I set out three main desirable factors to guide the project forward. These were the following:

1. The project theme needs to address a market of substantial size.
2. The project theme needs to address a need of substantial importance for the user.
3. The project theme needs to allow room for innovation and to rethink the way current solutions address the problem associated with the theme.

These factors were based upon certain key business strategies that I’ve discovered when reading biographies and stories about successful entrepreneurs. The question and ultimate goal I set out for myself was whether I could use these business strategies to move the design process forward, due to this, my design process was based upon creating concepts that could generate business models and be feasible from a production standpoint.

Upon starting this project I practically knew nothing about air pollution or the problems people are facing being exposed to dirty air. By stating this, the journey that would follow upon picking the topic truly made me discover new methods and areas within the field of product design. I applied most of the methods I have learned during my industrial design studies, but by mixing them with business model and market strategy methods I felt a great satisfaction and learning insight when entering undiscovered territory. This way of trying new strategies and nevertheless flying out to a foreign (and to me) undiscovered country with a camera and a notebook was a significant boost to my personal development as a designer and researcher as well as battling my fears and challenging myself.

My final result is far from what I predicted it to be initially, when looking back at the research I feel that the final result has a clear link as a result from my research, but I know that the project could have taken a different turn if based on one of the other business models which could be interesting as well. One of the negative aspects that I can see looking back is not to have a collaboration partner, not from a financial standpoint, but from consultation. If I would have had a collaboration partner such as 3M or Dräger, it would have been easier to validate concepts from a technological point of view and I believe the decision making process would have moved on smoother.

The intention for my project was to explore a concept that would be for manufacture and not remain on a conceptual level, therefore I also feel that the execution my concept could have been simpler, something that could have been achieved if a different business model would have been chosen earlier on. With the result presented, I experience that it needs a lot of storytelling to come across to an audience in order to explain all the decision making in terms of engineering, design and business strategy. Initially, I anticipated to create something that would have a flavour of “Aha!” to it, where the message would come across purely from looking at the product.

Generally, when looking back at the outline that was established when starting the project, most desired factors set out were accomplished. I’ve learned new ways of looking at my process and I am very satisfied with the decision to make a “fi-cious” start-up project. It led me onto paths that in my opinion will be extremely beneficial for my career and an important part in realising my dream of becoming an entrepreneur.
REFERENCES

People Interviewed
HE, Chang
XIAOXIAO, Jin
FAULK, Lars
SACHS, Anders
FANG, Siyuan
WOO, William
XU, Kelly

Books
Business Model Generation
OSTERWALDER, Alexander / PIGNEUR, Yves

Valuation
Methods and Models in Applied Corporate Finance
CHACKO, George

Blue Ocean Strategy
How to Create Uncontested Market Space and Make the Competition Irrelevant
W. CHAN, Kim / MAUBORGNE, Renee

Reports
Air quality in Europe - 2014 report
ORDER ID (Catalogue Number): TH-AL-14-005-EN-C

Selected pollutants: WHO guideline for indoor air quality
ISBN: 9789289002134
Publication Date: 2010

Health effects of particulate matter.
Policy implications for countries in eastern Europe, Caucasus and central Asia
ISBN: 978 92 890 0001 7

Centre for Cardiovascular Sciences, Edinburgh University, Edinburgh, UK
Penetration of commercially available filters

Web
http://totobobo.com/faq.html
http://solutions.3m.com/wps/portal/3M/en_US/3M-PPE-Safety-Solutions/
http://aqicn.org/map/china/
http://www.greenpeace.org/eastasia/campaigns/air-pollution/
http://beijing.usembassy-china.org.cn/aqirecent3.html
http://www.who.int/phe/health_topics/outdoorair/databases/en/
http://en.wikipedia.org/wiki/Particulates
http://en.wikipedia.org/wiki/Respirator
http://airnow.gov/index.cfm?action=aqibasics.agi
http://www.theguardian.com/cities/2014/dec/16/beijing-airpocalypse-city-almost-uninhabitable-pollution-china
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