WHAT CAN BE DONE TO IMPROVE THE PERSONAL PROTECTIVE EQUIPMENT FOR AUTO BODY PAINTERS?

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The background and objectives of the project will be presented to give a clear picture of my ambition and goals.

Collaboration partners and supervisors are introduced and their specific roles in this project are defined.
Today there are more new cars sold than ever. Cars with new materials and constructions, creating new demands on auto body repair workshops around the country.

The auto body repair industry is constantly evolving when it comes to the materials and tools used, work efficiency and more, but when it comes to the personal protective equipment for those working in this profession nothing really happens.

The auto body painter is one of the persons who suffer most from this stagnation of development.

The aim of this project is to investigate what requirements and necessities is needed to help the auto body painter profession to continue to evolve in the future. This will be done through visits to workplaces, research and idea generation.

The project will result in an overall concept that is optimized for this particular profession. A product that belongs in the context and corresponds to a specific set of requirements.
Attention

COLLABORATION PARTNERS

The project was done in collaboration with Attention, Umeå Billackering and Pensole.

Attention is a design agency in Copenhagen, and I have had weekly contact with their design director, who helped with guidance, support and evaluation of concepts. Attention is also the main sponsor of this project.

Umeå Billackering is the local auto body repair shop who helped me the most during the work; their auto body painters have contributed with important insights and have been closely involved in the project.

D’Wayne Edwards, founder of Pensole, is a former design director at Nike and Jordan Brand in the US and has served as my source of expertise during the past work.

Contacts during the project:
Berker Diker, Attention
Industrial designer
D’Wayne Edwards, Pensole
Founder of Pensole
Magnus Öhgren, Umeå Billackering
Owner
Paco Lindoro, Atlas Copco
External project supervisor
Johan Gustavsson, Struktur Design
Internal project supervisor

TARGET GROUP

The project will target auto body painters that work in an auto body repair workshop, which for the most part doing insurance claims. Focus will also be on the next-generation auto body painters, who are more safety conscious and also demand the best possible work environment conditions.

I have chosen to work with this profession because of my own interest in this industry and in my opinion deserves the best of development. I still have many contacts within this professional group, managers, auto body painters and material suppliers.

Working with this profession felt right since I myself am a trained auto body painter and have been active in the profession for several years, working at a auto body repair shop between 2010-2015.

LIMITATIONS

I will only focus on auto body painters working in insurance claims workshops, no industrial painting. I will research Swedish workshops and their requirements. The project is limited to the auto body painter’s personal protective equipment.

WHY AUTO BODY PAINTERS?

It’s a profession that’s close to my heart and in my opinion deserves the best of development. I still have many contacts within this professional group, managers, auto body painters and material suppliers.

These contacts could be very valuable in this project.
THE INDUSTRY IS EVOLVING
The auto body repair industry faces an interesting future. Sales of new cars in Sweden reach record levels every year, which means that the number of cars on the roads is constantly increasing. Today’s modern vehicles are manufactured using more plastic and aluminum components than ever before, forcing all body repair workshops to adapt to these new materials when repairing existing vehicles.

Workshops also work hard to recycle and repair as many vehicle components as possible to reduce the environmental impact and to be cost effective. A consequence of this is that the number of plastic component repairs is increasing.

PAINT AND SOLVENTS
When it comes to the repair materials used in a auto body repair workshop, the trend is to continuously develop new and less toxic alternatives. Almost all paint today is water based, and the goal is to use as few solvent based products as possible. This has a significant impact on employee health and working environment.

Today’s available paint systems are developed with the aim to use as little paint as possible, mostly because it is cheaper, but because less waste means less environmental damages.

WORKING ENVIRONMENT
The industry is constantly evolving, but when it comes to the employees’ working environment change is very slow. The working clothes are not specifically adapted to the toxins found in these environments. There are lots of toxins in the air, from color and trowel to other solvents floating around in the workshop.

You also have to constantly change your physical working positions, because all jobs are different from each other, meaning that flexibility and mobility are extremely important factors.

Some protective gear, such as respirators, are upgraded frequently, but when it comes to working clothes and protective footwear nothing has really happened in the last few years. This is one of the major problems in the profession.

Another problem the collision repair industry faces worldwide is the aging of the workforce. Demand for new, and younger, employees is huge, but few are available, or even considering the auto body repair industry at all. The profession doesn’t attract young people today. Could there be a connection between the lack of interest from potential employees, and the poor working and safety conditions in the workshops?

THE AUTO BODY PAINTER
One of those who suffer most from these conditions is the auto body painter, the last person in the production chain, and the one facing the most performance pressure – it’s often the quality of the painter’s job that determines how the quality of the total collision repair is perceived.

The painter is predominantly working in the paint booth where the environment can differ a lot. The ventilation is constantly creating “windy” conditions, that can be cold. At the same time there’s usually a 60°C (140°F) hot furnace connected to the paint booth.

So the temperature and climate changes all the time.

Physical working positions also change all the time, which means that the painter performs the most mobile tasks, and constantly needs to be flexible and adapt their work after how many objects that are placed in the paint booth.

This makes it very uncomfortable to work as a painter – you have to be extremely mobile while having to wear all your protective equipment: a breathing mask that must stay on at all times when performing a job, protective overalls, gloves and footwear.
During the research I will document the situation on site, gather information and interview users, to be able to create as a clear picture as possible about the process and workflow in the workplace.

After this phase, the project’s final focus area will be determined, and the key problems and challenges will be presented.
VISITS TO AUTO BODY SHOPS

The project began with me visiting three different auto body repair shops, to get a picture of how it works in reality. How do the processes work, and what responsibilities do auto body painters have at the different shops.

The first auto body repair shop I visited was Widells Bilplåt in Västerås. I chose to visit this insurance claim workshop, for many reasons; it’s my old job, so I know everyone who works there, which meant that I could easily schedule time for interviews. Once in place, I could document the entire process freely without being guided or having to ask permission.

I documented the surroundings and interviewed auto body painters, and other relevant staff. Next stop was PPG Industries, the local paint supplier in Västerås. There I investigated what kind and brand of protective equipment that are the top sellers.

The second visit I made to Autolacken in Umeå. I documented the workplace and interviews were conducted with the manager and staff. Autolacken is one of the largest auto body shops in Umeå, so it was very busy during my visit, but there was still time to talk to the auto body painter on duty, even though he painted in two boxes simultaneously.

My third and final visit was Umeå Billackering. There, I talked a lot with the owner Magnus, who also showed me around the premises and introduced me to auto body painters Robin and Desiree.

They were very positive, and wanted to help later in the process, with the evaluation of early concept or if I need to take more pictures.

VISITS TO SCHOOLS

As a minor part of the project, I wanted to explore how the new generation of auto body painters view their personal protective equipment and overall safety. To find out, I visited two high schools that have auto body painting programs, Westerlundsska High School in Enköping and Liljaskolan in Vännäs.

I talked with teachers and students at the two schools, and it was very interesting to hear their different perceptions of the profession. These two visits were also documented.

For both programs, the number of applying students have declined sharply in recent years. If this is because there are fewer people in the younger generations, or whether it is because the profession is becoming obsolete is difficult to determine.

It was very positive that the students I talked to consider personal protective equipment as extremely important. Everyone uses the mask when dealing with solvents and make sure to wear gloves.
During my visit to Widells Bilplåt I had the opportunity to document and observe how the work is done in a paint booth. Especially how the painter moves in different situations. I felt it was very important for the project to be able to show what kind of movement that is needed in the paint booth and show how much the auto body painter moves daily.

Each situation is unique, it's never the same car getting painted, so the auto body painter must constantly adapt to the objects found inside the paint booth.

The work involves producing as much as possible every day, painting many parts, so that more cars can get to customers faster. This means that this is a very stressful profession, and the paint booth is often crowded with objects.

Everything was photographed and filmed. I then edited a short film from the raw material, that shows a sequence in the paint booth: from the car entering the booth, to its completion. This was done to show the process in a easy and understandable way for outsiders.
A paint booth is just what it sounds like, a square booth, where objects are painted. These objects can be everything from whole cars, to small details. The objects are placed manually in the best possible position inside the booth when it is time for painting.

In the paint booth, there is plenty of ventilation, both in the ceiling and in the floor, where the main ventilation is located. This creates an airflow that goes from top to bottom, a flow that removes paint dust so the auto body painter always has a clear view.

When the objects in the booth are finished, they are placed in an oven next to the paint booth to dry. In this place, the temperature is around 60°C (120°F) and the objects are burned for about 40-50 minutes until the paint has hardened and is dry.

This procedure is made about eight times per day, depending on how many objects are painted at the same time and how large surfaces that needs to be painted.
The equipment an auto body painter wears daily includes coveralls, a full face respirator hood and a pair of work shoes. The same type of equipment is used by all auto body painters in Sweden, just different brands of the products, but the features are the same.

The full face respirator hood is connected to the air pressure system inside the paint booth, via a belt that the painter is wearing, this belt also contains a filter that cleans the air. The coveralls used, are disposable coveralls and changed very often.
A auto body painter have other tasks in addition to paint different objects in the paint booth, and even though these do not take as large part of the working day to perform, they are important moments in the process.

To actually visualize this and be able to communicate it in a simple way I created a flow chart that summarizes the work task for auto body painters based on the three different auto body repair shops I visited.

FLOWCHART

READ JOB ORDER
PLACE OBJECTS IN PAINT BOOTH
MASK AND WASH OBJECTS
MIX BASECOAT
PREPARE SPRAY GUNS
APPLY BASECOAT

DRYING TIME
MIX CLEARCOAT
APPLY CLEARCOAT
CLEAN SPRAY GUNS
PLACE OBJECTS IN OVEN
EMPTY OVEN

X8
I analyzed the flowchart to find out which part of the protective equipment that is active during the different tasks. The three components that I analyze were the full face respirator hood, the coverall and the work shoes.

The analysis made it clear that the full face respirator hood only is active and used during coating in the paint booth, which is quite obvious. The mask is removed and put aside when the painter perform the other steps in the process.

What I found interesting is that the work shoes are the only protective equipment that is active throughout the whole day, from early morning to the end of the day. They are active even during the mixing of paint and cleaning of spray guns, as it protects against solvents and paint splashes.

The three components that I analyze were the full face respirator hood, the coverall and the work shoes.
1,500-2,000 PAINTERS

30-35°C INSIDE THE BOOTH

9 KM EVERY DAY

JOINT DAMAGES

STATISTICS

During the research I tried to get as much data as possible, which could facilitate my future work. I reached out to IF Metall and Målareförbundet, which is the trade union for auto body painters, to get rough estimates for the amount of auto body painters in Sweden today.

I contacted the Swedish Work Environment Authority where I requested the statistics of injuries in the profession. They sent their own composite report to me about the profession “Spray painters”. What was interesting about this report was that the majority of the recorded injuries are muscle and joint problems. Registered problems with the lungs and breathing were the second largest group.

To find out more information about the environment inside the paint booth, I had to find this out for myself. Umeå Bilackering had thermometers in both their paint booths in the workshop and the average temperature in these were 30-35°C (86-95°F). This is because there’s a furnace connected directly to the paint booth.

I bought three pedometers that I gave to Robin and Desiree at Umeå Bilackering, and to Kalle at Widells. The idea was that they would wear them for an entire work shift so that an average value could be developed. This was very helpful when I wanted to have statistics and evidence on how much a car painter really moves every day.
INTERVIEWS

During my visits to workplaces and schools, I interviewed a lot of different persons. People who were active in the profession, persons that don’t work inside the paint booth anymore, and the new generation of people, about to enter the working life.

The mixture was very good, and it felt I got a comprehensive picture of what people in this profession think and feel about personal protective equipment, regardless of gender or age.

The people I interviewed shared everything about their own protection equipment, why they chosen to work in that particular mask, or why they do not like their current work shoes. Many personal opinions were expressed and everyone was very helpful.

The summarized result from my interviews made it quite clear which part of the personal protective equipment that I wanted to focus on and develop during this project.

“My feet are completely exhausted on Fridays. Because you move around so much on such hard surfaces.”

- Fredrik 32, professional auto body painter

“Shoes are a problem. Can’t wear a steel toe cap. Clogs are practical and not so warm, but they’re not flexible. The full face respirator hood is clumsy.”

- Raino 45, professional auto body painter

“The hose in the booth is annoying, it is always in the way or get stuck, so you have to constantly kick it. It is annoying to change gloves and visors on the full face respirator hood often. The shoes wear out quickly, way too quick.”

- Robin 28, professional auto body painter

“Today’s equipment is quite good, but it is a pity that the equipment wears out fast. It is annoying when the equipment fails, especially the shoes. But I don’t bother buying a new pair, as they would look like these directly.”

- Desiree 25, professional auto body painter

“We get protective equipment from school that is perfectly okay. But the shoes school gave us no one use, they are too bulky and big, so I just took a pair of shoes from home.”

- Saga 20, trainee

“It is hot inside the coverall, it’s not breathing good enough. The shoes are breaking. This is the fourth pair of shoes that I have worn since I started my education two years ago.”

- Viktor 18, student

“It is a mentally demanding profession, a lot of stress. Students and trainees always want to paint in the booth when they get here, but regrets it quickly because it is so demanding.”

- Micke 53, manager
During my research of the current personal protective equipment, I concluded that there already exists an established standard when it comes to full face respirator hoods and coveralls. Although it rarely happens, the full face respirator hood is updated at times getting better, modern and more efficient.

One area with no clear standards or benchmarks are work shoes. In other auto-related professions the steel toe cap is required by law, and within these sectors a certain type of shoes is used, but for auto body painters there is no requirement to have steel toes.

This is because the environment as a auto body painter is not classified as dangerous, due to very few foot related accidents and injuries.

All the auto body repair shops I visited reimburse the painter for new shoes, but it is up to the auto body painter to decide what kind of shoe they want and where they want to buy it.

The painters I talked to motivated their choice of shoes with them being comfortable, cheap, or just any old, available pair from home.

Based on interviews and personal experience the life expectancy of a pair of shoes that are constantly used in the paint booth is about six months. They can survive a year if you’re lucky. All because there are no work shoes specifically made for the environment inside the paint booth.

Another reason why I choose to focus on work shoes is that I find it an area with great potential for development. One area where I can test new solutions and materials that are even better suited for this context, but not yet established.

There are great opportunities to explore and develop an entirely new design, and to design a product that even could be able to improve the status of the profession.

If the products develop, the whole industry develops.
After the project’s direction was determined, I began to investigate the problems surrounding the work shoes used today and how they are affected by the environment inside the paint booth.

Since the aim is to create a final product for a very specific area, that means that the specific problems in this area must be solved.

I have listed four main problems, concluded through my research, personal experience and opinions regarding the protective equipment in my interviews.

The majority of the interviewed users mentioned problems with the shoes, so it was easy to summarize them:

**PROBLEM DEFINITION**

<table>
<thead>
<tr>
<th>WHAT?</th>
<th>A new type of work shoe</th>
</tr>
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<tbody>
<tr>
<td>WHO?</td>
<td>Auto body painters</td>
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<tr>
<td>WHERE?</td>
<td>Inside a paint booth</td>
</tr>
<tr>
<td>WHEN?</td>
<td>2017</td>
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<tr>
<td>WHY?</td>
<td>To meet extreme demands</td>
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</table>

**HEAT**

A lot of movement causes heat, and at the same time the temperature inside the paint booth is 30-35°C (86-95°F), making the environment extreme. Paint dust prevents breathability.

**PAINT DUST**

Paint, solvent and paint dust builds a hard surface on the shoe after a while. This layer clogs the material, eventually leading to cracking. Laces get destroyed and the overall lifespan of the shoe shortens.

**WEAR**

The hard concrete floor combined with the metal grid causes wear on the outsole, mostly in the forefoot area. The amount of movement and rotation during work, contributes to this wear.

**MOVEMENT**

To be able to move freely is a vital part of this profession. The feet are supporting in all of the working situations.
To further immerse myself in my chosen focus, I decided to analyze the shoes used by auto body painters today. There is a great variety of shoes, but they can be summarized in four categories: classic work shoes, modern work shoes, clogs and running shoes.

Classic work shoes are heavier footwear, often with steel toe caps. These shoes are very durable and strong, but also heavy, providing a robust expression of stability and security.

The modern work shoes available on the market today, look like hiking shoes, are functional and pretty hightech. They have a steel toe and a feel of technology.

Some of the auto body painters that I talked to were using clogs, because they are easy to slip in and not so hot on the feet.

One advantage with clogs is that they have a small heel, so that the user gains some height from the ground, which can be helpful in certain situations inside the paint booth. A disadvantage with clogs is that exposed socks have a very short lifespan.

A large number of auto body painters use running shoes because they are easy to walk in, provides cushioning and are very flexible. Suspension is necessary when the floor in a paint booth is metal grids or concrete, sometimes both, which makes the ground in the box is very hard to walk on.

The problem with running shoes is that the material (fabric/leather) does not withstand the environment inside the paint booth. They wear out faster than working shoes, especially the laces and outsole.

To evaluate these different shoes I put them into two different charts that shows the different characteristics that they hold. This way I could easily categorize the different shoes and see the advantages and disadvantages of certain models.

In these charts, I marked where I want my final product to end up, in order to clarify the goals I have with this project.
The aim of this project is to create a new standard and a new type of work shoe specifically designed to withstand the demanding environment of a paint booth. The final product should look like it belongs in its context and meets the demands the profession imposes on the product and the auto body painter.

The specific problem areas, heat, wear, paint dust and movement, must be solved and every detail on the product must have a special purpose.

The product must encourage the use and hopefully raise the status of the profession in the long term.

VISION

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<th>FUNCTION LIST</th>
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<tr>
<td><strong>PROTECT THE FOOT (HU)</strong></td>
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<tr>
<td>Against injuries, paints/solvents and environment</td>
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<tr>
<td><strong>WITHSTAND THE ENVIRONMENT (HF)</strong></td>
</tr>
<tr>
<td>Adapted for life inside the paint booth</td>
</tr>
<tr>
<td><strong>SUPPORT MOVEMENT (DF)</strong></td>
</tr>
<tr>
<td>Not interfering with the painters movements</td>
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<tr>
<td><strong>OFFER FLEXIBILITY (DF)</strong></td>
</tr>
<tr>
<td>Support all different work positions</td>
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<td><strong>OFFER STABILITY (DF)</strong></td>
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<tr>
<td>Offer support and ergonomic features</td>
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During the ideation phase, I will explore different concept ideas, then visualize these and evaluate together with users and collaboration partners.

The focus will be on idea generation and problem solving, to finally be able to determine what features and functions the final product will have.
In order to get a good start of the ideation phase I decided to organize a workshop with the aim to brainstorm on different ideas and thoughts based on the problem areas that I have chosen to focus on.

I gathered a mixed group of participants, a diverse mixture that can help move the project in a good direction. Participants had varying prior knowledge and interest in shoes, but all contributed with their perspectives to create the best conditions possible.

The participants were asked to answer three different questions relevant to my project, in the manner they preferred. They were allowed to sketch, write or talk out loud about ideas concerning these subjects.

The three questions I asked was;

How can the shoe in this environment be protected and more long lasting?

How can heat be prevented or shielded?

How can you tighten and enter a shoe without laces?

After the workshop I summarized the result. Gathered all the ideas and categorized those according to my problem areas.

Many good ideas concerning the heat problem were generated, and how ventilation can be created.

The participants came up with some interesting ideas about how to put on the shoes and tighten them without using laces. A good foundation was consolidated before the sketch process begun.
Before sketching I created three different boards that would symbolize the expressions that I want the final product to reflect. These boards will serve as inspiration and reference for my product.

Since my aim with this project is to create a new standard for the new generation of work shoes, it means that I have the opportunity to explore new forms of expression by creating a completely new design language. An opportunity I will take advantage of.

Each board has its own purpose because they symbolize different focus areas, but together they’ll make the product feel coherent and uniform. An important focus point when I made these boards, was that each one should be able to fit in the original context.

The three boards that I have produced focus on feeling, form and materials.

EXPRESSION

The work as an auto body painter is a precise profession, it’s all about detail and delivery. I wanted to capture this feeling in my moodboard, and also the feeling of elegant movement, which is the way a painter moves inside the paint booth.

MOOD BOARD

The final product is still going to be a work shoe, but the new generation of it. More futuristic and modern, but still with the classic feel and appearance.
Detail is important in this profession, and through details you can really tell a story. I want the details and shape of the final product to show that this is a product you can count on, that is reliable, high tech and made for its users.

The form board is quite context driven, you should be able to tell that the final product belongs in a paint booth, even if you see the product outside it's right environment, you should be able to tell were it belongs.

The material should show that the product is durable and resistant against paint dust and solvent. The shoe is capable to survive in it’s extreme demanding environment.

The shoe should feel sleek, flexible and innovative. The expression should reflect agility and support any kind of movement. Mixing the right material with the right technology.
Using the results from my workshop and inspiration from my boards, I began sketching. Throughout the sketch process the focus was on my problem areas; heat, protection and wear of the outsole. Mobility is also extremely important, so I wanted all the sketches to convey that expression and feeling.

I explored the possibilities to interchange different parts of the shoe, new materials and constructions. I also explored the possibilities to make use of the existing environment, transforming the negative into an advantage, into something positive.

The best ideas from these sketches were then summarized into three different concepts.
CONCEPT 1

This concept takes advantage of the existing air pressure system inside the paint booth, the same system that is used to power the spray gun and the respirator hood. Using the air to provide ventilation in the shoe, through cold compressed air, and also to use the air pressure to tighten the shoe.

The outsole contains of two interchangeable pieces, so you’re able to change these parts when they’re worn out.

The upper is made of the same rubber material that rubber boots are made of, but less thick, so it’s more flexible. This material is solvent resistant and easy to clean.
CONCEPT 2

I wanted to really capture flexibility with this concept: less shoe, more opportunities. This shoe is basically a sock construction with a sole. The upper is made of breathable textile that is solvent resistant and waterproof.

Helpful details such as a pull tab makes the shoe easy to handle. There’s also a removable carbon fibre toe cap, so the user can decide if extra protection is needed or not.

The outsole is interchangable and it features a hole grid, this detail makes it possible for the ventilation of the shoe to be powered by the ventilation underneath the paint booth floor. The shoe takes advantage of its surroundings.
CONCEPT 3

This concept really explores if it possible to create your own ventilation while walking. The shoe features a midsole with a bellow system that creates its own ventilation each time you take a step.

The upper is made of a transparent and solvent resistant material, that embraces the color and paint dust. So after a while your shoe will be in a solid grey color, but only after you earned that color by putting in working hours. A sign of dedication and hard work.

Inside the shoe there’s an inner sock, just for comfort. The inner sock features an auto lacing system which automatically adjust itself after your feet, since they could swell in heat, so you always have that perfect fit.

This system is powered by a small generator that turns your movement into electricity.
As part of my design process, I went to Umeå Billackering to get my concepts evaluated by my users, and to collect information that can be valuable for the final direction of the project.

I presented my three concepts for Robin and Desiree, and then we talked about the pros and cons for the different concepts.

Their favorite concept was Concept 2, because the shoe looked very movable and comfortable. They liked the fact that the shoe was a hightop and works like a slip-on.

The idea of using the existing air pressure system would be “cool” if it worked, and it would be no problem having hoses inside the coveralls, attached to the shoes.

They felt that it would not be a major problem to change outsoles and other parts of the shoes after wear, because this is an operation they are used to, especially when it comes to the maintenance of the full face respirator hood.

The advantage of Concept 2 and 3, was that the two are “self-sustaining”, they create their own ventilation automatically. We concluded that a mixture of all these details could create a very good final concept.
After evaluating my concept with my users, collaboration partners and project supervisor, I created a list of requirements with all the components that my final concept will contain. The final concept fulfills all the functions listed in the function list.

Ventilation should come through the hole pattern in the midsole and at the bottom of the outsole. This way, the existing ventilation in the paint booth can be used to solve problems with too warm shoes. As an option, it will be possible to use the existing air pressure system, which means that an air pressure connection must be available as an extra unit.

The upper of the shoe will be made as a sock, using material that can survive the intended environment. The midsole should extend as a heel counter to provide stability and support for the foot. The midsole also rises a bit on the front side of the foot. That area is designed to provide extra protection when the painter kicks the hose in the paint booth.

A reinforced area will be located at the toes, to prevent wear and create some stability in the upper construction. Elastic material will be placed in strategic locations, to make the shoe easier to put on, and use.

The insole is also a focus, with potential to increase the comfort and the feeling when you use shoe. The insole includes a pattern massaging the footbed. After exploring reflexology, the pattern will be adjusted to best suit the auto body painter.

This pattern will also be found on the inner lining of the shoe for comfort and massage. Since a auto body painter is standing all through-out the shift, it is only natural that your feet hurt after a week’s work. The pain can be prevented by this pattern, that massages the muscles in the feet and makes the blood circulation continuously strong.
Further development of the final concept consisted of a lot of forming work. During this phase, I explored the expression and form through sketching, three-dimensional work and digital visualization.

The final design of the product is determined during this work. The development of the air pressure connection and a color analysis of the context will be presented.
When the final direction of the project was determined and I had clarified my requirements list, the true forming work could begin.

During this process, I tested different expressions, while I tried to get all the components to fit together nicely, in a way that felt natural and right.

The focus was to create an attractive silhouette, representing all the values and emotions that my boards symbolized, but most important was to highlight all the special features that I wanted to include.

The outsole pattern was explored, and it was important that the pattern would match the overall design language, creating a uniform look and feel.

SKETCH DEVELOPMENT
In parallel to my sketch work, I built a clay model in the workshop, to be able to explore the shape, ideas and thoughts in three dimension. This was also a good way to get the proportions right for the shoe. I wanted it to be experienced as lightweight and flexible, yet sturdy and durable.

The clay model changed a lot during this phase and everything was carefully documented. Pictures of the model were used as foundation for further sketch work.

One advantage of working with the clay model was that I could examine all views simultaneously, and I really came to understand how some forms would work together. A lot of time was spent on designing the heel counter and midsole, and much of this work was done on the clay model, because I could quickly build up different volumes and hole patterns.

When I was getting closer to the form and expression that I liked, I made some more advanced digital sketch renders on this concept, making it easier to demonstrate the concept to collaborations partners and users for feedback.

At this stage, I had a defined silhouette and clear side views of the shoe. Much time was spent making accurate paths of the shapes digitally, helping me getting the proportions exactly as I desired.

After much exploration of the pattern on the sole and insole, I came up with a pattern that could be applied over the entire shoe, which also feels connected to my chosen form language.

Renderings were produced of the insole and the inner lining of the shoe – an easy way to visualize how the massage pattern would look and function.
FORM DEVELOPMENT

After I presented the digital sketches for my collaborations partners, I made some changes to really be able to optimize the shoe’s purpose and design. It was very good to get an extra push to continue develop the form to really get a completely worked through design.

The silhouette was adjusted a bit, to more resemble a running shoe, this is required because a car painter moves so much every day. The pull tab and the pattern was changed due to the design seemed recognizable, something you’ve seen before, and my goal is to come up with something new and fresh for this project.

The sketching of the new shape and details was done both analog and digital, but most digital since I already had a good base with some of the exact proportions that I chose to keep.

The design of the shoe’s lateral side is now different from the design on the media, this is due to the different sides require different attributes, to really optimize the shoes purpose.

FINAL SHAPE

To really verify the final design of my product, I went down to clay workshop again to adjust my model according to the latest sketches.

This time I defined the final details and decided how the different split lines and materials meetings should be designed. Focus was to get the right proportions and sharp lines.

The final design of the heel counter was defined during this process, as well as the outlet pattern on the midsole.

Much time was spent completing the different surfaces on the model, to get them as accurate as possible. The idea was to use my clay model as the basis for the final model. Make a cast of the clay model, and then create a solid plaster model.
Once the final design of the shoe was determined I could spend some time designing the air pressure connect. This connection unit will be used to regulate the flow of air in the shoes if desired.

The form development of this product was mostly done by 3D modeling, because the right dimensions were of great importance. The connection must be able to fit with the existing compressed air couplings used in the profession.

After the correct dimensions had been decided, sketching were done to produce the final design of the unit. The design is very driven by functionality, the two hoses connected to the shoes should fit, together with the switch that allows starting and stopping the flow of air.

Screenshots of the 3D model was printed to be used as a underlay during the sketch process. It was important that the design of this unit would reflect the design and form language of the shoes.
Because the final product should belong in its context, the colors of the product is extremely important. The colors should blend in inside the paint booth, along with other products a auto body painter uses.

Therefore, I analyzed the colors usually found in a paint booth, in order to produce a color board, which I can use in order to decide the colors for my product.

I also investigated the most common equipment found in this environment. Most products are in the same grayscale colors that can be found inside the paint booth, but with details in a clear accent color.

The picture to the right is a compilation of the most common base colors that are found in this environment, as well as the most common accent colors used in this industry.
In the last part of the project the final product and the design is presented. Details and features will be highlighted and explained.

The material and color choices will be shown, and the product name together with a clear overview summarizes the concept.
The final result shows a whole new vision for future work shoes within this profession. A product that meets all requirements for use in the intended environment.

With this product, I want to change the standard for how a work shoes should look and function. Challenge the industry as it exists today and show that development is necessary for this profession.

The choice of materials, functions and the execution of the final design will together create the ultimate product created for its users.
The final product is equipped with the functions and details necessary to facilitate the work for the auto body painter. Functions that are active during the whole day, contributing more efficiently and extending the lifespan of the product.

The midsole features a reinforced heel counter, offering stability and keeping the foot in place during work. The outsole creates good traction against hard surfaces, and has added thickness for a longer lifespan. The sole offers ventilation and comfort for its user.

Elastic parts in the upper makes it easy to put on the shoe, and helps creating a perfect fit. Details like a stretch cut and a pull tab makes it easier to handle the shoe.

FUNCTIONS

The characteristics of the shoe enables flexibility during all the different working positions. This, together with the light weight, makes the product really adaptable and mobile. Strategic flex grooves in the sole makes it possible for the shoe to flex in all directions.

SUPPORT

Elastic parts in the upper makes it easy to put on the shoe, and helps creating a perfect fit. Details like a stretch cut and a pull tab makes it easier to handle the shoe.
To present a clear overview of the final design, orthographic views were created. This way, it is easier to visualize the right proportions of the shoe, along with the feel of expression and fit.

The design of the lateral side is different from the medial side because both sides of the foot have different needs and requirements that I wanted to address. The foot is more flexible on the medial side, demanding more need for stretch possibilities.
The inside of the shoe is designed for the user’s increased comfort and well-being. The inner lining and the insole is composed of soft nubs, offering massage, which improves blood circulation in the foot and thus counteracts pain after a long working day.

The insole features a hole pattern allowing ventilation. Hole patterns and ventilation channels are found inside the shoe, maintaining a comfortable temperature during use.
In order to offer true mobility, the outsole features a series of flex grooves that go through the rubber, making it easier for the sole to bend. The hole pattern in the sole facilitates lateral movement and reduces the overall weight of the outsole.

The parts of the upper consisting of elastic material make it easy to move around in the shoe, although the top is quite high and tight. This is required for the auto body painter to carry out their work without irritation.
The final product is able to use the already installed air ventilation inside the paint booth in order to create a consistent flow of air inside the shoe. Most facilities have a paint booth made up of metal grid floors. The main ventilation is placed below this grid. This ventilation creates a constant flow of air sucked down through the floor of the paint booth.

The shoe uses this ventilation through the hole pattern found in the outsole and insole. This way the air can pass straight through the shoe, creating a flow of comfortable temperature. The midsole also has a hole pattern that connects to the internal channels, to create an optimized air flow.
To further enhance ventilation it's possible to connect the shoe to the air pressure system inside the paint booth. This system provides a constant pressure of cold air.

A tube is connected to the heel counter, and the air travels through small vents that emit air at different places inside the shoe.

Control of this flow is done by a air pressure connection unit, that is connected to the full face respirator hood unit.

This unit is part of the belt that is worn during the work in the paint booth. The narrower tubes from this unit run inside the coverall and can be attached to the shoe by a piece of elastic that holds the tube in place.
The air pressure connection is connected to the belt that the auto body painter is wearing. The unit is connected between the respirator hood’s fresh-air filter and the existing hose inside the paint booth.

The control knob is facing out from the body, to facilitate handling of the air flow. Two tubes exit the connection, and lead to each shoe, which means that the controlled air flow is the same in both shoes, at all times.
The final product’s materials are able to withstand the extreme environment inside the paint booth. The materials are lightweight, mobile and sleek, to really suit this profession.

The upper is treated with a thermoplastic polyurethane coat, which is resistant to paint dust and solvents.

The midsole is made of a lightweight material, coated with protective paint. The outsole is made of soft rubber, which creates great traction against the metal grid. The rubber is also changed by the heat in the box, which contributes to additional traction that creates even better grip.

The elastic parts and the inner lining of the shoe consist of the same material — flexible and easy to mold with heat.
FRM Aircon comes in four different colorways. In addition to the standard colorway, there are three other color combinations to choose from: Safe, Sport and Stealth.

All colorways are based on the color analyze of the contextual environment, created to express various emotions.

The standard version is simple and fits in the environment. The colorway Safe is made to feel more secure and more stable, while the sport version feels easy, clean and fast. These colorways contains more accent colors to further stand out.

Stealth is a premium version, signaling an expression of precision and attitude.
Newly registered cars:

http://www.bilsweden.se/publikationer/pressmeddelanden/nytt-bilrekord-att-vanta-for-2016

Injuries:

“Dokument av anmälda arbetssjukdomar för sprutlackerare (yrkeskod=7132)”, from Kjell Blom, investigator at Arbetsmiljöverket.

Amount of auto body painters:

Information from Stefan Cedermark, representative of Svenska Målareförbundet.

Other:

I have collected facts about how much a auto body painter moves per day and how hot it is inside the paint booth, and in the oven, through my visits in the different workplaces I’ve visited, workplaces have thermometers indicating the temperature inside the booth, and I used pedometers to see how much my users moves during a working day.

To get a clear picture of what is happening in the industry right now, I have experienced and documented materials and methods development in the places I have visited.
To end this report, I like to say thank you to the ones that have been supporting and helping out during the process. Not only for this particular project, but for the last few years. Since the 17 year old boy on the picture to the right painted his first fender, until now.

Ulrika Eriksson - Mom
Roger Eriksson - Dad
Hanna Eriksson - Sister

Grandma och Grandpa

Family and friends in Västerås

Classmates

Other friends all over the world

Widells Bilplåt
Umeå Billackering
Autolacken
Attention
Pensole

Mats Eriksson - Teacher at Westerlundska
Johan Gustavsson - Internal project supervisor
Paco Lindoro - External project supervisor
Per Sihlen - Examiner
Eva-Lena Backström - Examiner
D’Wayne Edwards - Founder of Pensole
Suzette Henry - MLab
Berker Diker - Industrial designer Attention
Martin Pråme - Manager Attention
Ludwig Ostman - Maya expert
Tomas Lindhäll - Laser scan expert
Robin Backström - Umeå Billackering
Desiree Olund - Umeå Billackering
Magnus Ohgren - Umeå Billackering
Anders Ögren - PPG Industries
Jonas Sörensen - Widells Bilplåt
Viktor Vestling - Student at Liljaskolan
Micke Andersson - Teacher at Liljaskolan
Tobias Wallin - Sociology student
Daniel Rosenblad - Sociology student