NEW
COMMUTING
EXPERIENCE

LAHDEN AMMATTIKORKEAKOULU
Lahti University of Applied Sciences

NEW COMMUTING ***EXPERIENCE***

LAHTI UNIVERSITY OF APPLIED SCIENCES
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CHRIS LUCHOWIEC

Lahti University of Applied Sciences
Institute of Design and Fine Arts
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Chris Luchowiec
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Abstract

The self-assigned task for this graduation project was to look into the problem of daily commuting and urban transportation issues in Finland in order to envision a new, sustainable and enjoyable transportation solution accessible for all members of society.

The theoretical part comprised observations and analysis of local conditions, social aspects, technological research, and a literature study about emotional and sustainable design. Due to the great complexity of the issue and limited amount of time to conduct the research, this project gives only superficial understanding of the problem. However, it is in-depth enough to create a totally new solution.

The project includes service design which I used as a basis for the vehicle concept development. Such approach allowed me to create a consistent, multi-layered vision of future transportation system.

The main emphasis of this design work has been put on creation of the vehicle concept which is the visual representation of the transportation system concept. The usability and accessibility aspects have been brought into focus I also paid a lot of attention to emotional aspect of design as I wanted to enhance the form with positive feelings and give the vehicle it's own, distinguishable and affectionate character. Due to futuristic and conceptual nature of the project I did not attempt to solve all technological issues. The final result is a friendly-looking autonomous vehicle concept called 'Bot', supported with a service presented in a storyboard. Together they stand for my vision of new commuting experience.

This project is also personal manifest of my own interests, opinions and concerns about various issues (ecology, sociology, psychology, economics) In a way, it is a representation of design ideology that It want to represent. I believe that no matter what field designer is focused on, he should always understand the bigger picture and make carefully considered decisions. This work also shows how challenging it is for a lone designers to find the right answer for such complex problem as transportation system. It leads me to a conclusion, that such projects should be carried in teams of experts from different fields. Therefore this project should be seen as just an inspirational material for city planners and vehicle manufacturers to consider, not a turn-key solution.

Key words: sustainalbe transportation system, autonomous vehicle, socio-behavioural change, emotional design

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1. Introduction


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1.1 Subject

Every morning hundreds of thousands of Finns get into their heavy cars and drive to work. Just as many people wait impatiently for their bus or train, hoping that they will find an empty seat. They are all commuters, and on average they spend half an hour every day to get to work. It is a daily routine they may not necessarily like - they get frustrated every time they get stuck in a traffic jam or they miss their connection, forcing them to wait, often in cold or rain, for a next one. They may feel powerless, out of control of this part of their day. Their punctuality is frequently on the mercy of other drivers or the weather. Commuting has often negative influence on peoples' mood. They find it stressful and unpleasant. What's worse, at some point it may even lead to health issues such as neck and back pains, obesity and insomnia. Such problems may occur especially with longer commutes. It has been even proved by researchers that commuting may lead to the feeling of social isolation! And then there come environmental issues. While public transportation does quite well in that matter, there is no good excuse for people to use vehicles that weight over 1 ton just to move their bodies that weight less than a tenth of that every single day. It's just extremely wasteful use of our Earths resources. And if you just take a look at a road, you'll notice that most of people are driving those heavy, metal 'cages' just by themselves.

This lead me to a question - how can we improve the existing situation? Should we all be forced to switch to public transportation and bicycles? Or perhaps there is still space for a new, personal mean of transportation? New technologies, electric engines and capacious batteries prove that it is possible to create vehicles that are much more efficient than those big, gasoline powered, fume emitting cars. In recent years more and more such concepts have been appearing and some fresh ideas are already finding their way to the market. However, those designs are mostly technology-driven. I am convinced that we should take more holistic approach to the problem of commuting, not only thinking of technology, but also of desirable user experience, related services and in bigger picture - of its possible social and environmental impact.

Seeing existing problems, I got inspired to create a clear vision of sustainable, innovative and desirable **commuting experience**. But I didn't want to focus only on commuters - the best solution would be the one, that would include and address needs of all members of society. Is that even possible?

1.2 Theoretical basis

I approached the problem firstly by gathering the knowledge about local conditions, society and existing transportation solutions - thus giving me better understanding of the conditions I wanted to address. I wanted to deal with only up-to date information, therefore I used Internet as my main source of information. I was also trying to confront found the information I found with the observations I've made on my own. I also used web as main source of information for the research of new technologies, as it's the easiest way to find out about scientific findings. However, my approach to environmental and sustainability issues and user experience design, which don't get overdue that quickly, was based on literature. My thinking and approach to design was greatly influenced by texts written by Victor Papanek, Dieter Rams, Patric W. Jordan and Donald A. Norman, who covered environmental, sociological, ethical and psychological issues that many designers tend to so easily forget about. It's important to note that most of the knowledge found on the next 40-or-so pages was just a basis for me to create a brief and get an idea what to do. Some findings may not directly relate to the final result, but being aware of them may have affected my way of thinking and allowed me to make more concious decisions. I did not carry any surveys as I believe that even people who do notice those problems don't really know solutions to them. And I just didn't want to do tedious questionaries just to get statistical proof of existence of problems with different means of transport in Finland, that I have already observed myself. Most of car-commuters I have talked with did not even see any problem with the practice of lone-driving - therfore how could they help me to find a more environmentally friendly solution. One hundred years ago Henry Ford said:

If I had asked people what they wanted, they would have said 'faster horses'.

Nowadays people would more likely ask for cheaper gasoline and more (free) parking spaces.

A good hockey player plays where the puck is. A great hockey player plays where the puck is going to be.
- Wayne Gretzky

Following the logic of Wayne Gretzkys (a Canadian sportsman who was called to be 'the greatest hockey player ever') words and those of Henry Ford, I decided that I should come up with something people haven't thought of yet, that actually might need. I asked myslef a question - could there be any other way we could travel within cities? Is there a way to encourage people to get rid of their cars without forcing them into overcrowded buses and trams or asking them to cycle in the rain, snow and mud?

Once I found my lightbulb, I immeresed myself in a lone, long creative process, trying to give my idea a truly humane form. Ocasionaly I was confronting it with other people just to ensure I was on the right track. However, at some point I realised that the problem wasn't really about getting and visualising an idea - considering the amount of creative minds around the world, it's just selfish to think that no one else has ever had similar one. The real challenge was how to communicate that idea to people in an easy way, so that they would understand the problem and really want the new solution. This book is not really about doing that. This is just a report of my design process and unlike the final presentation (which hopefully will be also available in a video form), it might hardly arouse great excitement. It should, however, give you, dear reader, knowledge of my findings and better understanding of the reasons for my certain design decisions.


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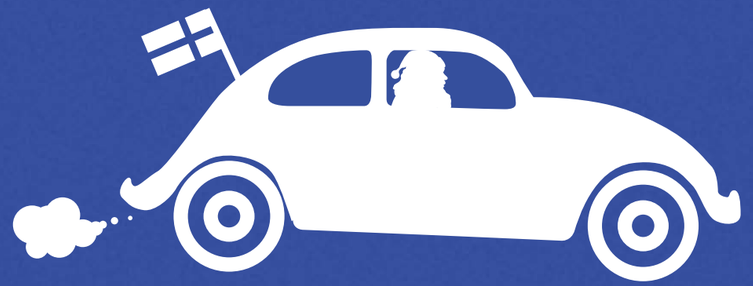
2. Commuting in Finland



commute - to travel some distance between one's home and place of work on a regular basis.
- Oxford Dictionary

I believe that a designer can only come up with good solutions for problems that he personally observes and understands. Therefore I decided to choose Finland as a setting for this project - the country in which I currently live and study. Experiencing and observing local conditions and people has crucial influence on development of the project. I think that there is no single solution for commuting problem that would work on a global scale - in any country, any agglomeration and in any culture. Instead I want to focus my efforts on a smaller scale which will allow me to get greater understanding of the situation I am dealing with. In this chapter I will introduce the commuting reality in Finland. However, firstly I'd like to focus on the bigger picture, by characterizing Finnish nation, it's economical situation, attitudes and conditions people live in.

2.1 Society

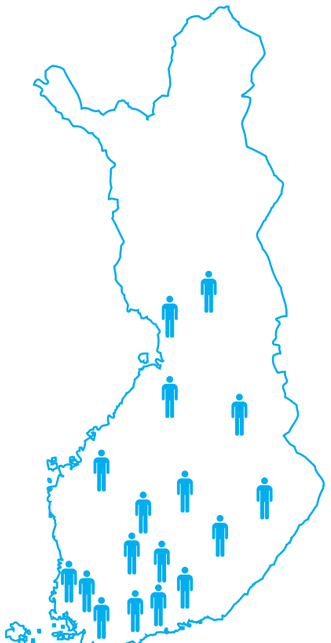
Population
Finland is a North European, well-developed country, Despite its size (with 338,000 square km it's the 8th biggest country in Europe), it has only 5,5 million inhabitants - making it the third most sparsely populated country in Europe. However, the distribution of population is very uneven - it is concentrated on southwestern region of the country. About one 1,4 million people live in Greater Helsinki - metropolitan area containing Helsinki, Espoo, Vantaa and surrounding commuter towns. It means that 25% of population is inhabiting only 1% of Finnish area! With progressing urbanization, by 2012, around 85% of Finns lived in towns in cities. Despite that, there are only 8 cities with population greater than 100.000.

5,5 mln
PEOPLE LIVE IN FINLAND

4,6 mln
OF THEM LIVE IN CITIES

1,4 mln
OF THEM LIVE IN GREATER HELSINKI

Attitudes
Finns are nature-loving, peaceful people. Equality and honesty are important values in this country of thousands of lakes. In fact, they were the first nation to give women the right to vote in 1906. They are also very dedicated people - whatever they need to do, they do it with focus and efficiency. Finnish people gained their welfare after second World War through hard work, partly motivated by having to pay off war reparations to Russia. It is fair to say that Finns know how to quickly respond and adapt to new challenges and circumstances. Their strength of will, determination, decisiveness and perseverance in the face of adversity, which they call *sisu,* is deeply rooted in their culture - and they are proud of it.



Finns and technology

Finland was leading nation in development of mobile communication network, with Nokia as the worlds biggest phone manufacturer for many years. Already in 1998 the number of cell phone subscriptions outnumbered fixed-line phone connections and in mid-2007 number of cellular phone subscriptions made up for 109 (!) percent of the population. Use the of Internet also quickly became a common thing. With almost 96% of the population online, in July 2010, Finland was the first country in the world to make access to Internet a legal right. Finnish people are not only connected; they are also heavy users of online services. For years public libraries and schools have been connected to the Internet. Also many social services are easily accessible online. It is truly one of the world's most advanced information societies, quickly and willingly welcoming and adapting new technologies to their every day life.

Finns and environment

Finns value being close to nature, they spend a lot of time in their summer cottages, usually placed by a lake or sea, far from civilization. Therefore ecology is very important issue for Finns. They willingly participate in recycling, build energy-efficient houses and carefully manage their forest resources. They pay a lot of attention to execution of laws by the enterprises, house owners and to other things on which the state of environment depends. It is Finland's great strength how environmental protection is considered in all sectors of society combined with highly effective environmental administration and legislation. It is worth noticing that the purest water in the world is in Finland, where 80 % of it is classified as exclusively pure. Finland has been rated among the world's top countries in many international comparisons of environmental protection standards, such as the Environmental Sustainability Index regularly compiled by Global Economic Forum. However, not all comparisons are so positive. Improvement is still needed due to Finland's large ecological footprint, high levels of energy and material consumption, and, last but not least, excessive greenhouse gas emissions.

Finns and design

Finnish people understand the need for good design in their lives. They have long tradition of creating simple and very functional objects. Finland has many valuable brands known around the world, such as Fiskars, Iittala, Marimekko, Nokia, Genelec, Suunto and others that constantly push the envelope of quality in design. Finns are willing to spend more money to get extra value that comes with well designed products - you can find such objects in every Finnish household. In recent years the idea of using design methods to improve services has been introduced and kindly welcomed by many public and private institutions.

Finnish lifestyle

The Finnish family life is typically based on the nuclear family model. Couples have one or two children. Nowadays, both men and women are providing for the family by having a full-time jobs. Their children seek independence quite early in their lives, typically moving out from their parents' residence around the age of twenty and settling in private apartments. Finns really value their privacy. It's very uncommon for them to share their room with someone, single people prefer to live by themselves as long as they can afford it. It doesn't mean that they are unsocial, it's more that they want to be in better control of their social interactions. Having own, quiet, personal space means much more to Finnish people than to many other societies such as the Mediterranean or Asian ones for example.

2.2 Conditions

Financial situation

People living in Finland can enjoy one of the world's most extensive welfare systems that guarantees decent living conditions for all residents. Finland's per capita output of $36,700 (by 2011) places it among other western economies such as France, Germany, Sweden or the United Kingdom. Finland ranks among the top countries in terms of salary equality (with its Gini Index of 28.2 by 2010), although that has been deteriorating in recent years. With ongoing economic crisis the rich get richer but the poor get poorer. By the end of 2012, the average monthly earnings in Finland was around 3200 euros. Despite its small economy, with GDP (Purchasing power parity) per capita of $36,236 Finland can be considered as a wealthy nation.

Distances

The growth of urban areas means that more and more people are forced to commute to their work places which are distant from their residences. According to Finnish Environment Institute SYKE, the average commute in 2007 was 13 km - distance that has doubled in past twenty years. Such distance can hardly be considered as walkable.

Unfortunately there is barely any reliable data on commuting times in Finland. It has been estimated that the average time is around 38 minutes, but it doesn't really tell the whole story. Finland is a country of low population density and long distances. In rural areas the work travels may be long in distance not that long in time. It is better to assume that collected data only gives a hint of commuting times in Finland and cannot be considered as very reliable.

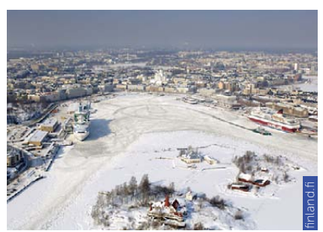
Helsinki Region Environmental Services Authority (shortly HSY) has been monitoring amount of people commuting to the capital area and it noticed that such practice has increased rapidly in recent years. Over 35% of all employees in areas distant up to 50 km from Helsinki Metropolitan Area are daily travelling to capital region. And there are thousands of people who commute

to HMA from regions 150 to 200km away - a practice that didn't even exist 40 years ago. Statistics are showing a trend that people are much more willing to travel even very long distances to their workplaces. That obviously means increased traffic and consequently air and noise pollution.

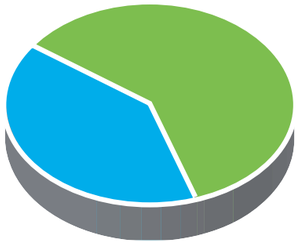
Roads
There are around 80.000 kilometres of public roads, 65% of which are paved. Speed limits depend on the time of the year; on motorways it varies between 120 km/h in the summer and 100 km/h in the winter, while main roads usually have limits of 100 or 80 km/h. In urban areas speed limits vary between 60 and 30 km/h. Due to small population size and low population density, the traffic congestion is not problem in Finland. The most of actual traffic jams occur on the major routes to Helsinki, affecting people who commute to work in the metropolitan area. However, these traffic jams are fairly small compared to those in bigger metropolitan areas such as London or Berlin.

13km
Average commute distance in Finland

38.5
Minutes Finns spend on average every day on commuting according to Statistics Finland



Climate
Finland's climate has big influence on peoples lives with it's huge diversity - long, dark winters, relatively short springs and autumns and fairly warm and bright but rainy summers. Although Finland can enjoy milder weather than other regions of the world situtated that far north (i.e. Syberia, Alaska), its climate is still relatively colder than of most European countries. Climate of Finland, as it is close enough to Atlantic Ocean is affected by the Gulf Stream that flows off Norway's west coast. Many lakes and long coastline with Baltic Sea help give the country a relatively mild climate. Summer temperatures in Finland average 13° to 17°C with few warm days inland reaching 35°C in July . Finland's winters are long and cold with February being the coldest month of a year, with temperatures often falling for many days below -20°C. In northern Finland, winter temperatures can drop as low as -30°C or even below, sometimes with strong winds bringing cold continental air from Russia. In southern Finland the land is covered by snow from about late November until mid-April. In northern Finland winter can last as long as 200 days, and it is snowbound from October to even first weeks of May. In winter most of the country is icebound giving Finland hard driving conditions and forcing many drivers to use studded tires.
In winter, Finland has long periods of continuous darkness. While in the northernmost, barely inhabited areas of the country the sun stays below the horizon for almost 2 months, southern Finland receives about 5-6 hours of daylight a day in midwinter. Short days are know to have negative effect on people's mood - depression is a common symptom of not getting enough sunlight.



Wintry, slippery conditions in southern Finland can last up to 5 months - 40% of a year!

2.3 Transportation
Having presented some basic knowledge about society and living conditions in Finland, let's get to the merit of this chapter - how Finnish people commute to work. As Finland is located far from the main transport and logistic arteries of central Europe, its traffic has mostly domestic character. Finland has well developed network of roads, motorways and rail tracks, making it ease to move around. The most popular way to commute to work in Finland is by car and by public transportation: buses, trams and metro (the last two can be found only in Helsinki). Many people use trains, especially in Greater Helsinki due to its good urban network (commuter trains). Cycling has been gaining popularity, but due to tough winter conditions it still seems to be mostly a seasonal habit. I will discuss all these transportation types, tell about their characteristics, advantages and disadvantages.

Public transport
Public transportation has been gaining popularity with the increasing costs of driving and maintaining a car. Costs are reasonable as long as monthly tickets are purchased, otherwise it can be very costly with frequent trips. Helsinki region has really good public transport system (HSL) that incorporates buses, trams, metro and local commuter trains. An electronic travel card allows to easily and freely use all of of all the mentioned above.

150000
PEOPLE COMMUTE DAILY BY TRAIN IN GREATER HELSINKI REGION

Trains
Rail is the most environmentally friendly form of transport because of its energy efficiency and low carbon dioxide emission. It has been measured that train energy consumption and fume emission are approximately five time smaller than those of passenger cars. Finland spends around 350 million euros every year on maintaining 6000 kilometres of railway tracks. There is only one, private operator of the tracks - VR Group, which has 5% of overall passenger market share. It's worth noting that 80% out of its passenger trips are made in Greater Helsinki. In 2008 a total of 69.9 million journeys were made in passenger traffic. VR trains are clean, reliable and usually on schedule. Train connections go to all the major cities and many rural areas, and if necessary, they are complemented by bus connections. There are high-speed trains complemented by modern Intercity connections that go from Helsinki to other major cities. Unfortunately, due to high ticket pricing they are not an attractive option for every-day commutes. Cheaper, older long and short distance trains operate in areas with fewer passengers.
The most popular train connections are within already mention Greater Helsinki, where people can use fairly priced and regularly scheduled commuter trains. The whole region is divided into zones and the ticket price depends on the amount of zones being travelled through. Commuters can purchase an electronic monthly ticket (HSL travel card), which brings big savings comparing to single ticket purchases.

In recent years VR focused on increasing eco-efficiency of its trains. The enhancements came through increasing the percentage of electrical trains, bringing the proportion of electric traction up to 83%. Nowadays most of trains are equipped with electricity saving devices that recover energy

from breaking back into the power line. Such solution recycles 25 percent of commuter train braking energy back into use.

Trains are affordable and efficient way to commute to work. However, they are not a perfect solution. There is a so called problem of 'the last mile'. A train can take you only to another train station and if the workplace is not near enough to walk, a person has to switch to a local public transport or a bike. It not only increases the time needed to get to and back from work, but also has negative affect on a persons mood. The feeling of being out of control, nervosity about the possibility of missing the connection if late, and frustration when a train is out of schedule does not contribute positively to a human well-being. That is not such a big problem as long as trains run often (every 5-15 minutes), but if any technical issue emerges or if a heavy snow storm comes, the waiting period can extend exponentially. Also having to squeeze into an overcrowded car or seeking an empty seat when feeling tired can bring anxiety and increase stress.

Buses

Bus services play a major role in the public transport. Local bus services inside cities and towns are regulated by the councils, meaning that they differ from town to town. In all Finnish cities there are enough connections to easily move around. The level and reliability of bus services is often dependant on local levels of traffic congestion, and the population density. In the big cities buses are driving quite often, yet their speed might be heavily affected by traffic. In more distant districts, they don't go as often but they may be driving significantly faster. In big cities bus services operate on specific timetable giving times of departure and arrival at waypoints along the route, but in less populated areas with few regular commuters timetables may not be that reliable. In Lahti, for example, schedules only show the time of bus departures from marginal stops, forcing people to guess how much time it will take the bus to get to their stop. New technology is increasingly being used to improve the information provided to public bus users. Vehicle tracking technology is becoming more and more common. It helps with scheduling and allows displaying live information of schedule at bus stops.
One of the problems related to bus services is a phenomenon called bus bunching. It has probably happened to all of us when we waited for a delayed bus and when it finally arrived, it was followed by buses of same line turning up on a stop almost simultaneously. This can occur in rush hours when number of passengers at a stops rises, increasing the loading time, thus delaying scheduled service. Due to fewer passenger waiting, the following bus then catches up and, to annoyance of people, appears on the stop right after the previous bus.
Buses service is an efficient way to transport people around cities, however it can hardly be called tthe most enjoyable one. Apart from easily occurring delays, the passengers have to deal with not very smooth rides. It is often full of rapid breaking and tight turns which create forces that can throw a standing person across the bus, if he or she doesn't hold the hold tight enough. For Finns, who value their social distance zone, being in an ovecrowded bus is not the most enjoyable experience. Luckily it doesn't happen very often, even during the rush hours in bigger cities.

Metro

Metro is one of the best possible ways to move across metropolises. Helsinki Metro system, opened in 1982, currently consists of seventeen stations. The Y shaped line connects the city centre with the eastern suburbs. With trains running every 4-5 minutes, there is little time wasted on waiting. Many bus transport links are running between the metro stations and the surrounding districts making it a core mean of transport. Taking a bus to the nearest metro station is often the only option to get to the city centre from some of Helsinki districts. The Metro is by far the cheapest form of transport in Helsinki to operate - the costs are 7 times smaller per passenger kilometre, than the cost of operating trams. It uses almost two times less energy per passenger kilometre comparing to Helsinki trams. It is also one of the most enjoyable means of public transport. With very few delays, spacious, long trains, and underground station sprotecting from unpleastant weather conditionst, there

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are few reasons for people to complain. Building a metro line is extremely expensive, meaning that only big metropolies, located on a solid ground, can afford it. It also requires years of planning - building only 20 kilometers of Helsinki metro took 27 years. Other Finnish cities, usually placed on soft, wet ground, can only dream about having own metro network.

Trams

Helsinki's electric tram network has existed since 1900. All of the tramways are located on the streets, both in mixed traffic and on dedicated tram lanes. The network covers the densely populated central districts and some of the surrounding areas. Over 50 million trips are made with Helsinki trams each year. The tram network has been modestly expanded since 1950s. However, seeing its growing popularity and efficiency, Helsinki Transport Council has recently made plans for its huge extension within next few decades. It's worth to note that Turku also had a tram network but it was closed in 1972 and replaced by buses. At the time, buses were considered to be a more modern and practical technology in opposite to 'old-fashioned' trams. However, in 2009, the Turku City Council approved a plan for 2020 to build a light rail (similar solution to trams) for heavily congested routes, provided that finance situation will allow for such investment.
One of the main problems of tram network is noise and vibrations it generates, which may negatively affect living quality in tightly built-up areas. Such problem can be addressed by modernization of rail tracks - but it is costly and it may paralyse a whole tram line for a long time, if it is impossible to diverse the traffic. It is also very hard to build tram network in a city with established traffic infrastructure, where it would be impossible to fit a tram lanes into narrow roads. Such investment would also have to be backed with big number of potential users, which considering the scale of Finnish society, might not neccessarily be a case.

Other problems with public transport

The problems with using local public transport are similar to the ones of using trains. Having to adjust yourself to connection schedules, waiting in the cold or rain for a bus or a tram to come and having little privacy on the vehicle can discourage people from using public transport in favour of comfort of driving own car.
Most public transport services move

people in groups over scheduled routes, which in actually have inherent inefficiencies. For passengers, time is wasted on waiting for the next arrival, indirect routes to their destination, stopping for passengers with other destinations. Slowing and accelerating large weights can undermine public transport's benefit to the environment while slowing other traffic.
Public transport has to operate, even if there are no passengers. Half-empty or even completely empty buses are not a rare sight in Finland. It was really surprising for me, upon my first arrival in Finland, when a 50-seat coach bus from the airport to Lahti (100 km distance) departed with only 3 passengers on board - and it was afternoon of an ordinary day. It also wasn't the last time I had such experience, despite the fact that I rarely travel by bus. I've noticed that many bus lines in Lahti that reach sparsely populated districts, are often running empty after the rush hours. That forces the service provider to increase ticket prices to cover for lower income resulting from low passenger number. It's also not so environmentally friendly anymore. Besides, high prices don't contribute to the increase of popularity of public transport. Therefore I have serious doubts if mass transit services alone are that well suited for Finnish conditions.

wikipedia.org

Car commuting

Despite increasing popularity of public transport, cars are still the most popular way to move around Finland, especially in rural areas. Just as in most western societies, car increased social mobility and contributed vastly to existence of dormitory suburbs strangling the cities. There are almost 2,9 mln registered passenger cars, meaning that mathematically there is one car for every 1,8 people. Just to compare, in neighbouring Russia such rate is 3,7.

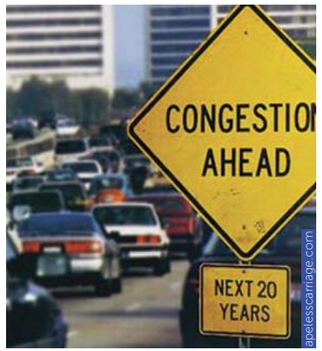
Finns have particular liking for cars, as it allows them to quickly travel directly to their destination in a comfortable way. However, in winter time they have to deal with arduous task of removing the snow and scraping the ice of the windows, warming up the engine and driving on slippery roads. Because of that, time saving factor which is a reason why many people still drive cars is a bit illusionary. However, that problem can be easily addressed with parking garages. Another problem with owning and driving a car is cost. Apart from high prices of new cars (vastly increased by Finnish taxation) there are constantly rising prices of gasoline, insurance expenses and costly repairs, which eat out big part of a personal budget. Because of that, many people decide to buy older, second-hand cars which contribute to high emissions of greenhouse gases more than new vehicles. Owning a car is considered as status demonstration and a sign of independence, thus few people are decide to give up the car entirely. Parking space has become a problematic issue in most big cities around the world, however it is fairly well dealt with in Finland. With paid-parking zones in the city centres, people are choosing their parking places more wisely. The idea of having to pay quite a lot of money for a parking space may discourage to use cars in city centres. It is a considered policy of city councils which want to encourage people to use public transport more often. It can be seen especially in Helsinki.

moo!.myshopify.com

MOST CARS ARE PARKED
90%
OF THE TIME.

2,9 mln
REGISTERED PASSENGER CARS IN FINLAND

The fact is, commuting in cars is a gigantically inefficient use of space - particularly when you can take a look around at traffic peak hours and notice that the vast majority of cars only have one person inside them. Very often both spouses have their own vehicle - for people who can afford it, it's much easier to drive own car. But think of it this way - people use machines that need enough power to move weight of around 1 tonne or more, just in order to transport a body that is than 10 or more times lighter. How inefficient is that! Just compare it to efficiency of using a bicycle, which weights roughly 15 kilograms and needs only little human-muscle power to move.
Another issue is unsustainability is in the manufacturers' interest for the customer to replace cars as often as possible. With current economy and sales strategies, companies are rewarded for unreliability, high maintenance and short product life.



apelesscarriage.com

Last, but not least, there is the issue of safety - most of commuting accidents include the use of a car. Hundreds of people are killed on road annually, and thousands get injured. It's not only a personal tragedy, it also has negative economic implications due to decrease in labour force and costly treatment.
Is car really the ultimate commuting vehicle, as it's so commonly perceived by western societies? I dare to say it is not.

Moped cars

In Finland known as mopoauto, these are four-wheeled micro cars with weight, power and speed limited by law. They are not heavier than 350 kilograms, and drive with the speed up to 45km/h. Because of such specification, only moped license is required to drive them, allowing 15 year-old teenagers to use them. Some commentators, including road traffic safety, have been concerned that the slow pace of moped cars can be hazardous to other traffic. Because of that these vehicles need to carry warning triangle sign on the back. Although seeing a moped car in Finland is not unusual, the general public opinion about them is mixed, and many


ikalehti.fi

people make fun of them and their users. Moped cars are safe and efficient way to commute, but not being able to keep up the pace with the traffic is a huge flaw.

Bicycles
As mentioned already, bicycle is one of the most energy efficient mean of transport known to men in terms of how much energy a person must spend to travel a given distance. Just by using the same amount energy required to walk, a person can travel on a bicycle at a speed of around 16-20km/h. Most of big cities have well developed networks of bicycle paths, making it fairly safe for bicyclists to move around. The biggest benefit of cycling is extremely low cost. A new bike can be purchased in Finland for around 250 euros, but it's easy to get a second-hand bike for a quarter of that price. Bicycles can be used for many years, with little maintenance required which can be done personally or with little cost commissioned to a professional service.
It is important for bicyclists to have a helmet, lights and reflectors as careless car drivers can be a threat. For many Finns cycling season starts with the spring and lasts until the first signs of winter, lasting around 6 months. Cold, snowy conditions discourage most of people from cycling. The most dangerous time to cycle is by the end of the winter (usually between March and April) when melting snow freezes during the night, creating very slippery and bumpy surface to ride on. Also rainy weather, not uncommon in Finland during summers and autumns, vastly reduces the comfort of cycling. It is possible to cycle all year long, but it does require good water- and wind-proof clothing and some determination. In windy conditions and on hilly area, it can also be quite tiring and makes a person sweat. If a formal dressing is required at work, cycling is hardly a good choice. Because of local conditions, it is not very likely that cycling in Finland will gain as much popularity as it already has in Netherlands or Denmark.

Scooters and motorbikes
Two-wheeled motorized vehicles are very popular in many parts of the world due to their great manoeuvrability and small size, which allows to travel through the city even in heavy traffic congestion. Other positive sides are low cost of purchase and operation and convenience in parking. It's interesting to note that governments in Europe, Australia and elsewhere seem more interested in deterring motorcycle use than encouraging it - but the simple fact is that in vastly congested cities, a bike can get to places quicker, fit through spaces that stop cars dead, and generally park much closer to the destination than a tonne of metal with four doors.
For many people, safety is a matter of concern - especially in wet weather. What's more, Finland has long winters during when it's even more dangerous. Therefore it is more of a seasonal mean of transport and for most of motorcycle owners it is more of a hobby rather than a way of every-day commuting.

General problems
There are significant environmental challenges for the transport sector. Finnish Ministry of Transportation tries to address such issues like climate change, noise, degradation of air quality, the use of natural resources, waste production and the decline of biodiversity. Transport sector is known to cause about 20 per cent of Finland's greenhouse gas emission. Transport also increases impurities in the air mechanically for example by rising street dust. The noise and vibration from traffic degrades the quality and comfort of living environments and also has an adverse effect on people's well-being.

Considered changes
Finnish Ministry of Transport and Communication started a policy on renewal of the private car fleet by setting a target for emissions of new cars sold in Finland and trying to bring renewal of the car stock to an annual rate of about seven per cent. Car tax reform is considered so that it would influence the choice of more eco-efficient cars and bring promotion of fuel alternatives.

Finnish representatives also want to direct the growing passenger traffic volumes in urban areas to more environmentally friendly means of transport. They hope that by 2020 there will be 100 million more mass transport journeys and 300 million more journeys on foot and bicycle than today - 20% more than today. Improvement is also looked for in transport control and coordination

The picture coming from this review of transportation means in Finland is quite clear - the only real choice people have nowadays is between using public transport services and their own car, with only seasonal ability to use bicycles and motorcycles.

2.4 Services
In Finland one can find other services related to commuting methods described above, such as carpooling, taxis or rentals and leasing.

HSL travel card
Already mentioned before, in Greater Helsinki a commuter can get one card that allows to easily use public transport services in the entire region: in Helsinki, Espoo, Kauniainen, Vantaa, Kerava, Sipoo and Kirkkonummi. It allows to travel seamlessly from one city to another, transfer from bus to commuter train as well as to use Metro, tram and even ferry services in Helsinki.

Carpooling
The custom of sharing car journeys so that more than one person travels

in a car exists since World War II, and it peaked in popularity in 1970s in USA during oil crisis. By having more people using one vehicle, carpooling reduces each person's travel costs such as fuel costs, tolls, and the stress of driving. It is also environmentally friendly and sustainable way to travel as sharing journeys reduces carbon emissions, traffic congestion on the roads, and the need for parking spaces. Carpooling has been steadily gaining popularity in Finland in recent years thanks to the Internet. There are several ridesharing Finnish websites. The oldest of such services is kimppa.net, which was founded 12 years ago. By 2012 it had 40.000 monthly visitors. Another online service for offering and requesting carpool rides is kyydit.net. Founded in 2007, the service now has a total of 3,700 registered users. Some municipalities also help their residents to find shared rides. For example the City of Kouvola set up a service in 2009 to facilitate its employees commuting in the city area that had recently been expanded through a municipal merger. Even though advertising for carpools is active, the demand and supply do not always meet, as there are still not that many users of the service. Perhaps there is a social barrier that is hard for Finns to break - with quite introverted characters it may not be easy for them to welcome strangers in their cars.

Vehicle leasing
There are services that allow leasing of a motor vehicle for a fixed period of time, commonly offered by dealers as an alternative to vehicle purchase. The difference between a lease and purchase is that after the primary term, which usually lasts couple of years, the vehicle has to be returned to the leasing company. Lease agreements typically have an early termination fee and limit the number of kilometres a lessee can drive. For passenger cars, a common number is 15.000 kilometres a year, but the limit can be increased if there is such demand, although it may come with a higher lease cost. Lease agreements usually specify how much wear on the vehicle is allowed, and the lessee may face a fee if the wear is bigger than anticipated. A lease can include all vehicle maintenance costs except for fuel and insurance. There are many advantages of leasing, both for

buyers and sellers. Lease payments are usually lower than what payments on a car loan would be. It also allows lessee to simply return a car and get a new model after the lease expires, allowing him to drive a new vehicle every few years. Unlike a normal vehicle owner, he does not have to worry about future value of the car as he is not going to be bothered by the task of selling the old one. The benefit of the lease-giver is that leasing generates profit from a vehicle he still owns. After the lease has expired he can simply lease it again or sell it. So far it sounds like a really good solution, however on the long run (meaning more than the first lease period) leasing can turn out to be a really expensive way to own a car. It is widely used by big companies as a way of acquiring vehicles that are used to run business and make profit. For individuals who are looking for a long term investment, vehicle loan doesn't make as much financial sense. However leasing is a good option if someone:

- wants lower monthly payments than from a credit loan,
- likes having a new car that has the latest features and is always under warranty,
- doesn't like selling used cars, doesn't care about building ownership equity,
- has a stable predictable lifestyle,
- drives average distances,
- properly maintains the car
- is willing to pay more over the long haul to get these benefits

That is without mentioning the sustainability issues which I will be covered in the 4th chapter.

Car rental

There are numerous companies in Finland that rent cars for periods of time varying from a few hours to a few weeks. Such service is organized with numerous local branches, allowing user to return a vehicle in a different location. They are usually placed near airports or in city centres and are complemented by online reservations services. Car rental agencies mainly serve people, like tourists or people on business trips, whose cars are out of reach, or owners of damaged or destroyed vehicles, who are waiting for repair or insurance compensation. However car rental offer is not targeted at daily commuters, considering high prices of such service in Finland. If a commuter needs a car for a year or two, he may consider getting a car on a lease.

Taxi

Taxi is a service of short-term hire of a vehicle with a driver. A taxi transports people between the locations of their choice. In Finland, a taxi can be obtained either by calling the taxi centre, a taxi car or directly at the taxi stop. In some cities it is possible to order a taxi by a text message. There are also smartphone applications that help with getting a taxi ride - phone is located by gps, the client confirms the address and orders with a press of a button. Taxi service in Finland is quite costly and only few people can afford to use it on a regular basis.

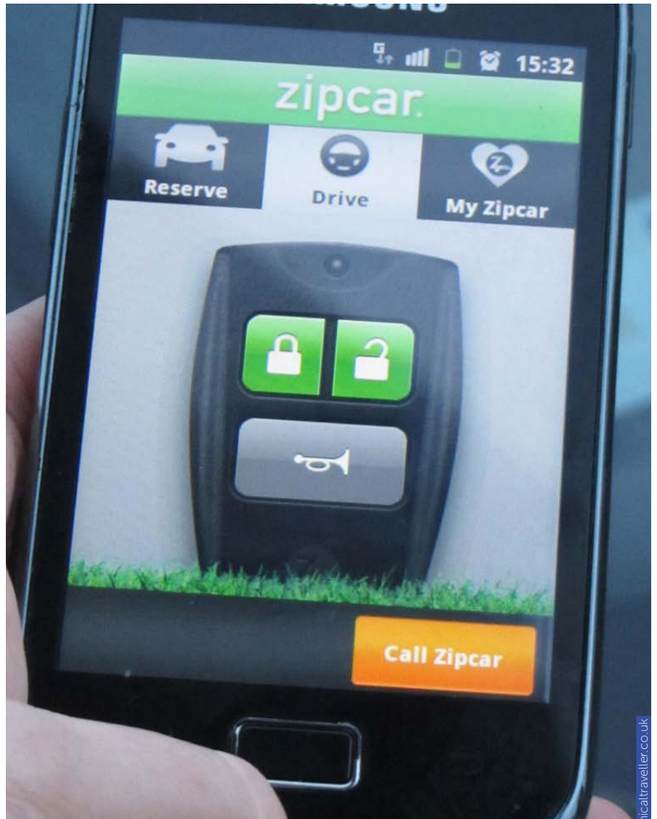
2.5 Service benchmark

Zipcar

Zipcar is a membership-based car-sharing company that provides automobile rentals to its members, payable on an hourly or daily basis.

Members are able to view vehicle availability and reserve a self-service car through the internet, smartphone app, or telephone, for time as short as one hour and pay only for time they reserve. The user recieves information where is the car he rented and opens it with his membership card, by holding it in front of the card reader located behind the front windshield. The keys are pinned just next to the steering wheel. There are some slight inconvieniences of this system - user should check the car for damages first (in case of which he or she should notify the service), and also adapt seat and back mirror positions to his liking. Also cars can be left only at designated places.

Zipcar was founded in 2000 and in 2009 it has become the world's largest car-sharing service, sharing 6,000 vehicles among 275,000 drivers. It has proved to be more easily accessible than typical car rental and has become a reasonable alternative for owning a car. It also rationalizes the use of a car - people have to think whether they really need to drive it at specific occasion and if they want to pay for it.



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2.6 Conclusions

There are some conclusions I can draw from this chapter. Finns are quick to adapt new technologies, partly due to the small size of the nation. It's much easier to implement new technological solution in a country with 5 million people than in a one with 80 million. Good education and social awareness of ecological issues give hope that Finns will be able to change their lifestyles for the greater good. Cold climate conditions and low population density make it challenging to create an eco-efficient transportation system. Reducing carbon dioxide emission of cars will only partially solve the problem, as the traffic congestion issue will still remain. Public transport solutions are efficient in densely populated areas, but not so much in small towns (which there are many). Buses and trams suffer from poor travelling experience, which only encourage people to use their own cars. Sure, travelling by public transport eases home budget, but that gives only a rational reason use it- and we'd rather do things that are also bringing emotional satisfaction.

Also, with Finnish, not very sociable, attitude it could be a hard task to encourage people to share their daily rides. Besides, being responsible for driving other people or having to ask others to drive you would make commuting even less enjoyable. Whatever the right solution would be, it shouldn't force people to adjust themselves to scheduled timetables or to plans of others as it makes people feel less in control of their own time.

3. Users

Gathering knowledge about the potential users, who they are, what they need and what they wish for is crucial aspect of doing a good design work. Although the main need I'm dealing with is travelling to work, people's bahaviours and desires may vary depending on such factors as age, profession, wealth, self-perception and many others. The goal of this chapter is to look deeper into people's attitudes, understand exsisting trends and possible life scenarios. I also looked for insights by carrying conversations and empathizing with some daily commuters I know. Because of limited amount of time given for this project, I consciously decided not to carry out any surveys or sociological study, as to avoid spending much time on generating vast amount of data that would likely be just as confusing as insightful. I decided to rely mostly on found data (discussed in 2nd chapter), my empathy, observations and imagination of various life scenarios.

3.1 Inclusive design

Population ageing
One of the trends currently seen in the world and in Finland is that people are living longer. According to the United Nations, the number of people aged 60 years and above is growing faster than the population as a whole. This can be clearly observed in Europe. The ageing of the population has numerous implications for product development. On the individual level, as we age, we gradually lose functional capabilities, and try to compensate for these losses

65.4%
OF POPULATION IN THE WORKING AGE OF 15-64

3,5 mln
POSSIBLE COMMUTERS

with behavioural adaptation. Promoting social integration and independent life through technology products is a way of improving older adults' well-being. It's worth noting that working age is being increased along with the life lenght expectations, therefore it is not completly abstract scenario that in 20 years even 70-year old people might be forced to commute. Unfortunately, with progressing age the reaction time and sight worsen, increasing the risk of an accident to occur on a road. It is important then to think of solutions that would counteract this problem.

Disabilities
There are reported to be around 45,000 disabled people (t in the public labour market in Finland. 35% of them have physical disabilities, that challenge them to work and to commute. Only 15-20% of disabled people have a paid jobs compared with a rate for the whole population of about 70 %. Perhaps, with a transport solution more friendly for people with disabilities, that rate could be increased. Bringing more equality to labour market is a good cause. Therefore, while thinking of the right solution for commuting problem, I should keep in mind possible users who use wheelchairs and crouches as well as the blind ones.

3.2 User profiles

Almost any person in working age may have to commute daily to work. In Finland that means people in the age between 15 and 64 years who are 65,4% of Finnish population. But should I limit the target group only to the daily commuters? Perhaps I will be able to find a solution that could suit other vehicle-need scenarios. After all, nowadays public transport, cars and bicycles are used for many other reasons than just travelling to work. It would be very ignorant of me to overlook those scenarios. I decided to create various user profiles, focusing on different Finnish lifestyles and some daily activities that could help me in defining the needs I should address.

Teppo, 26 years
He is a programmer in big software company located in Espoo. He owns a small apartment in Vantaa, 16km from his workplace. Because his girlfriend and most of and friends reside in Vantaa, he is not willing to move closer to work. He spends over an hour on commuting every day - he uses local buses. Owning a car seemed to him too costly just for those daily rides. Sometimes on the bus he meets his friend who he enjoys talking to. Apart from work, he regularily goes to a gym, which is two commuter

train stops away from his house. On rare occasions, he asks a friend to give him a ride, for example when he wants to buy something from IKEA.

Jonna, 31 years
Happily married, mother of two, she lives with her family in the suburbs of Turku. She runs a fashion store in the city center, 5 kilometers away, making a decent profit. Her husband works in Raisio, 10 kilometers in different direction. They used to own and drive two cars to their workplaces, but since Jonna crashed her car in ana ccident, she was forced to switch to public transport. Her bus runs only three times per hour so she has to be careful not to miss it, otherwise she may not be able to open the store on time. After work she often does groceries in a big market situated next to her store, and then carries them on the bus - the nearest grocery store in her living area is 1,5km away from her house. She is considering buying a small car which she would use only to get to work and to do groceries, as the other car is big enough to carry whole family if needed. She used to ocassionaly drive her daughter to and from dance classes.Ever since she lost the car, her kid has to always go by bus, as father works long hours.

Ilkka, 40 years
Recently divorced, he lives with a dog in Kallio, a district of Helsinki located very close to the center. He is a creative director in an advertising agency. He usually has numerous meetings and runs many errands around the whole city, meaning that he is often on move. Despite well organised local public transport, he prefers to drive his own car, a BMW combi, thanks to which he is able to quickly get to any part of the metropoly. He really values the independence the car gives him, although he sometimes has trouble finding a parking space, which he finds very annoying. He mostly uses the car for work related matters, sometimes drives to a shopping mall in the outskirts of the city. He rarely leaves the metropoly - if he wants to travel he prefers to fly abroad and there simply rent a car. He sometimes feels that his car is too big for his needs and considers changing it for something more swift for urban driving conditions. He made use of the cars big trunk very few times, for example when he was helping his friend to move or when he was buying some furniture in IKEA, Sometimes he drives with his dog to a forest.

Mikko, 37 years
A boat engineer, living in Helsinki. Despite a good financial status he doesn't own a car - that is because of ideological reasons. He considers it as a symbol of the wasteful culture of modern civilization and he wants to reduce his contribution to the process of environment exploitation. He mostly uses his bicycle to commute to work, but when the weather is bad, he switches to the public transport. Sometimes he prefers just to walk, as it gives him plenty of time to think. When he's about to go with his family on vacation or for a weekend in his summer cottage, he simply rents a car for the time needed, which proves to be much cheaper solution than owning a car all year long. Having no vehicle in family at home sometimes is a bit problematic, but luckily most of public services are in walking distance from his home.

Tuomas, 62 years
Tuomas has been using a wheelchair ever since he lost feeling in his legs in a car accident. He lives in the suburbs, 1km away from the bus stop, which sometimes can be a cumbersome distance, especially when the weather is bad. In such case can call a big taxi which can pick him up straight from his house. Beacuse it's expensive, he prefers to stay at home most of the time, leaving only when necessary.

August, 24 years
He is a student in Lahti, working part time in a bakery outside of town. As he works late ours, he can't use buses which don't run in the night. He drives an old which can be a drag to start in winter. He likes to visit his brother who lives on the other side of city, and have some beers in sauna with him. On such occasions he calls a taxi to get back home or cycles. He's unhappy that despite of all the costs of owning a car he still has to use other means of transportation.

Antti, 32 years
Every day he drives 50km to and back from work. He wishes that he could spend that time more productively.

Ida, 71 years
She is on retirement and doesn't need to travel much. She enjoys walking, but when she needs to go somewhere further she either goes by bus or a taxi. However when she wants to visit her family, which lives in other town, her son usually comes by car to pick her up.

3.3 Use cases

Basing on those user profiles and other possible scenarios I can create a list of various use cases
• daily commute,
• running errands around the city,
• shopping,
• taking children to school/training/extra classes,
• going to a hospital,
• going somewhere on a wheelchair,
• going somewhere with a stroller,
• going somewhere with a dog,
• changing appartments,
• going to the airport/trainstation,
• returning home after a party,
• taking a broken bike,
• sightseeing,
• visiting family, friends
• going to a summer cottage,

3.4 Needs and Trends

Apart of being able to do certain things with the new transportation system, users may have emotional needs that it could help to fulfill

Physio needs:
• sitting comfortably,
• being able to stretch the legs,
• being warm,
• cooling off when too hot,

Socio needs:
• meeting friends and family,
• meeting new people,
• having coversations,
• belonging to a society,

Psycho needs:
• 'waking up' on the way to work,
• relaxing after a day of work,
• enjoying the smell, colour, sound,
• enjoying the aesthetics,

Ideo neeeds:
• living sustainably, ecologically,
• being a part of positive change,
• fulfilling one's dreams,

Trends
There are some social trends I have observed in Finland, that should be taken under consideration:
• owning a smartphone,
• using debit/credit cards instead of money,
• belonging to social networks,
• doing sport activities, going to a gym,
• shopping in the cheapest store, not the necessarily the nearest one,
• more responsible consumption,
• holding on to old things that still are functional

4. Sustainabilty

We are constantly persuaded to buy things we don't need, with the money we don't have, in order to impress others, who don't care.

Designers are in the business of making stuff. When done well, it makes people consume more in order to help businesses grow. This simple equation used to be very definition of successful design, but it was also, in many cases, undeniably narrow-minded as well, helping to encourage a culture of consumption that currently threaten literally to consume itself. So how is the designer's role evolving as our world-view expands to consider some big questions about the fate of Earth?

4.1 Post consumerism

Even nowadays, with strong environmentalists movements around the world, design is mostly judged be its ability to have instant appeal to the target audience. Whatever gets a positive reaction and sells, is judged to be good. Such cynical attitude is supported by the fact, that our whole economy is based on a need to grow, produce and sell more. From the moment we are born, we are destined for one purpose - to consume. We are being constantly stupefied, being told that our happiness relies on the things we have. And how can we enjoy life if we don't have the newest, fastest, and nicest looking product that is so aggressively advertised. Because of such vicious practice, the environmental balance has been ruined. If we want to guarantee good and healthy conditions for future generations, we need to change ossified structures of the consumer society. The crisis of our product culture is slowly forcing us to adopt new design ethic. The value of design should be judged on the contributions it makes to sustainability of our civilization, not on the financial profit it manages to generate. We already see trend of companies trying to improve ecological quality of their products, but the amount of goods being manufactured daily is overwhelming. We should seek reduction in that quantity, and try to bring into force words of Dieter Rams: 'less but better'. But the real change should happen in the way we live and consume. We should move from 'purchase-own' culture to more sustainable 'lease-use' and service models. That means that the user would pay for the use of the product and its maintenance, not for ownership. Such consumption model would change the way we perceive products, by putting bigger stress on longevity and usefulness of the product. What we need is not more but less. Less growth, less of things, less of civilization noise that we trapped ourselves in. But things that we will have should have deeper and fuller value. In future, economic growth should mean growth in quality, not in quantity and wasteful consumption of our natural resources. As Papanek said *'Design to be ecologically responsible, must be independent of concern for the gross national product'*.
Such change needs starting points and designers seem to be the right people to initiate it. By doing experimental projects, they can visualize the new direction in an easy to understand way. And we certainly need visions of future product culture that conserves the ability to sustain life and environment in good condition. But to make the change happen, all forces should work together: industry, technology, education and politics. A conscious cultural decision needs to be made by societies to demand sustainability in all areas of our lives. I strongly believe, that Finnish society is mature enough to make such decision. Even if this project won't turn out to be a directly feasible solution, I hope that it will at least inspire others and raise a discussion.

4.2 Efficiency

In our pursue of sustainability we need to rationalize our energy economy. Apart from looking for emission free energy sources we should also considerably improve the efficiency of products, so that as little as possible energy gets wasted. We should seek for solutions that use only as much energy as is needed to achieve certain goal. If the problem is to transport a person from home to the office, then moving a 1-tonne metal box on wheels with that person is a very inefficient and way to solve it. Especially if it uses unrenewable source of energy - as that's what gasoline is. We need solutions that dramatically reduce the amount of energy wasted on our comfortable lifestyles in order to achieve sustainability. However, efficiency cannot be the only driving factor in development of new products and systems. Others, such as user experience, user needs and recyclability should be considered with equally high attention.

4.3 Cradle to cradle

It's a matter of great importance to understand and consiously design obsolescence of products. Whether a product is designed to last for a few days or for a couple of generations, we cannot overlook its end of life. If a designer truly values this important moment, it necessarily impacts on all design decisions that precede it. In fact, from being limiting to great design, a sustainable mind set simply requires that we enrich each choice we make with an extra level of care and meaning. By designing the end with as much creativity and passion as we do the beginning and middle, we can create solutions that will have considerably smaller impact on our environment. Instead of thinking of product life as of a straight line with creation as its beginning and end-of product life as its end, we should think of it as of a closed circle - just like a circle of life in the nature. It would be fantastic to find a solution for commuting problem that could forever last in a sustainable way, but whatever it would be, at some point it will most likely be replaced by newer and, hopefully, better solution. Therefore, as a designer, I should make decisions that would have as little impact on environment as possible by the end of the lifetime of the product I am about to create.

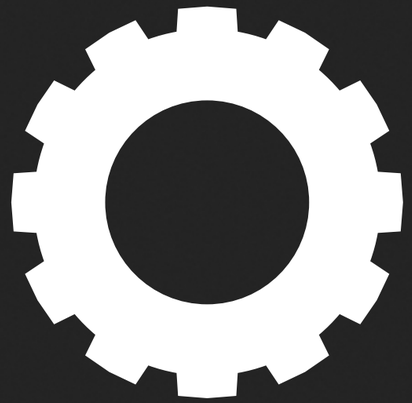
4.3 Materials

In the case when long product life cycle is crucial, it is important to use high quality, durable and long lasting materials. But even those should be chosen carefully - designer should know if production of those is harmful for environment because of excessive use of energy or toxic chemicals, in case of which he should seek for alternatives. It's also important that the material is recyclable or at least upcyclable. Being able to use materials in a closed circle is the only, true sustainable solution. Because my concept is going to be targeted at future 10-20 years from now, I won't be able to exactly predict what materials will be accessible at that time. Instead of choosing from materials available nowadays I will further on describe properties of the materials that still could be developed.

4.4 Change of attitude

Any attempt to change current consumerism-based culture will fail if it won't be followed by the changeof our attitudes and our behaviour. We should more carefully and humbly measure our needs and consume accordingly. The access to goods such as water, food, electricity, internet, clothes has become so easy and effortless that we just take those things for granted, constantly overusing them. We have become so comfortable with them and so dependent on the constant access to them, that whenever water stops running from the tap or internet connection stops, we get mad, cursing at whoever who caused the breakdown. What we don't know is how complex the whole structure that provides those 'goods' for us is, and how much effort must have been put into developing them and maintaining them. It might sound a bit naive, but we should more humbly appreciate those luxuries all the time, and use them with moderation. There is a tremendous cynism in our culture. Barely anyone even thinks if we even deserve all those 'life enhancements' - they just have to be there for us and we demand it! To paraphrase words of a comedian, Louis C.K., people think the world owes them things, they didn't even know existed 30 seconds ago. If only we would, with same level of firmness demand rationalization of power consumption and implementation of ecological solutions. It seems that we can only limit our blind consumption only when facing a major crisis (such as the oil crisis in seventies) - when such ends, we go back to leading exactly same lifestyle as before to shortage. We should start applying new standards to assessing quality of our lifestyles. Hopefully in future people will not envy those who live in biggests house and drive the most luxurious cars but envy those who can happily live in modest conditions. It has been found, that in past 50 years in U.S., despite noticeable growth in wealth and amount of possessions, the level of happiness in society remained on the same level. Clearly the problem is with our attitude. If we can't rationalise our own consumption, how can we expect others to fix the environmental problems?

5. Technology



Science fiction movies often show us visions of future cities, which, instead of typical road traffic, that we know from our every day lives, have futuristic looking vehicles pacing on multi-level air routes. Such fantastic pictures, as much as desirable they can be, are still far from reality and from what technology we currently possess can provide. But we already can assume that heavy and noisy car traffic, that hugely defined landscapes in 20th century, at some point will inevitably have to fall into oblivion. In this chapter I will cover existing and coming technologies that may revolutionize the way people commute in Finland.

5.1 Other transportation types

In the 3rd chapter I wrote about solutions that are currently in use in Finland. However, there still other ways of transporting people that could be potentially introduced in Finland.

Trolleybuses

Trolleybus is an electric bus that draws its electricity from overhead wires. They are advantageous on hilly routes, as electric motors are more effective than diesel engines for climbing steep hills. Trolleybuses are used extensively in many large European cities, especially where electricity is cheap. The construction of trolleybus lines was considered by Helsinki city council but eventually the city decided to drop such plans for the foreseeable future. Trolleybus systems are often criticised for aesthetic reasons as overhead wires, especially at intersections often have a "webbed ceiling" appearance. However, with the introduction of hybrid designs, trolleybuses are no longer have to be tied to wires at all time, giving them considerable advantage over trams In terms of user experience, there is no significant difference comparing to traditional buses or trams, however the generated noise is smaller.

Monorail

A monorail is a rail-based transportation system using a single rail, which acts as its sole support and its guideway.
The first concept of a monorail was introduced in Russia already in 1820, but it wasn't until 1980 that monorail started being seriously considered as public transport solution. With the rise of traffic congestion and urbanization, monorails have experienced a resurgence in interest for mass transit usage, notable from the early use by Japan and now Malaysia. Tokyo Monorail, the world's busiest monorail line, averages 127,000 passengers per day and has served over 1.5 billion passengers since 1964. Monorails have also seen continuing use in niche shuttle markets, as well as amusement parks. Almost all modern monorails are powered by electric motors.
Magnetic levitation train (maglev) systems were built as straddle-type monorails, as they are highly stable and allow rapid deceleration from great speed. When in full-speed operation maglev trains hover over the track and are thus not in physical contact with it. The maglev is the fastest train of any type, the experimental JR-Maglev

having recorded a speed of 581 km/h There are also slower maglev monorails intended for urban transport, such as Japan's Linimo. Unlike some trams and light rail systems, modern monorails are always partitioned from other traffic and pedestrians by being elevated from the ground, with lines running from 5,5 to 18meters above the street level. Such solution is very costly and it's benefits, similar to a metro line, are rarely a good enough reason for an investment, considering much lower costs of maintaining normal road traffic.

Hanging railway

It is a suspended, driverless passenger monorail system, first introduced by Siemens in Germany in 1975. Two such installations exist, one, 1,5 km long is at the Düsseldorf International Airport. The other is at Dortmund university campus where it's 1,05 km long. The cabins are centrally controlled and don't need a driver. Interesting thing about this railway is that the system can operate on a schedule or on-demand

- a passenger can request a carriage by pushing a button just like with an elevator. The maximum speed is 50 km/h.

Aerial tramway
It is a type of aerial lift which uses one or two stationary ropes for support while a third moving rope provides motion. Typically this sort of transport is used in mountains, often for ski resorts. However, in recent times aerial tramways have been brought for usage in the urban environment. The Roosevelt Island Tramway in New York City and the Portland Aerial Tram are examples where this technology has been successfully adapted for public transport purposes. They are used as a way to transport people between shores of wide rivers and canals or to an island. Potentially they could be an alternative for ferries used for public transport in some regions on Finland. Aerial tramway has some shortcomings. It has low line capacities and high wait times.

Tilting narrow-track vehicles
There's no getting around the fact that our urban road infrastructure can only deal with a certain number of vehicles. Most cities' road network, originally built in the days of horses and carts, are regularly clogged by traffic brought by rapid urbanization and population growth. And as space continues to tighten, and populations continue to move into cities, the problem will inevitably escalate. That's where a reasonably new class of tilting three and four narrow-track wheelers comes in. A tilting vehicle with 3 or 4 wheels is much harder to crash than a motorcycle - and that is without adding a huge amount of width to the vehicle nor that much technical complexity. What's more, according to people who had chance to use them, provide really enjoyable driving experience. Even though they haven't really gotten big market share yet, it's clear that a lot of companies see potential in such vehicles, as there are more and more such concepts appearing around the world. Nissan's

Land Glider, the 4MC, the Sidam Xnovo, Persu and the Naro tilting car all show different interpretations of how it might end up happening, and sit at very different points on the scale between car and motorcycle. It may be however a questionable solution, as due to the functionality limited by their size, they could hardly be considered as true replacements for cars.

Personal rapid transit
Also known as podcar, personal rapid transit is a mean of public transport that uses small automated vehicles operating on a network of fixed tracks. The vehicles are usually sized for individual or small group travel, being able to carry 3 to 6 people. Guide ways are arranged in a network, with all stations located on sidings, and frequent merge/diverge points. This approach allows for continuous, direct travel, without stopping at intermediate stations. There are many advantages of this system like low cost of operation, lighter rail cars, and use of less space.

In 2011 a podcar network, called ULTra was introduced at London Heathrow Airport and ever since it was running 22 hours a day, 7 days a week between the Terminal 5 and its business parking lot. It has 3.8 kilometers of track and 21 vehicles. Since the introduction it has won numerous awards, mostly from London Transport Awards and the British Parking Awards. There are plans to bring personal rapid transit systems to South Korea and India. PRT systems offer benefits similar to cars, such as the ability to travel on own schedule and privacy.
There are, however, some problems with personal rapid transit that seem to slow down the development of such networks. Those issues are associated with the requirement of building whole infrastructure with many stations. It is also believed this type of transportation system is more functional in small communities. Past attempts have failed because of small financing, regulatory and political conflicts, misapplied technology, and flaws in engineering or design. That means that, for the time being, a city-wide PRT network with many lines and closely spaced stations has yet to be constructed.

5.2 New technologies

Electric motors
Internal combustion engines are relatively very inefficient at converting on-board fuel energy to propulsion (rate of only 15%-20%) as most of the energy is wasted as heat. On the other hand, electric motors are much more efficient in converting stored energy into driving a vehicle. Electric drive vehicles also don't consume energy while at rest or coasting, and some of the energy lost when braking is captured and reused through regenerative braking. Efficiency of electric drive vehicles is nowadays at the rate of around 80%, but new motors are being developed with efficiency as high as 95%.

Wheel hub motor
Also known as in-wheel motor, it is an electric motor that is incorporated into the hub of a wheel and propels it directly. Eliminating mechanical transmission like gearboxes, differentials, drive shafts and axles provides a significant weight reduction and lowers manufacturing cost. It also decreases the environmental impact of the product. Steering actuators, suspension and braking can be also incorporated right into wheel hub motor.

Batteries
Finding the economic balance between performance, energy density, and cost challenges electric vehicle manufacturers when choosing accumulator type. Nowadays most highway-speed electric vehicle designs focus on lithium-ion and other lithium-based variants a variety of alternative batteries can also be used. Lithium based batteries are being chosen for their high power and energy density that comes with low weight but also the cost of such battery is bigger than of other, less efficient technologies. Li-on batteries still have fairly limited cycle lifetime of around 1600 charges, which could increase the maintenance cost of electric vehicle on a long run. Variants such as Lithium iron phosphate and Lithium-titanate attempt to solve the durability issues with lithium-ion batteries. Many companies focus on development of batteries with greater longevity and capacity and at this point it's hard to predict which technology will prove to replace lithium-ion batteries. I found two technologies in research especially interesting.

Lithium air battery
The biggest benefit of the Li-air battery is great amount of energy it can store for a given volume. It actually rivals that of traditional gasoline powered engines. Li-air batteries gain this advantage in energy density since they use oxygen from the air instead of storing an oxidizer internally, as it is in Li-on technology. The technology is still in its infancy and will require significant research efforts in a variety of fields before a commercial implementation is created.

Graphene-Based supercapacitors
Researchers at UCLA made a discovery that using graphene, already well know substance, could change how battery-based vehicles and devices could be powered in the future. During a process of developing a fast and cheap way of creating graphene it was discovered that the material can hold a charge similar to a battery. A small piece of graphene, when charged for 2 to 3 seconds,

powered a small light for around 5 minutes. By developing a supercapacitor made with graphene, one could, at least in theory, charge a consumer electronic device in a fraction of the time it currently takes. Such technology is yet in very early development stage, also graphene is not available in production quantities. It may take many years until it becomes commercially available, however when it does, we might face new technological revolution.

Self-driving vehicles
An autonomous vehicle is capable of sensing its environment and driving on its own. A passenger of such vehicle only chooses a destination, but is not required to control the vehicle him/herself. Autonomous vehicles sense the world with such means as radar, GPS and cameras. Advanced control systems interpret the information to identify appropriate navigation paths, as well as obstacles and relevant signage. Autonomous vehicles typically update their maps based on sensory input, such that they can navigate through uncharted environments. Autonomous cars are still in development, but their introduction could bring quite many advantages such as:
• Increased road capacity and smaller traffic congestion due to reduced need of safety distance between vehicles.
• Ability to better manage flow of traffic.
• Less accidents - by taking out the individuals from the transportation equations you also remove most of the likelihood for an accident. Computer with a high-speed camera can anticipate distances a lot faster than a human brain, therefore allowing for reducing the following distances.
• Relief for people from driving and navigation chores.
• Higher speed limit for self-driving cars
• Removal of constraints on occupants' state - it would not matter if the passengers are under age, over age, blind, distracted, intoxicated, or otherwise impaired.
• No need for redundant passengers - people are not required to take the car anywhere, as the autonomous car can drive independently to wherever it is required. This would especially affect taxis, trucks and car-sharing services.
• Less space needed for parking.
• Smaller need for traffic police and vehicle insurance.
• Reduction of road signs - autonomous cars could receive necessary signals wirelessly
• Improved power-consumption efficiency of vehicles.

By the end of 2012 Google's autonomous car has driven over 300.000 miles without any accidents, proving that such technology is very promising. Google is looking to share its technology with car manufacturers. Autonomous vehicles have been already legalized in Nevada, Florida and California. Volvo plans to sell self-driving cars by 2020. Are we just about to experience a revolution in the road transportation?

Solar energy
The photovoltanic technology is consequently becoming more and more efficient. Sadly Finland, due to it's geographic location has a little solar electricity potential, making it hardly applicable for all-year-round working vehicles. It's likely that they will have to be charged with electricity coming from local power plants.

Artificial intelligence
Artificial intelligence is a branch of computer science that aims to create intelligent machines. It has become an essential part of the technology industry. Research associated with artificial intelligence is highly technical and specialized. The core problems of artificial intelligence include programming computers for certain traits such as knowledge, reasoning, problem solving, perception, learning and planning.
Manipulating and moving objects
AI technologies have been in development already for over 50 year, and even though we're still far from creating human-like intelligence, we already have machines specialized in dealing with certain tasks, that I able to do it better and faster than we are. Artificial Intelligence is a an often occurring topic in projections about the future of technology and society. The existence of an artificial intelligence that rivals human intelligence raises difficult ethical and economic issues as it could make human labour even more redundant potential power of the technology inspires both hopes and fears. The potential benefits of using AI should not be ignored.

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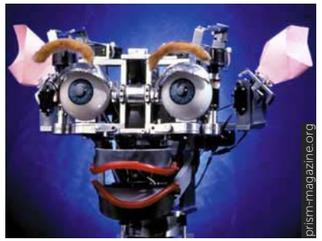


Affective computing
There are systems and devices in development that are able to recognize, interpret, process, and simulate human emotional states. They are usually connected with development of AI. Emotion and social skills play two roles for an intelligent agent. It helps with predicting the actions of others, by understanding their motives and emotional states. It can also tremendously enhance the human-computer interaction. If intelligent machines would to be able to display emotions—even without actually experiencing them— they would appear to be sensitive and easier to empathize with. First machines, that were able to show emotions, such us Kismet, were developed already in early 1990s and since then progressed tremendously.

5.2 Materials

Instead of doing very broad research of different materials, which would take considerable amount of time, I decided to focus on those more important from users point of view rather that the one of an engineer.

Water-repellent glass
Water-repellent glass is a chemical film that is baked into the factory-fitted glass on the windows of a vehicle to maintain proper visibility in wet weather. It is produced and patented by Volvo Cars. It is claimed to take water in any form of: rain, mud, snow, sleet, or ice, and disperse it into tiny droplets that quickly slide off the windows of the car. The water-repellent chemical must be applied on the glass after every six years.

Soft silicone coating
Honda started developing a soft coating that could cover the entire body of a vehicle. Aside form adding more friendly feeling to them, it would prevent bumps and scratches, which so easily occur on metal surfaces. It would also increase the safety of pedestrians, by providing slight amortisation in case of hitting someone.

Stain repellant nano coating
Coatings have been developed that protect fabrics right down to the fibre with a completely undetectable, breathable & flexible nano-layer that repel water, stains & oily liquids. Any type of textile with a nano coating become easy to clean, mould-resistant & longer-lasting. For example liquid glass nano coating by Nanotrac is water-based & made from eco-friendly and nontoxic ingredients, that eliminates the need for toxic cleaning chemicals & stain removers.
Using such coating in the interior of vehicle, would allow to easily keep it clean and would to some extent prevent vandalism.

Intelligent materials
In general intelligent materials materials have properties that can be altered through applying some stimulus. The ones I find especially interesting for the cause of vehicle design are:
• self-healing materials have the ability to repair damage due to normal usage, thus expanding the material's lifetime
• shape-memory materials in which large deformation can be induced and recovered through temperature changes, stress changes or some other factor.

6. User experience

In order to be successful product or service should not only be addressing user needs, sustainability and efficiency issues and ideological requirements, it should also provide good and desirable user experience. In fact, if the whole user experience is lacking and unsatisfactory, the whole solution might be completely neglected by society. Therefore it is crucial that designer pays a lot of attention to it and tries to make it as much pleasurable as sustainability reasons allow. There are many factors that stand behind the user experience, and I shall consider all of them. According to psychologist Abraham Maslow, people are 'wanting animals' who hardly reach a state of full satisfaction. If such state is reached, it will most likely be just temporary as once the old desire has ben fulfilled, there will be a new one emerging soon. There's a model of hierarchy of user needs that gives an idea of how those desires 'evolve'.

6.1 Functionality

Functionality is the very basis of user experience and is the most crucial reason for existence of things. No matter what it is, a hair drier, a painting, a car, or a rental service - it should fulfil its function. Those functions can be very physical in their nature (e.g. drying your hair) or quite abstract (e.g. painting satisfies your senses and brings visual pleasure). If it doesn't do it's function, it is simply pointless. And if there's no reason to use or have something, then there will be no user experience related to it. It will be ditched and forgotten, until someone finds use for it.

6.2 Usability

Once we get to use or interact with something, we will be able to speak of our experience related to that interaction. Object that fulfils its function won't satisfy us if the interaction comes with any sort of mental of physical strain. Therefore we speak of usability and ergonomics. Usability stands for the ease of use and learnability of a human-made object. Usable object or service, comparing to unusable one, takes less time to accomplish a particular task - meaning that it is efficient. It's also easier to learn and understand how to use it. It is best, when it can be done simply by looking at it. Usable also means satisfying to use. Ergonomically designed solution means that it fits the human body and its cognitive abilities. User's capabilities and limitations have to be considered to ensure that tasks, functions, environment and information suit each user. Usability and ergonomics together stand for user accessibility and friendliness and are the most crucial factors for satisfactory user experience. My design should not only be easy to access for young ones, but also for the elders, young mothers and people with disabilities. Solely usability-based design approach brings a limited view of product usage and in a way is quite dehumanising. Looking at a user just as a merely physical component of a system that also incorporates product and environment of use and designing only to minimise cognitive and physical demands on the user means ignoring the factor of user attitude and emotions - things that, after all, are crucial for ultimate users satisfaction.

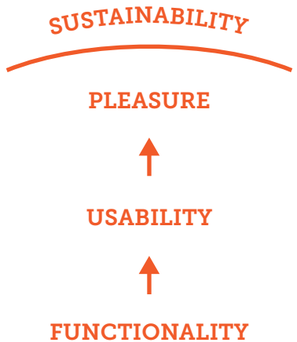
6.3 Emotional aspect

A crucial aspect to consider, while creating a new experience, is how people personally feel about it. Can we reinforce their attitude with a positive emotional response? Can we design objects that are both usable and pleasant to use? The problem with planning affective side of a product experience, such as pleasure, is that it is a very intangible and non-rational matter than can vary depending on many factors such as culture or personal preference. There have been studies about product emotions, that can help designers understand on what levels objects appeal to us. Sadly, there are no specific rules to follow if one wants to achieve particular response. It is possible for an object to elicit several emotions at the same time, depending on what concerns of ours it responds to. We might be attracted to something by its appealing form and colour but at the same time we can contempt

its bad impact on environment. And despite that we would still desire it as we anticipate the experience of product use. I've created a list of aspects and concerns that I want to imply a positive emotional response to, that hopefully help me later in my design process.

- aesthetics - is it visually appealing?
- personality - does it have character?
- relationship- can we develop a deeper connection with it?
- social attitude - does it strenghen our self-esteem?
- social standard - how does it affect the society and environment?
- design standard - is the idea original and daring?
- desirability - can people picture themselves using it?
- enthusiasm - is it fun, pleasant to use?

4 levels of pleasure
I want to address all levels of pleasure - physio, socio, ideo and psycho. My design should be able to reinforce positive feeling through its physical feeling (soft, warm, comfortable to seat), sociological aspect (by helping to maintain healthy social relationships), psychological (allows the user to relax and have sensual pleasure) as well as by addressing ideological concerns people may have. While focusing on pleasure aspect of design, it's important to consider the ceiling that sustainability sets to pleasure. After all, products made to deliver pleasure as the only goal can be very unecological (e.g. gas consumption of sport cars). Therefore it's crucial to put user of



products in perspective that stresses global awareness an sustainable lifestyle. In other words, sustainability factor should limit pleasure factor if they are in conflict.

Aesthetics
Good object aesthetics can greatly contribute to achieving pleasurable experience. However, perception of beauty varies, not only from culture to culture, bad also from person to person. It is simply impossible to satisfy everyone. As far as designer should understand what is praised by the target group he is designing for, he cannot completely rely on the 'average taste' as it will result in an average-looking product. I believe that designs created from personal inspiration rather than and impersonal, sort of scientific survey selection, have deeper character and are much more enjoyable to interact with.

As first inspiration I selected various objects that are both minimalist and that have strong character, unlike things that fool the observer with excessive gimmicky surfaces, usually used in future vehicle concepts. Instead of using sci-fi stylistics, I want to create something that is deeply human and understandable at the first sight. I'm tired of seeing future vehicle concepts that are more representations of cold technology and dynamism, than deeper, as to say 'warmer' values. I'd rather see future marked by empathy, essentialism, minimalism and positive attitude. It's also worth to note that 'futuristic' aesthetics create obsolescence. It's clearly visible in automotive industry - every new generation of a car makes the previous one look old and undesirable, even though just 3 years earlier it was setting aesthetic standards. Sustainability and product longevity should be also promoted by aesthetics. Thus I will avoid excess of pointless visual features, which carry no function and instead focus on purity, simplicity and iconity of the form. After all, it's Finnish cities in 20 years will most likely look the quite same as they do now. 'Space age' vehicle aesthetics will be simply out of context, when put next to traditional Finnish wooden houses.

Personality
There are many human personality dimensions that can be identified in the objects around us. By empowering the design with specific type of personality, designer can arouse emotions that can support positive emotions. Patrick



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fetbal.com
dodo.ru

luvie.com

dustbowl.com


despoke.com
viaduct.co.uk

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W. Jordan identified 17 personality dimensions. Those are:
- kind/unkind,
- honest/dishonest,
- serious-minded/light-hearted,
- bright/dim,
- stable/ unstable
- narcissistic/humble,
- flexible/inflexible,
- authoritarian/liberal,
- value-driven/non-value-driven,
- extrovert/introvert,
- naive/cynical,
- excessive/moderate,
- conformist/rebel,
- energetic/unenergetic,
- voilent/gentle,
- complex/simple,
- pessimistic/optimistic

Out of these I decided to choose a few that I really wanted to describe my project. These are: kind, honest, light-hearted, extrovert, humble, simple and optimistic. In brief description the vehicle should be supportive, trustworthy, emotion-based, with a sense of humour, meek, allowing others to have personal freedom. It would be expressive and enjoying the company of others but also unsophisticated. Its design would carry the feeling that it's something active and lively, enthusiastic and positive. In order to apply such values to physical appearance I will have to carry out sketch studies, trying to figure out what forms and features can carry such 'message'. I also created a moodboard (next page) focusing on 6 key adjectives that I decided to be the basis for the design. The idea is to check every decision with those words and ensure that they suit the feeling and product personality I am aiming for.

HUMBLE
OPTYMISTIC
HONEST
SIMPLE
SOFT AND WARM
FRIENDLY

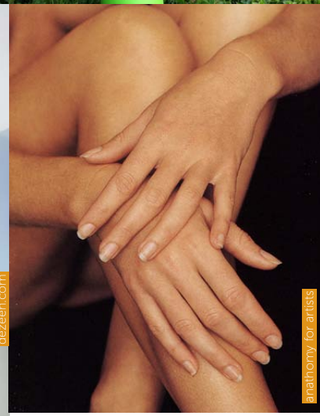

wallpaper.com


conceptcarz.com


dezeen.com


decoracao.com


dezeen.com


square-of-knowledge


coolantarctica.com

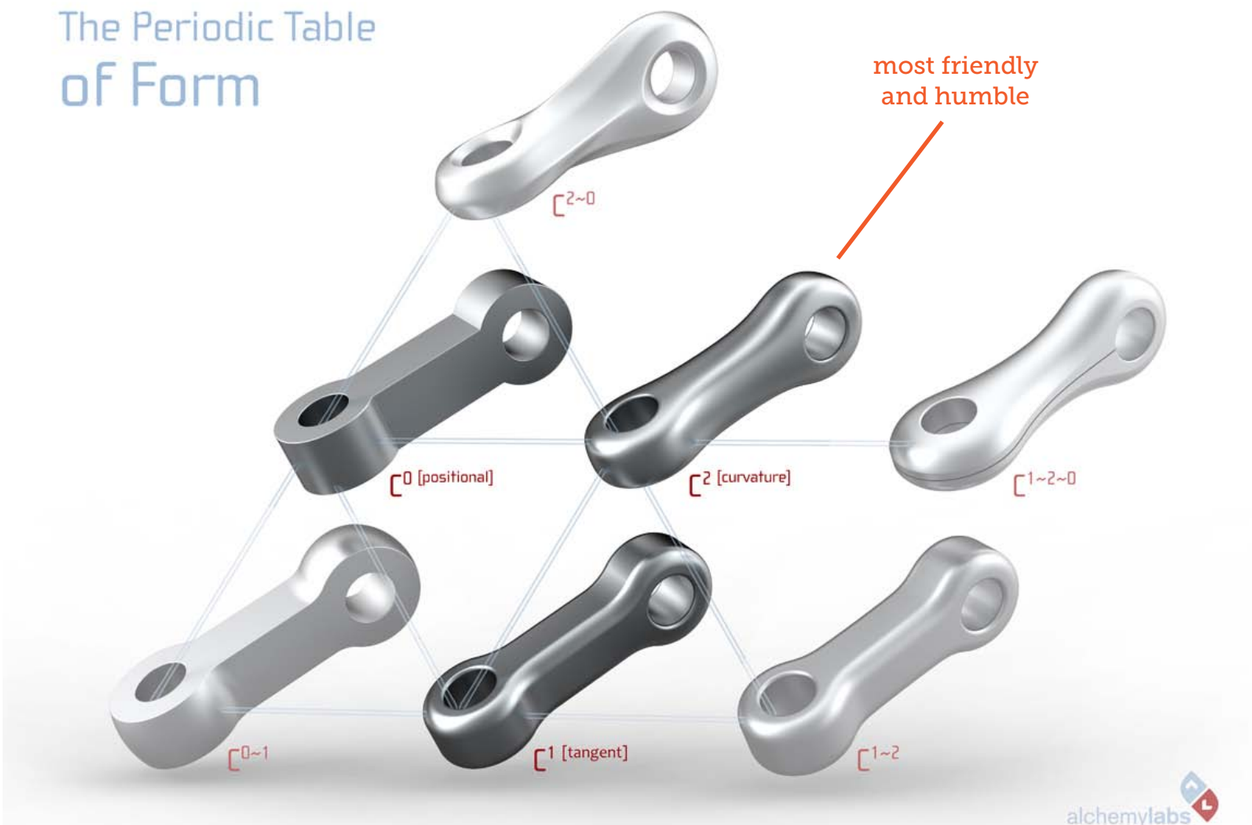

dezeen.com

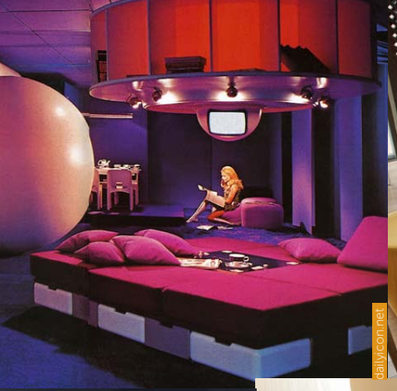

largesmileyfaces.com


laurizblog.com


suvseite.com

Form character
To better understand what forms carry those feelings I also did a more understandable comparison of forms. The periodic table of forms seen on the far right was created to showcase the types of surfaces (varied by continuity level), but I decided to evaluate them in terms of emotional response they arouse. Types C0 and C0-1 have very cold, machine feeling. C1 and C1-2 are more friendly, yet they they don't seem to be very honest in that way. Somehow they are like a wolf in a sheep clothing, pretending to be harmless and approachable, but their true nature is not very humane. Then there is C2 which to my sense feels the most natural, simple and harmless. C2-0 is also natural, yet it is much more dynamic and looks more like a fast raptor rather than something you would want to cuddle. C1-2-0 is somehow troubling - it feels very modern and simple, but it combines forms that come from different worlds -the world of nature and the world of machine - an artificial creation, human-made hybrid. Not very humble. Just like the vehicle designed by Janusz Kaniewski seen on the right. On one hand it has very friendly, happy face, making it look quite like a toy, but then it there are areas where the form is sharp and hostile (just look at that exhaust pipe). To me it's somehow inconsistent in the emotional message it carries. Making such analysis should allow me to more consciously choose the direction for my design. But as mentioned before, I will still carry my own sketch studies.





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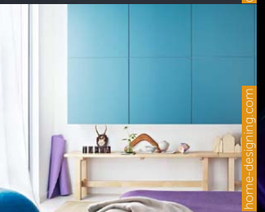

home-designing.com


wikipedia.org
retroeurope.com

Interior
Instead of focusing on surface gimmickry, so typical for automotive industry, I'd like to approach vehicle interior design in a different way. While keeping the interior elements in simple, Scandinavian stylistics, I'd like to enhance the small space with ambient light and colour. Light has special value in Finland, especially in winter when the sun rarely appears on the sky. Colour would also bring some joy to everyday gray monotony of commuting, defined by greyish upholstery of cars. With rising popularity of Marimmeko, it seems that Finns are finding liking for bright, joyful colours. Such interior should also consist soft, warm materials that are pleasant to touch. Nowadays, especially in public transportation, people are surrounded by cheap, plasticy materials and cold steel which don't support the feeling of cosiness. Could the interior of the vehicle allow the commuter to relax for a while and truly forget about every-day issues? Perhaps the right use of lights supported by noise cancellation would create an abstract environment that would allow people forget that they're actually on a busy, noisy road.

Personal connection
What if in the future vehicles had an AI and their own character - just like the KITT car in the TV series from 1980s 'Knight Rider'. It could not only talk to you, it could actually be your friend. You could develop human-like relationship with the vehicle! It would feel like being driven by a personal chauffeur, except that it would be the vehicle would do

knightrider.pl

all the 'chauffeur duties'. Imagine all the possibilities - it would open the doors for you, you could tell it the destination where you want to go to, you could ask it to wait for you at specific place at specific time. It could tell you the weather forecast or even try to comfort you with some warm words after a bad day at work. Seeing the development of artificial smart assistants, such scenario could become possible very soon.

Relationship
It is known that users can develop a relationship with the objects. Sometimes when an unpleasant experience occurs, such relationship can end. Also happiness connected to owning latest, most-up-to-date model is likely to vanish when the next, new generation model is launched. Contrary to that, attraction based on ease of use and good reliability record is more likely to lead to a long person-product relationship. Prolonged relationship can be developed when our needs are more fully satisfied by the product. In fact, the sense of pleasure can even increase over time, as the product becomes a familiar, trusted friend. It is then important to think of solution for commuting problem, that would be enjoyable not only in the beginning, but also after many years of use. Perhaps bringing features that counteract monotony would be helpful. After all, isn't the monotony the reason why so many relationships fall apart?

6.4 Other aspects of enjoyability

There are also other factors that contribute to the general enjoyability of an experience that are not directly connected to physical properties of a design. Good reliability, punctuality, pleasant sounds and even smell may affect our impression. The spectrum of factors that have to be considered to achieve a fully enjoyable experience is so wide that it requires considerably long research and input of professionals from many disciplines to find the perfect solution to every problem (an approach of Kansei engineering). Due to the conceptual nature of this project, it's complexity and limited time and resources I won't be able to go deeply into every possible aspect that reinforces the enjoyability of commuting experience. However, I do understand how many aspects would have to be analysed and if the project will ever be put into further development, I will make sure to look deeply into all factors on which the pleasure of experience depends. Solutions that are unsatisfying on some level won't be sustainable, as they will be inevitably replaced.

7.
Aims and goals

"Always aim for the moon, even if you miss, you'll land among the stars" (unknown)

Most of sustainable, public transport solutions that are being proposed are aimed at big metropolies with high population density. In such environment, efficient public transport makes great sense, despite its poor user experience. In Finland, 20% of general population live in Helsinki metropolitan area, and that number is most likely going to increase. But that still leaves 80% of society sparsely living in small cities, towns and villages - places where mass transit will not be as efficient. Also, those municipalities won't be able to afford expensive infrastructures required for PRT systems, trams or monorails that some claim to be appropriate substitute for cars. In order to adress the commuting issue on a national scale, I should focus on using exsisiting, well developed Finnish road infrastructure, so that it could be fairly easily introduced in any town. One probable solution is based on using small, personal electric vehicles, that allow people to quickly and swiftly move around urban environment. But with Finnish wide roads and low traffic, those won't make big difference in this country, apart from just increasing the energy efficiency of commuting. Because such narrow-track vehicles have much limited functionality in comparison to cars, they will never fully replace them. I'm afraid that they would be just an addition to owning a car, thus reinforcing the consumerist philosophy of 'you need to own more'. And the goal I wanted to achieve was to allow people to have less, without compromising the quality nor comfort of life.

7.1 Sustainability

I want to envision a sustainable solution that is both socially and environmentally responsible. I want to advocate a change from consumerism-oriented lifestyle to one that allows well-being without need of excessive purchase and ownership of products. Instead of ownage-based solution I decided to look for a service-based one. Leasing-service didn't seem as a good option, as it proves to be quite expensive in a longer period of time. Finns also seem to have little liking for high monthly rents - they are more fond of idea 'pay once and never again'. Therefore I will have to ensure that my solution would not be a big strain for a personal budget.

7.2 Technology

As a technological basis I want to use the invention of autonomous (self-driving) vehicle. The amount of benefits that come with use of such solution is staggering, and it is said to have potential to radically change our lives. From other technologies I will choose one that have as little negative impact on environment as possible - such as electric motors instead of fuel ones. Materials with great properties of durability but also recyclability should be used to support longeivity and sustainability of the product.

7.3 User experience

My aim is to focus on acheiving positive emotional response, through functionality and usability, but also with help of aesthetics and ideological aspects. Vehicle should have very friendly and consistent character in every aspect. Forms should be soft and approachable. The interior should allow users to relax and forget about daily problems. That should be achievable with the use of lights. The final result should be describeable with these adjectives: humble, optymistic, honest, simple, soft, warm, friendly. User experience should encourage people to change their lifestyles and start consuming more responsibly.

7.4 Design brief

Considering all existing solutions for people transportation, new technologies in development and local conditions of Finland (climate, culture, distances), I decided to envision an entirely new solution that would allow people to commute in a sustainable, environmentally friendly way, without the compromises that come with mass transit nor with the burdens of owning a car. I want to create a clear vision of, what I could call 'autonomous personal rapid transit' that could be introduced in Finnish cities in 15-20 years. The project could focus around the service, just as much as it could focus on vehicle it would use. I need to decide what will be my focus - the system itself, the vehicle or perhaps both should be developed on the same level of depth. I also thought what skills could I showcase with this project. As I am mostly specialized in industrial design, I decided that I should pay bigger attention to the industrial design part of this project. Sadly the project is not long enough for me to bring both service and industrial design

part to a very advanced level. Therefore I decided to keep the idea of the system simple and use it as a basis for further, more product-oriented actions.

My approach to the project is orbiting around the issues of sustainability and user experience. My hope is to join the general discussion about the future of transportation by proposing an innovative solution, created with local environment in mind. It will not be, by any means, a detailed 'recipe' for a successful transportation system nor nor specific documentation of a vehicle design. The goal is to create inspirational material and to feed peoples imagination. Having said that, I won't be going to deeply into details. Instead I will try to create well rounded, understandable vision, and to present it in such a simple way, that even a kid would understand. In other words I want to tell a story of experience of future transportation, from designers (not of urbanists or economists) perspective.

Requirements
Having considered all the issues raised in previous chapters, I created a list of benefit specification the new transportation system and the vehicle should meet.

TRANSPORTATION SYSTEM:
- should be suitable for Finnish climate, urban and social conditions,
- should be a real alternative for owning a car,
- should be allow daily commute,
- should be more flexible and personal than existing public transport systems,
- should be sustainable,
- should be ecological,
- should be easy to use,
- should allow door-to-door transport (no issue of the 'last mile'),
- should be operational 24 hours a day,
- should be enabling social interactions,
- should confer the impression of responsible way of living,
- should be equally accessible ,
- should also support other use cases than commuting

VEHICLE:
- should be accessible for everyone: adults, elderly, children, people with disabilities and even intoxicated people,
- should be safe,
- should be ergonomic,
- should be swift on urban strees,
- should reflect postive emotions,
- should have a soft, approachable form,
- its interior atmosphere should support relaxation,
- should have friendly character,
- should use ecological technologies and materials,
- should positively affect the urban environment,

8. Design process

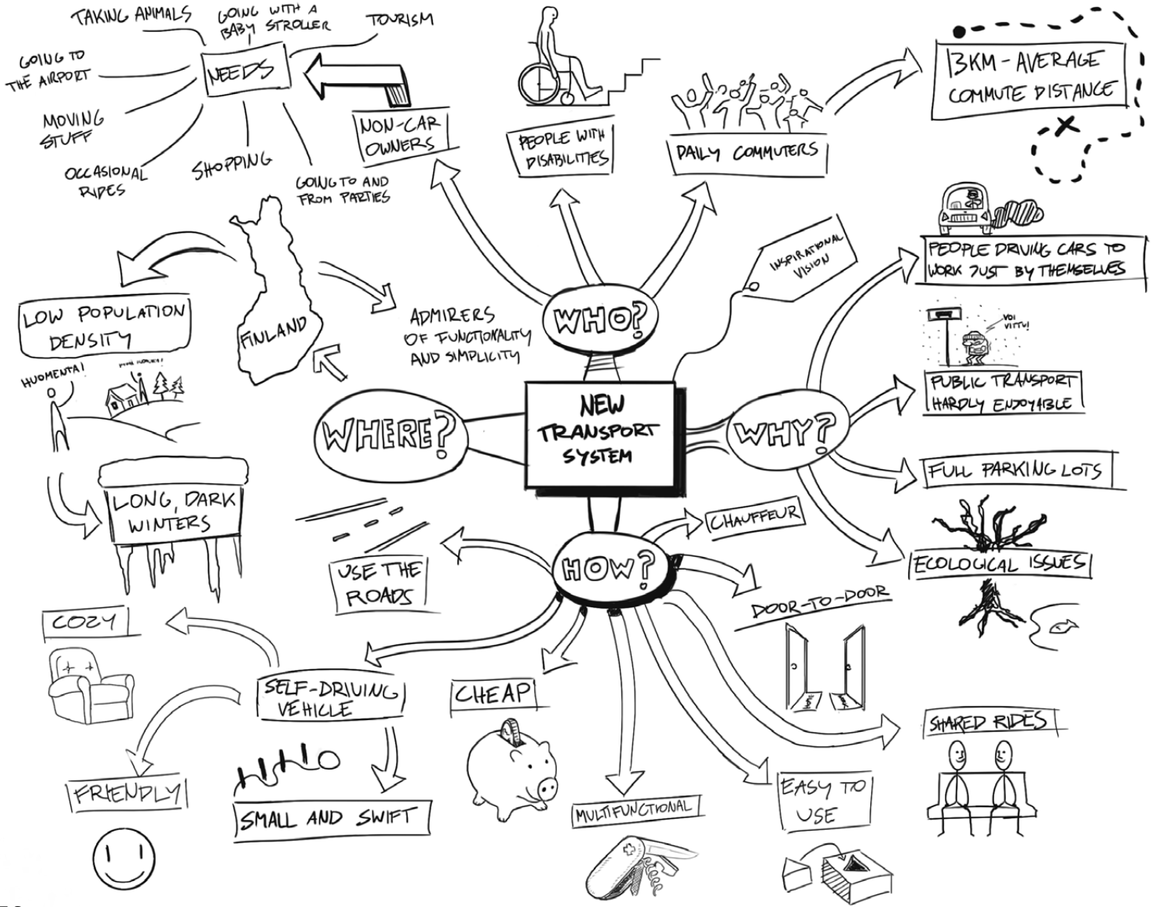
8.1 New transportation system

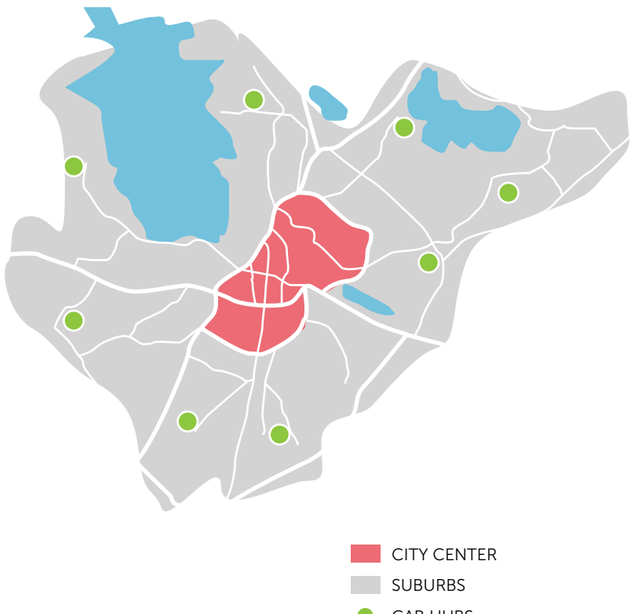
As stated in the aims and goals, I decided to envision a new transport system, that I would use as a basis for further vehicle concept development, rather than to develop it into complete and detailed design of it's own. However, as it would have tremendous affect on the design of the vehicle, I needed to think of many scenarios and draw from them the conclusions for further design process. I wanted to take human-centered approach, as I don't have enough eligibility to approach this topic from economic/financial point of view. Therefore I set as a goal for the development of the system concept to achieve the an easy, commuter friendly solution, not necessarily the most profitable business model.

The idea
After short yet intensive brainstorm I got an idea that may perfectly suit these conditions. It is to combine the concept of personal rapid transit service (such as the one recently introduced at the London Heathrow Airport), self-driving cars (currently being developed for example by Google and Volvo), taxi service and carpooling to create an automated shared-rides cab system, utilizing small electric vehicles able to carry around 4-6 people. Instead of owning a car or using public transport, people could use this service, get picked up at any place of their choice and be driven to their destination. The vehicles would keep cruising around the city and transporting people as long as needed and return to a base to recharge after doing their job. If found this idea to be very exciting, fresh and at the same time reasonable. You could call it 'autonomous share cabs'. Such vision would probably sound quite abstract a few years ago, but seeing technologies in development, it actually sounds doable within next two decades. But this was just a very general description of an idea - I still needed to think more deeply about its various aspects to evaluate its potential and find possible issues.

Structure
To envision how the structure of such system would look like, I first have to think of what are the patterns of driving and commuting in Finnish cities. Most of small and medium-size businesses are based in the city-centers.Bigger factories and shopping malls are usually at the outskirts of the cities, which helps to put off heavy traffic away from the centers. Instead of doing a wide research of road-traffic patterns, I decided to simply take a clue form urban bus lines which connect suburban areas with the city centers. Because many services are inaccessible in the suburbs, people need a way to easily travel to the center. Also, people who don't live in the centers are more likely to be forced to commute. What's also worth noting - people who live in the centers, are less willing to own a car, due to the close proximity of most important services, traffic jams and limited parking space. That's why it would make sense to set all 'hubs' for self-driving cabs in the suburbs, where they would be needed the most. If they were allowed to park only in specific places, destined for that purpose, around the city, we could regain considerable amount of valuable space in the centers, which is nowadays wasted on parkings. Then we could turn that space into recreational areas, create more parks, plant trees and thus increase the life quality of city dwellers. The cab hubs could take form of a space-efficient automatic parking that would incorporate all the facilities for maintenance of self-driving cabs.

Shared rides
Sharing a car ride with other people is a long-known way to deal with traffic, driving costs and low efficiency of personal transport. It is however not the easiest task to encourage people to car-pool their every-day commute. There are couple of online services in Finland that allow people to find someone for sharing a ride, yet their popularity seems to depend more on the price of gasoline rather than on people's attitude to environmental issues. Trying to create a share-ride commute system based on private cars for an entire city would probably not succeed, as it's efficiency would be purely depended on people will to consistently participate in it. And people are not robots - they forget, they can be late, they make mistakes. Many people would be just reluctant to welcome a stranger in their own car and just as many people would be unwilling to give up the idea of owning a car just to depend on other people to give them regular rides. After all, own





car is perceived as a personal space, and as mentioned before - Finns value their private spaces quite a lot. However the idea of shared rides gets a completely new dimension, when you think that it could be based on a system that would automatically take care of picking up the passengers and driving them to their destinations. All you would need to do is to inform the system where and when you need to go, and the system would check if there's anyone who you could share the ride with. However I felt that there should be a possibility to have a non-shared ride if needed. I would have to ensure though, that people would not overuse such feature which could lead to drastic reduction of efficiency of such transport. Such issue could be solved with a good ride cost policy.

But one issue emerged with the idea of sharing rides - how would it affect the efficiency of the system? The more people could fit in the vehicle, the more efficient a single ride would be. But there's another side to it. The more people could fit in the vehicle, the more often it would have to stop to let someone in or out. This is a problem known already for public transport - the more often a bus or a tram has to stop, the longer the ride will be for everyone. And unlike public transport, this system would drive people directly to their destinations, which already may add time to the travel of an unfortunate commuter who's destination happens to be the last among the passengers. And what's the point of creating a system if it would be slower than cars

and public transport? Sadly, without running complex simulations that would allow me to check what number of passengers allows the optimal ratio of time/efficiency I won't be able to make truly prudent decision. And the best solution could be different for different towns and cities, depending on their population size, density and road infrastructure. I also need to keep in mind that the vehicle wouldn't be driving full all the time, also complicating the decision about the size of vehicle. It is clearly a big issue that I won't be able to resolve by myself. I can only assume, using a common sense, that the rides would be faster (and still efficient) when the vehicle would be able to carry 4 people, than when it could carry 6 or more. This assumption will help me with deciding on the vehicle design later on.

Payment method and cost
There are many possible ways of charging people for use of autonomous cabs. It could be based on:

- ticket system, just like most means of public transport,
- direct charge system (payable with phisical money inside the vehicle),
- a pre-paid (charging pre-loaded special account for every single ride),
- charge sytem (charging directly our bank accounts for every single ride),
- subscribtion fee (daily/weekly/monthly/yearly).

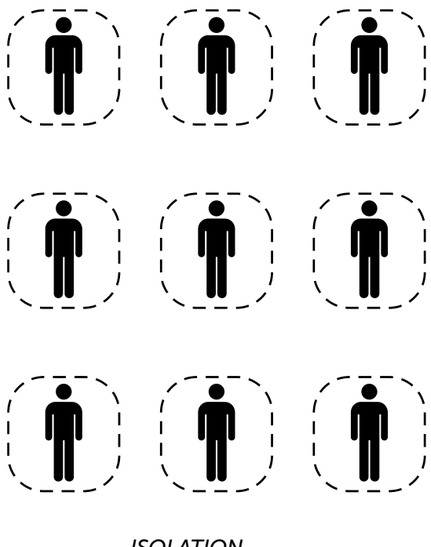
I wanted to go with a solution which would be as little obstacle as possible - meaning that the amount of actions to be able to have a ride should be minimal - no matter if you're a daily commuter or a short-term visitor in the area (e.g. a tourist). That led me to imidiate elimination of ticket system, which even nowadays is quite cumbersome. Subscription option, suitable for every-day commuters, unfortunately would be very unfriendly for one-time users. For those, some sort of direct charging would be the best. Considering that Finns adapt new payment technologies quite quickly (from my observations most people already make payments mostly with their debit/credit cards instead of paper money), I can assume that some variation of near-field communication payment method will gain a strong ground in the coming future, allowing to make all payments with a phone for example. The conclusion is - as the payment method would be wireless, there would be no need for any teller or ticket validating machine inside the vehicle.

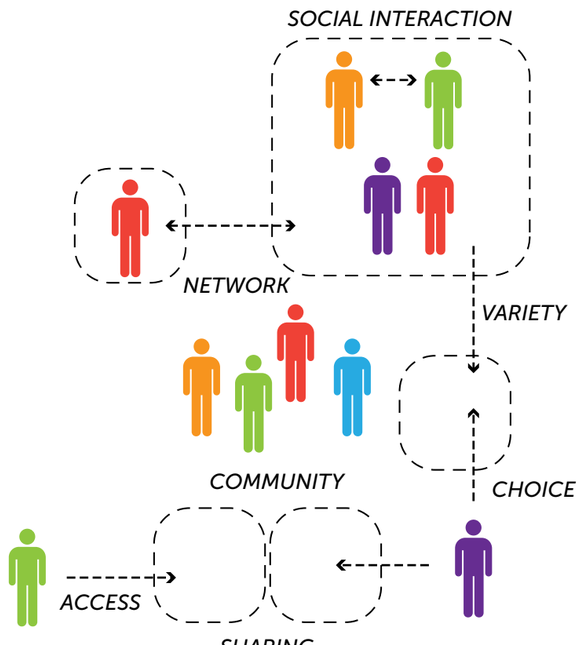
I do not want to go too deeply into the topic of cost, as it would inevitably lead to economic considerations. However I did want to think how could it affect people's behaviour and willingness to share rides.
It would make great sense, to have lower fee per-ride if a person shares the ride with someone else. That means, that whenever someone decides to have a lonely ride - it will cost more. The logic is simple - when you share your commute with others, you save money - a surely encouraging reason to do so. The cost should, however, discourage to have pointless short-distance rides (1km or less) - a distance a healthy person could easily cover on own feet. Of course that would not apply to people with serious problems with mobility. One thing for sure - in terms of cost, this service should be considerably cheaper than owning a car, and not much more expensive than public transport (assuming that it would survive competition with the envisioned service). At this point I realised that a whole thesis could be written just about the cost, and the conclusions could still prove to be indefinite without real-life testing. Therefore I decided to stop further considerations about this issue.

Transition
Such service would support a positive change from selfish ownership-based structure of our society to more open membership-like one. What does it mean? Just like the picture on the next page shows, that would encourage more social interactions, give people bigger freedom of choice (as they wouldn't be less tied to their posessions), and make it easier to share some experiences. It has been proved by American scientists that increasing amount of posessions is not really increasing the happiness of society. Perhaps participation in environmentally responsible behaviour would help people appreciate their days a bit more.

Social aspect
Perhaps Finns are not the most social people in the world. And probably they would not be incredibly fond of an idea of sharing rides with strangers in small

OWNERSHIP vs. MEMBERSHIP





vehicles. Maybe if they were given the motivational factor of saving money, they could more easily adapt to such solution But that felt to be to little to make people feel really good about it. Perhaps, if other aspects of using self-driving cabs would be enjoyable and filling with positive emotions, people would be more open for the company of new people. After all, it's quite uncommon for people to start a conversation with a stranger on a bus or train. In fact, Finnish people feel more comfortable when they don't have to get involved in social interaction with strangers who happen to be sitting opposite to them. But then, surprisingly, if the same people would find themselves in a sauna, they would probably start chatting right away. It seems to me that the problem is not really with people's shyness or introvertic nature, but rather with the of the environment around them. Buses, trams, trains are usually full of anonymous faces, people sitting quietly. It somehow creates an atmosphere that discourages spontanous chit-chats. In sauna, on the other hand, the more intimate atmosphere is just perfect for having a conversation - it actually helps to take attention from the heat that squeezes sweat out of our bodies. I also have observed, that in general it's easier to start a conversation when there are not too many people around - the atmosphere feels less intimidating. This will be an important factor when deciding on a number of passengers the autonomous cab could carry - less people could mean better chance of a social interaction to happen. It is too early however to say at this stage what the best number of passengers is. I should also ensure that the interior feels cosy, allowing people to relax.

User-service touchpoints

This is another very important issue that needs to be considered when envisioning a new service. What are the touchpoints between the user and the service? How can people order their ride? What do they need to do if they need to change appointment? As the system would work on a similar basis to taxi service, the touchpoints would be similar. Here's the list of possible interactions:

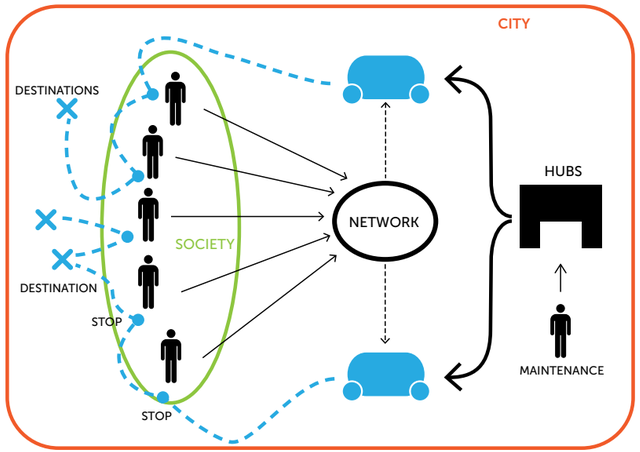
- ordering a ride or to scheduling daily commute-rides,
- rescheduling, postponing or canceling the ride,
- telling the destination,
- asking to stop, or wait,
- scheduling a return ride later.

There is a worrying trend nowadays to dehumanise service interactions. Instead of having an interaction with living people, we are often forced to deal with inflexible, digital interfaces. Sure, it may be cheaper or easier to run service this way, but doesn't it undermine the structure of our society that is based on natural, face-to-face interactions? We no longer have to ask people questions, if we can find the answer on a phone screen that we have in our hand. That's why instead of going for point-and-touch interfaces I would rather base the new transportation system on a more natural speech-interactions - even if the communication would happen just with a machine. We already have promising technologies that allow such interactions. Major mobile phone manufacturers started incorporating smart assistants in their devices, that allow users to ask questions and make requests in a completely natural way - with their voice - and then quickly getting the answers - spoken and/or displayed. Although it is not yet a true AI but just a voice-recognition system combined with a huge database of commends, I think we're on a good way to achieving very natural human-machine interaction. Therefore I think it's completely safe to assume that in coming years the technology will get so advanced and effective that we could easily use it as a basis for interaction with the service of self-driving cabs. Instead of inputting data with a keyboard, or making cumbersome selections from lists of options, we could simply make a phone call and say those things. Just like calling your friend and asking him or her to drive you somewhere. Except that it will never say 'no'. There should be a complementary visual interface for mobile devices, that people could use when unable to talk (for example when you have sick throat and need to go to a doctor). Perhaps there should be an option to order a cab with just one click, so users could efortlessly inform the system when they need a ride. Instead of trying to adapt themsleves to pre-scheduled time, they could more spontanously decide when they want to go somewhere.

Such solution would only require a simple application for mobile devices. I think that there's no point of trying to visualise the possible interface - seeing the incredibly fast development of mobile devices, I just don't want to suggest how the future devices and their interfaces could look like. But no matter if the interaction happens through speech or phisical interaction, we will need a mobile device to contact the service in the first place - unless we happen to catch the cab directly on a street. And as already nowadays almost every one in Finland owns a mobile phone, that should not be a problem in future.

How it works

From the user point of view, the service should be extremly simple. When you need a spontaneous ride, you should just 'inform' the system a few minutes beforehand about when and where you want to go. You wouldn't need to give your current location - the system could automatically check your postition by tracking your mobile device. Just before the arrival of the cab, you would get a notification that it's coming. Then you get in the cab and it drives you where you want. If there is someone who goes in similar direction, the cab can quickly make a stop to pick that person and carry on driving. When you get to your destination, you get out, and the cab drives to it's next appointment.
That's all there would be from the user point of view. The system that coordinates this whole transport system would be quite complex. It would



track every single cab and designate them wherever needed. It would have to respond very quickly to incoming requests and calculate the most optimal routes that would allow various people to reach their destinations, sharing same ride if only possible. It would also have to take under consideration traffic levels, so the cabs could avoid blocked road. That would surely require a powerful processing power and a really well written program. Artificial intelligence would allow it run autonomously without need for much interferance from people. It would surely be a great challenge to make it work faultlessly, but it's not impossible.

By who
Another question - who would take care of such transport system? It could be in hands of private companies, which would speed up the implementation process, as it would be a new market to fill. It would also give a field for healthy competition which would help with lowering the prices and increasing the quality of service. However it would also result in defrgamentation of such transport system - something that could confuse people (forcing them to choose between operators). The profit making policy of private investors could stand in opposition to the well-being of city dwellers, equality of access and sustainability. After all, it's the free, capitalistic market, which invented the planned obsolecence and made our lives orbit around the money. By no means am I trying to support socialistic ideology, I just have concerns if a system based on capitalism can be truly sustainable. This transport system should be created to serve society, not to fill someones pocket. Profits should be directed for maintenance and further development of the network. However, I'm not sure if granting the ownership of such transportation system to state or local municipalities would be a better solution. State controlled buisnesses usually struggle to maintain same quality of service as their private competitors, due to slower adaptability to changing conditions. No matter who would control this service, he should be focused on the sustainability and user satisfaction rather than on blind growth and market exploitation which are reflected by charts and numbers. The profit of making our lifestyles more sustainable and our lives happier should be sufficient.

When
Althought the technology of self-driving vehicles is already quite advanced, it will take many years until it will available for public use. Even when perfected, this technology will need a lengthy and very rigoristic testing to ensure that it's completely safe. It also will have to go through a legislation process - we would need to change many laws to allow such transport system to be allowed for public use. If the development process would start within next 2-3 years, we could probably experience it for the first time around 2030. And that would be a very optymistic scenario. For great things to happen in future, we need to start working on them now. Setting the vision of this transportation system in the year of 2030 will have an impact on the vehicle design, allowing me to use some futuristic technologies that are not yet commercialy available.

Sustainability
Even without shared rides, the system would still be more sustainable than private cars - that is because one self-driving cab could replace many cars. Sharing the rides would tremendously increase the efficiency of energy consumption. Nowadays driving a car alone is too easy . In the scale of one car, it's hardly harmful, in the scale of tens of thousands of cars it is a real issue. An issue, that we somehow don't want to notice nowadays. Perhaps it would be a slow process for people to adapt to the new system I'm proposing, but I believe that once people would have noticed the positive change, it would bring to our cities and lives, they would be much more willing to give up their own vehicles. To succeed, the system would probably require to be introduced in small-scale pilot programmes and expanded accordingly with the growth of its popularity. Self-driving vehicles would be much safer on the roads than those operated directly by people, resulting in reduction, if not complete elimination, of road accident occurance. Bad news for insurance companies.

Possible problems
Making such system work flawlessly would be a great challenge, considering how many people, destinations and varying times it would have to suit. Because it should be able to serve all commuters in the rush hours, it would require considerably big amount of vehicles. Maybe it should be less flexible during the rush, commuting hours. There should be one vehicle per 4 to 10 adult city inhabitants, meaning that an average-size Finnish city with 100.000 people would require at least 10.000 such vehicles in order to be able to sucessfully replace cars. That is a lot, in terms of production and cost. Obivously it could not completely replace private cars in one day. The system would have to be slowly implemented over the years, first provided only in specific areas of a city and then expanded to other areas. Maybe in the first years of functioning it would have to be subscribtion-only, and once the fleet of self-driving cabs would be big enough to serve more random requests, it could be available for anyone without having to pay regular fees. For many years it would only be an additional transport solution, an alternative for cars and public transport. Luckily as it would not require any new infrastructure except for the hubs, it would be easy to run pilot programmes.
It would be also barely possible to base entire system only on one specific vehicle - just as nowadays, there would be many companies manufacturing them, bringing the variation of looks and sizes. Vehicles could varry from town to town or even beteweend districts. Therefore my vehicle design should not be an attempt to create one and only solution. It will only be an example of what those vehicles, based on such service could be like.

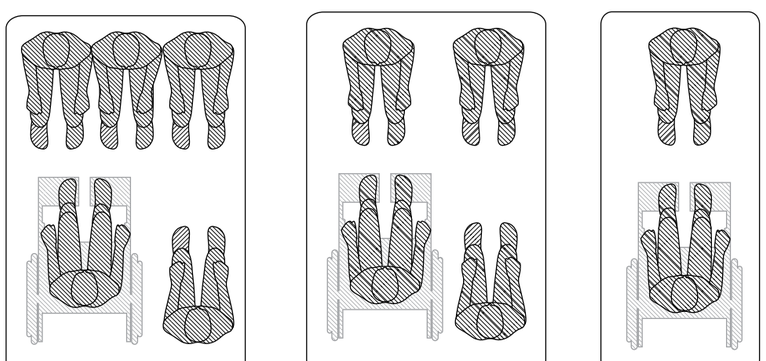
At this point I started realizing, that the investment required to built a smoothly running system of self driving-cabs in every Finnish town would be so big that even if introduced in 2030, it could be long after 2050 when it would have bigger ground over private vehicles. By the same time that we will be probably running out of fossil fuels. As much as compelling the idea is, it is not really a direct solution for already burning issue of commuting. It's more of a far fetched, perhaps a bit utopian vision that we could and should aim for.

Implications on vehicle design
The service created a basis and needs that I could now adress with vehicle design. I was very intruiged by the possible windows of innovation for vehicle design that this transportation system opened and I felt very motivated to do something new and unconventional.

8.2 Vehicle specifications

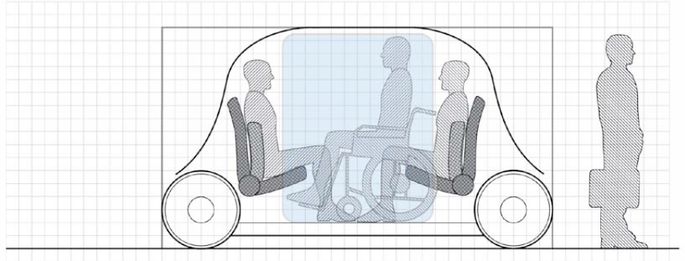
Size and seat layout

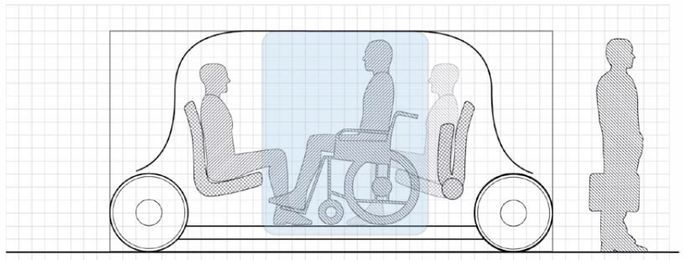
To determine the size of vehicle I had to consider many factors. First I needed to decide how many passengers it could carry. As the rides would be often shared, forcing the vehicle to stop in various places, it shouldn't be too big in order to allow it to swiftly move around narrow suburban streets, parking lots and busy roads in the city centres. Therefore I started thinking of something more of the size of Fiat 500 rather than of a sedan like Audi A6. Carrying too many passengers with different destinations would force vehicle to stop on numerous occasions, prolonging the commute times - a disadvantage common for public transport. I also wanted to ensure that passengers can ride comfortably without squeezing on the same seat with other people. From my experience, it is barely possible for 3 people to seat comfortably next to each other in a car with standard width of 1,7-1,8m. Another issue I had to think about was how easy would it be for passengers to enter and leave the vehicle. In a scenario where there would be three people sitting next to each other, it could prove to be problematic for the person sitting in the centre to bypass other commuters in order to leave vehicle. There could be also a case that doors can open only from one side, for example when stopping on a busy street. In such situation, person sitting on the other side of vehicle would be in a quite uncomfortable situation, especially if he or she would feel rushed to leave.
Also trying to apply rules of inclusive design, the vehicle should be spacious enough to carry at least one person on a wheelchair, and be easily accessible for anyone with any moving disorders. That means that there should be floor space at least 1m wide and 1,5m long. It should be also high enough for a person on a wheelchair to fit.
Considering all those factors, 2-seater seemed to be too small and limited, 6-seater on the other hand would force me to compromise either the compact size or the passenger comfort. A vehicle able to carry 4 people seemed to be a perfect choice. I decided that the passengers should be facing each other - after all, none of the people has to keep eyes on the road as it's self-driving, and such position would encourage social interaction - something I called for when developing the idea of the transportation system.

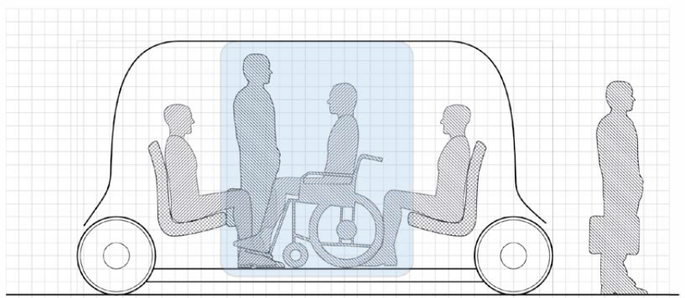


3 possible layouts with passengers facing each other. The option with 6 seats seems very tight, while with 2 seats only the transportation capabilities are seriously reduced. 4 seater seemed to combine both efficiency and comfort.

Having decided those things, I started aligning the vehicle layout using ergonomically correct figures representing 95 centile. I created 3 variations: small - with all seats folding, medium - with sides folding only on one side, and biggest - with non folding seats and height that would allow a person to stand inside. I found the idea of all seats separately folding especially interesting - it allows a considerable reduction of vehicle size but also brings more flexibility to the interior. For example, if there would be only one passenger, going to an airport with many bags, he could easily fit them inside while occupying one open seat. It would be also easier for a person on a wheelchair to turn around inside, with extra floor space given by the closed seats. Different case - when moving between apartments you could fill the vehicle with boxes and tell it to drive to your new place. Or simply when you take a dog with you, a folded seat would give a space for the dog to seat.. These are just few examples of multiple use cases that folding seats - unlike normal ones - seemed to be supporting. Getting extra floor space that comes with folding seats seemed to bring so many advantages, that I could simply not ignore that solution. There seemed to be also another side to that - the issue of choosing a seat. From my observations while using public transport it seemed that people usually consciously choose their seat, sometimes considering many factors, like the side on which the sun shines, who seats nearby, how far the seat is from the door and so

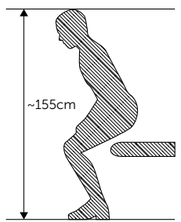






on. Surprisingly, choosing a place to seat is a fairly complex intellectual task. Now imagine that when you enter the vehicle, it automatically opens the seat for you, making that decision for you. And if there's someone in the vehicle already, you don't have to think whether to seat next to that person or opposite to him or her. I think that sometimes not having to make the choice makes life just easier. If you ever used buses, you must have seen some people changing their seats during the ride - being able to change one's mind about choices makes people less satisfied with the one they settled with. Even if it something just as trivial as choice of seat!

Coming back to the topic of height, ergonomically the best solution would be for a person to be able to stand fully straighten up. However that would mean that the vehicle would have to be at least 2,2 meters high. That would not only visually make the vehicle seem very big, it would also negatively affect



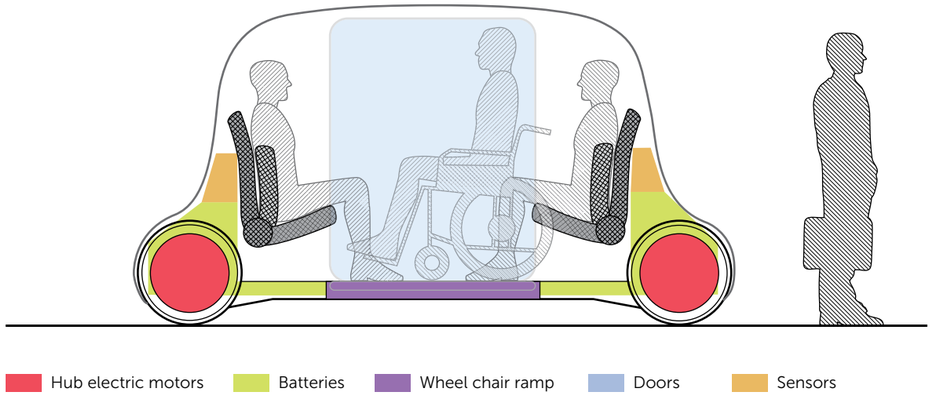
This is a natural position when sitting down and standing up

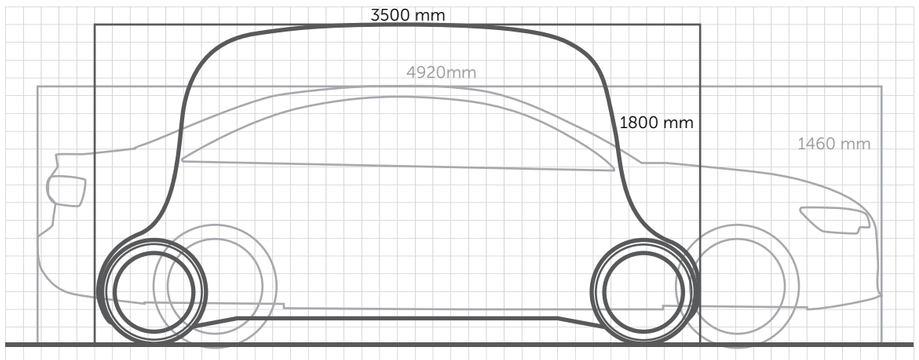
it's stability when combined with short length. It seemed to be in conflict with the aim of trying to make the vehicle as compact as possible. Having doubts I decided to carry real life study, to figure out how much space is needed overhead, to allow for comfortable getting in and out the vehicle. By simply using a chair and by setting different heights of 'ceiling' with a tape, I came to conclusion that the distance of 160 cm between floor and ceiling is enough. That is because while sitting down and standing up, we have to bend forward thus reducing the amount of space we need overhead. We can easily make a few steps in such bent position without feeling any considerable discomfort. I need to ensure, that seats are as close to the doors as possible - that brought me to conclusion that the doors should be on both sides. I do however, keep in mind situation, when stopping on the busy road, passengers would be able to enter and exit the vehicle from the safe, right side.

Package

The next step was to determine the position of other parts of vehicle - engine, batteries, sensors and such. Choice of electric engine seemed to be quite obvious, considering their efficiency and little noise emission. Nowadays the main problem with electric engines is the lower than satisfactory capacity of batteries - an issue that should be solved within next two decades - research of graphene supercapacitors casts a bright light at future possibilities. I also chose to hub motors, which have many advantages over traditional central engine unit. They eliminate need mechanical transmission, gearboxes, differentials, drive shafts and axles. That leads to a significant weight reduction which also means lower environmental impact. Independently powered wheels also help to drive in difficult, slippery conditions. Apart from motor, suspension and braking system that recovers power from braking can be into right inside the wheel, just as in recently developed urban electric car Hiriko. Using wheel hub motors leaves plenty of space for batteries in between. As the self-driving vehicles could be accident-free as most incidents happen due to human-mistakes, there is no need for smash zone.

In order to navigate on the streets a self-driving vehicle needs multiple sensors that scan the surroundings. Current version of self-driving google car has a kinky-looking laser scanner on top of the roof. I'm sure that is not the only possible placement of such sensor. They could be placed behind the front and back windshield, but it would have to be ensured that they have at least 180 degrees range. I also wanted to incorporate a ramp that would enable easy access for people on wheelchairs. It could be hidden under the floor and slide out whenever necessary. As to maintain normal-height suspension and low floor level at the same time, the ramp would have to be made out of thin, yet extremely durable material such as carbon fibre.





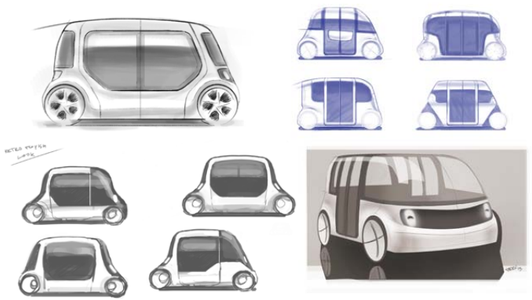
Size comparison to Audi A6

8.3 Exterior design

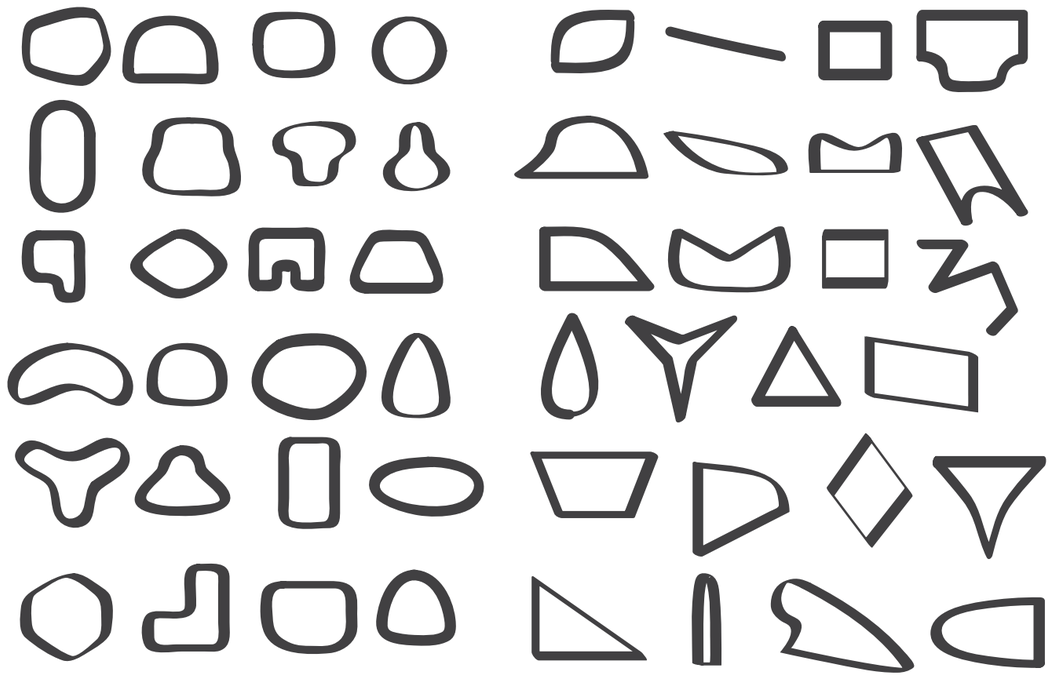
Attractive look of vehicles is one of the main purchase-decision factors. Where product is for one person, he or she may regard the choice of a product as an opportunity to express his or her personal taste. Some people find themselves enchanted by aggressive silhouette of BMW while some other might prefer more peaceful and cheerful looks of a Fiat 500 or Mini. However, this is not really an issue when the vehicle is designed for communal use. As we still more or less consciously evaluate the design of objects of public use such as buses, trams or park benches, we won't neglect them if their looks don't reflect our taste. Also, making assumptions about people's taste and values is becoming more and more difficult - it is simply impossible to satisfy everyone with one approach to stylistics. And, when it comes to concepts - those are usually visualized with one point in mind - to make them look futuristic and surprising.

Instead of following the typical automotive approach to exterior design, which fancies multiple sharp surfaces and beguiling reflections, to achieve the deceptive feeling of movement even when the car is standing, I decided to work out the premise of aesthetics from the ground up by myself. I just didn't want to take clues from current vehicle design ideology and trends, which in my belief wouldn't lead me to anything original nor humane. So I asked myself - what should a vehicle, that cruises the roads automatically, without any human-driver controlling, look like? What emotional response should it arouse? How could it express that it's just our humble servant?
It seemed obvious that it should not be a resemblance of our current cars, which are basically heavy metal boxes with aggressive expression on their 'faces'. Just imagine - would you feel safe if you saw a Lamborghini or a Jaguar coming automatically at your direction on a narrow street? I bet people would feel somehow threatened in such situation. After all, most of cars nowadays look like hungry raptors - we surely wouldn't want those razor-sharp metal killing machines running loose on our streets. The self-driving technology should come with much more friendly and approachable look. Just as I already established while doing the research, I wanted to create something that people could easily describe with following adjectives: humble, optimistic, honest, simple, soft, warm and friendly. Therefore I needed to find a way to express those values.

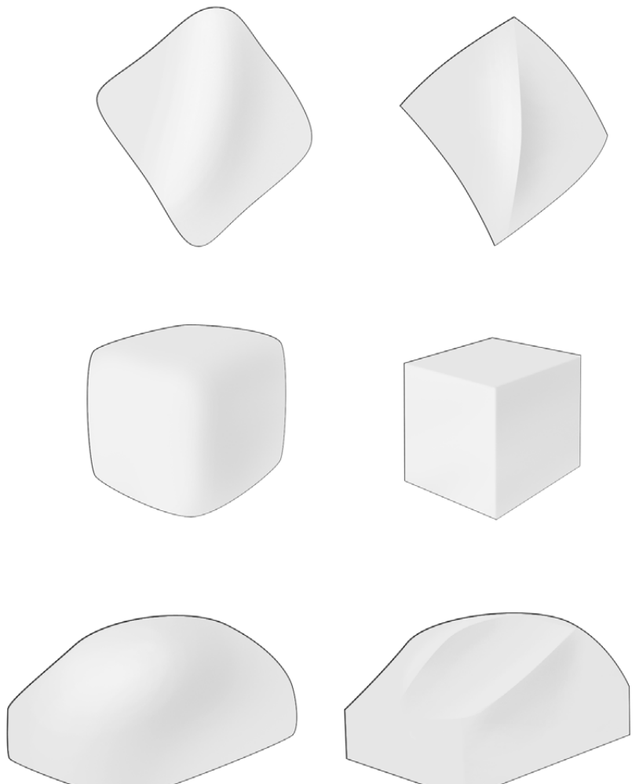
At first I jumped right into sketching vehicles, but that approach proved to be messy and very unbalanced (some of those sketches are shown below). Seeing no good results and being unable to decide which direction to follow, I decided to take a step back and started to think of forms in a more abstract way, and then to follow those findings in more systematic way.

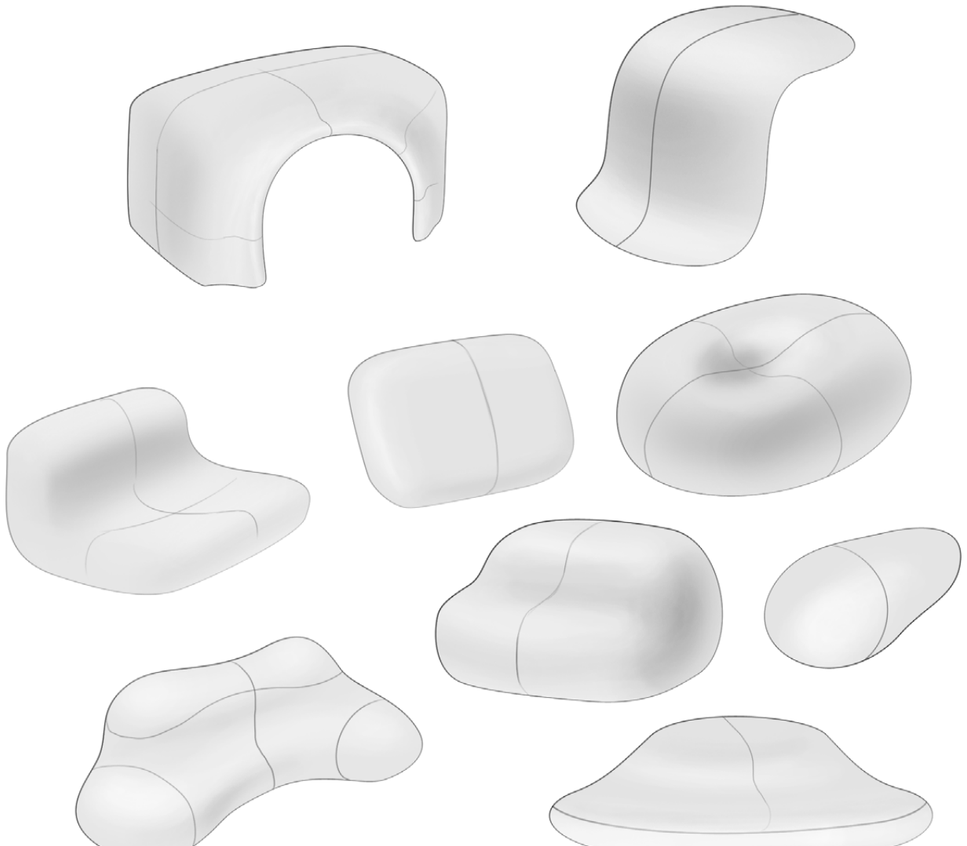


SOFT, WARM, FRIENDLY *SHARP, COLD, AGRESSIVE*

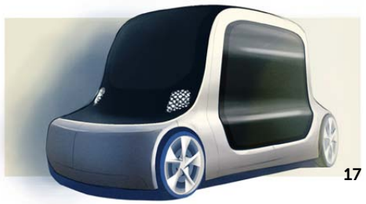


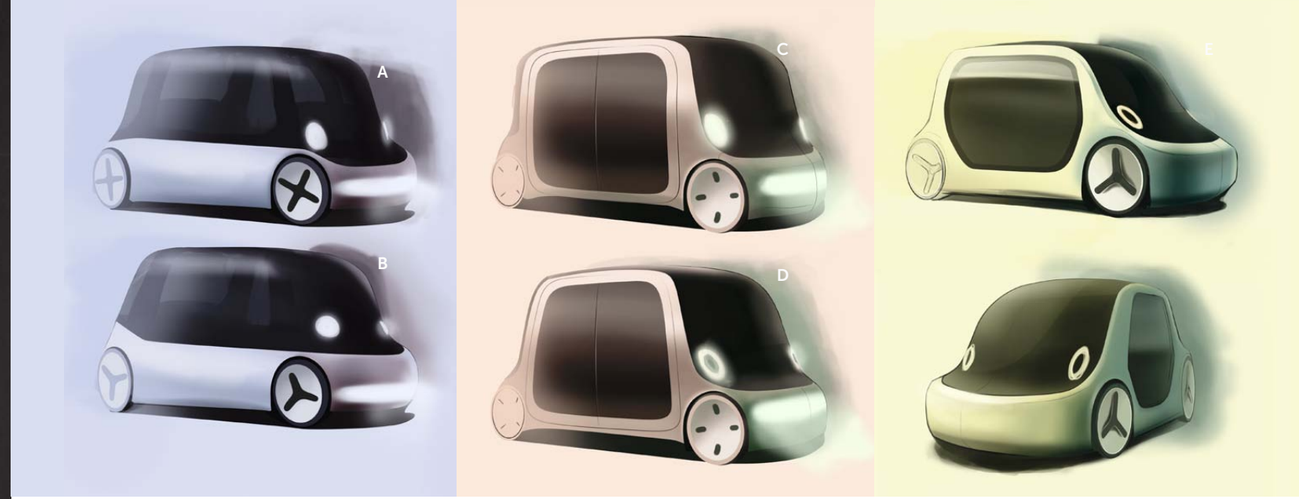
At first I drew multiple abstract shapes. Then by considering my emotional response to them, I divided them into two groups - forms that seemed soft, warm and friendly, and forms that had more aggressive and cold character. It seemed that to achieve the friendly character I had to focus on using rounded forms, with horizontal on vertical arrangement and big inner spaces. Anything that incorporated diagonal, oblique directions, sharp corners, concave arches and narrow spaces, fitted the other group. It was a great start, allowing me to eliminate at an early stage shapes that were carrying the wrong message. After that I started drawing more dimensional forms and surfaces, trying to establish clear difference between dynamic, sharp agressive forms and ones that are more peaceful, soft and friendly. By doing such simple comparison I got better understanding of the visual direction I wanted to take. Then I did more drawings of soft, simple forms to set better basis for further sketches of vehicles. True, strong arches and intersecting surfaces, so common in automotive design, allow for greater expression and add sharper, more defined character, to forms. But why should it be the only way to sculpt vehicles? The soft approach may be perceived by some people a bit retro and maybe even oldfashioned, but it is still the best way to express values of friendlinnes, humbleness and simpliness. Besides, going in the direction that has been somehow forgotten by industry, might be actually a breath of fresh air.





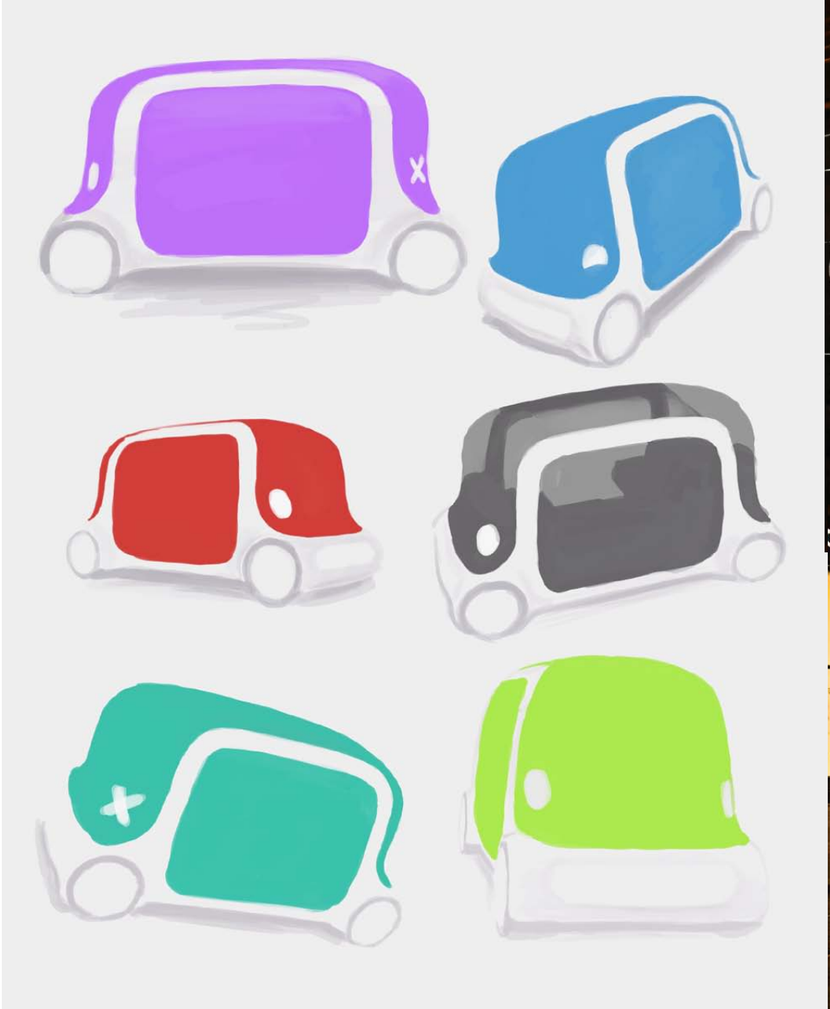
My next step was to do quick sketch studies of possible vehicle forms. At this point I didn't try to think of the package I decided on before. I just wanted to find some interesting forms that would feed my imagination. Sketch technique choice was quite important here. I didn't use sharp narrow lines, which I learned to have tendency to 'sharpen' the form - making them look more agressive.
To avoid that, I decided to sketch with wide brushes and color spots. At first I used wide, cool grey marker that allowed me to draw softer shapes. Then I used deep black colour to highlight the window and lights. I found to have most sympathy for more boxy-looking vehicles (2,3,7) rather than those that were remidning existing SUV's (8, 14).
I started doing more defined sketches (17-19), introducing more colour, but that approach took much time and slowed down the design process.





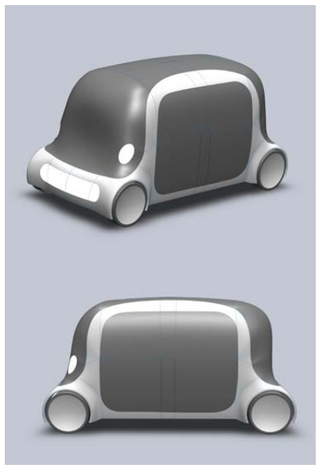
At this point I decided to generate numerous sketches including the package, to maintain the right proportions. Using vector graphics allowed me to have better control over the curves. I used approach called 'proximiy based styling'. The idea is to define forms in a few steps, in a way that we would recognize them starting from the far distance, adding more details as we get closer to the object. At first the most aquiline is silhouette. From 20 silhouettes I chose 4 that (marked with green colour) that were most balanced yet interesting. I proceeded with them, adding 3 value graphics (in this case - windows) variations to every one of them. From these 12 I decided to choose five for further development (marked with orange). The choices at this stage were more intuitive rather than rational. It's rather hard to find strong arguments for and against every single tiny sketch. After adding a bit more detail to the side views of the chosen five, I started drawing them in perspective, as to get better sense of what these forms would truly seem like. At this point I was still focusing more on the general feeling of the form rather than the details (such as wheel rims). Options A nad B looked really simple and friendly, however they were carrying a feeling of more personal car rather than something that is part of a public system. They also reminded me too much of Honda Puyo concept car. Options D and E because of stronger diagonals didn't seem to be visually spacious, and felt more sloppy and unbalanced, also trying to look more aerodynamic than they actually were. I was especially attracted to the idea of having a visible 'frame' around the squarish doors of option C. It was a feature giving the vehicle a clear, stable character and making it recognizable from a distance. Its kind of bulky, blocky form seemed completely unthreatening, very humble and settled, making it more trustworthy than other options. This and the fact that its overall form wasn't too sophisticated, made me think that it had the biggest potential of turning into iconic vehicle that would represent the new transport system.

At this point a new idea came to my head. In research part I have already stated that I wanted to create unique mood for the interior. However I did not think then, that the mood-lightning could be visible also on the outside. I thought of Lux Helsinki - an event in which various public areas in the capital are lit with colorful lights that start shining after the sunset, creating a truly magical atmospehre that attracts lots of people. Sadly this event lasts only for 5 days, and happens only once in winter. As I was going to incorporate huge windows in my vehicle, I asked myself - what if those could actually emit colorful light themselves? It may sound abstract or even a bit ridiculous at first, but when you think that we already have technology of transparent and flexible displays, then I think it's reasonable to anticipate that in 15-20 years we will be able to turn any transparent surface into a screen. The point of having light-emitting windows in vehicle is to bring more cheerful atmosphere to gray (at least in winter) urban environments. Another benefit of such feature would be an ability for the vehicle to identify itself. Let's say there is a situation, when couple of people are waiting for their cab to come - how would they know which cab came for them? If they got message that they will be picked up by a green one, then all they'll have to do is to wait for a green-light-emitting cab to show up. It's a daring idea, but as the whole nature of the project is trying to question fossilized transportation systems, I decided to carry on with it. It also gave interesting perspectives for the look of interior.

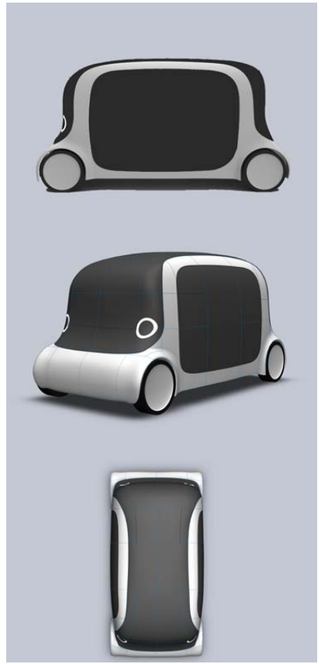


Further exterior development
One problem with sketching in two dimensions is that it allows to create shapes that later turn out to be impossible to be translated into 3 dimensional model. As I had already decided the dimensions, shapes and general proportions of the vehicle I took them into Solidworks for further development and refinement. The great benefit of using Solidworks is that it allows to modify any surface at any point without breaking the existing connection, thus allowing for quite natural, design process with little constraints. I did not however intend to create a final 3d model at this stage. I wanted to get better understanding of shapes and forms and use that knowledge for further definition of exterior by sketching. I could have done three-dimensional study of form using clay, but I thought that using 3d software for that purpose would be good warm up for creating the final model that I could later on print in 3d. It was also a bit more practical solution as I intended to design the whole interior, which would be much more cumbersome having only a clay model, as a three dimensional reference.

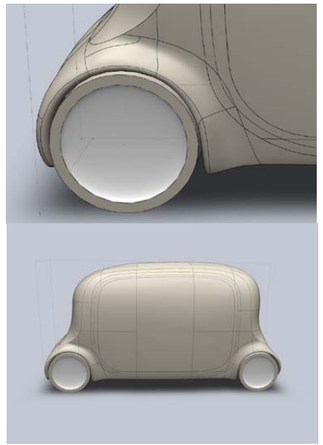
I started with a quickly made, sloppy model, to check the proportions and to discover possible problematic to model areas. In a way, this was a draft 3d sketch. I wanted to create a 3d model that I could easily manipulate, therefore finding those issues in advance was very valuable. The hardest area to solve was going to be the area where front and back windshields blend into wheel house shell. Also the split line between door frame and top windshield would require special attention. The side view didn't indicate strongly enough where is the front and where is the back side.



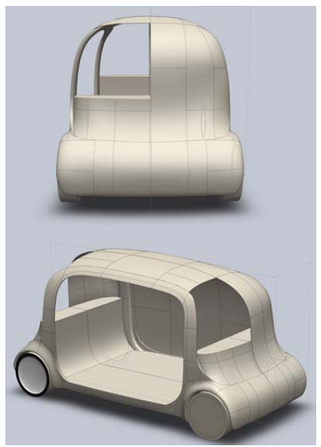
Instead of trying to address those issues by correcting the same model, I decided to built a new one putting much more attention into creating an ordered, easy to manipulate structure. It took more time to make than previous model, but allowed me to quite freely manipulate the shape.
I spent a few days adjusting the surfaces looking for the best proportions. Side



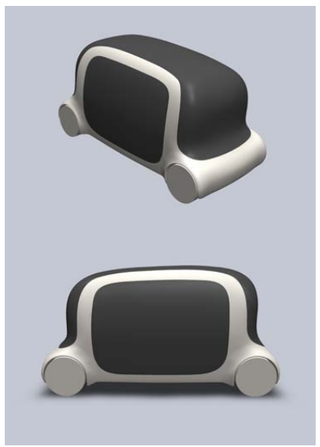
view was of great importance, as it was indicating the direction of vehicle. However the results were still far from satisfying. The window areas were especially badly resolved and the way I created those surfaces eventually proved to be too limiting. Again it was just better to start over again.



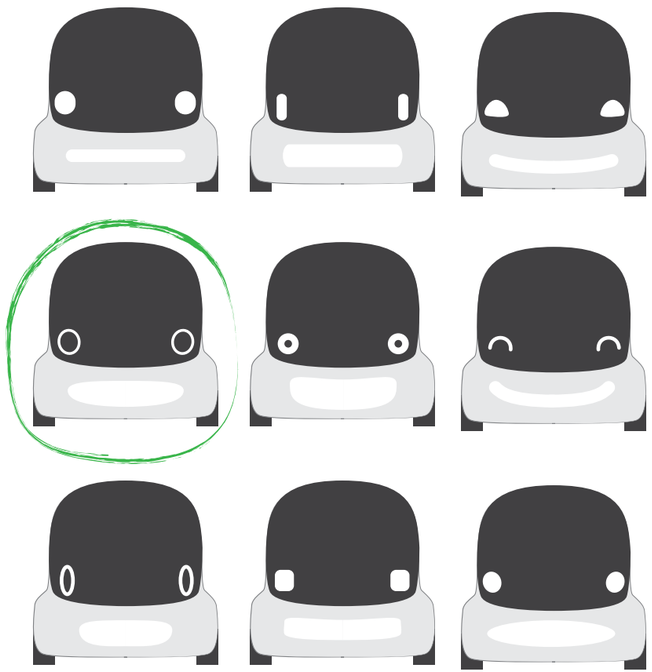
Once again I had to try different approach to creating controllable yet surfaces. I also started working on soft edges such as those around the wheels. But my general focus was still on the overall form. I wanted to keep the form as simple as possible. At this point I was gradually realizing that the issues I had with the form would be very hard to solve and fine-tune by sketching. Because of organic, soft form I was trying to achieve, I needed to be able to look at it and evaluate from many different angles. Well developed projections would not be enough to get a good result. But at the same time, I started to feel that creating a clay model would allow me to resolve some issues faster and perhaps even better. However, I stuck with the selected, digital method as I saw it as a good modelling practice. I added a bit of tilt to the vehicle, so the roof line was leaning towards the front. That made the form slightly more dynamic and gave clear indication where the front is. I kept the windows quite vertical, as they were making it look humble. Once I got fairly satisfied with the model I decided to check what was going inside of that shell. By doing so later on I could use the model as a help for sketching the interior, guaranteeing that the drawings are of right proportions. There were still some minor surface quality problems that were bugging me. At this point however, they were not a

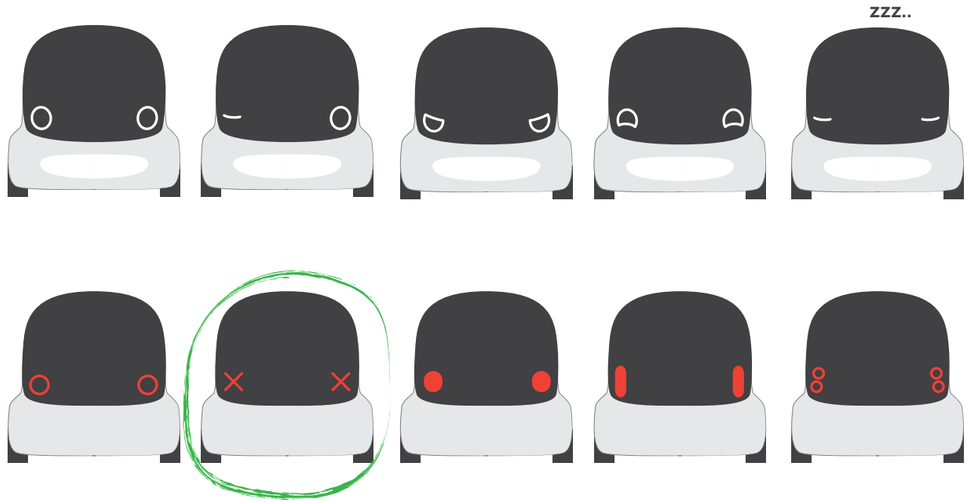


serious issue as I still wanted to go back to sketching. The whole '3d-sketching' process lasted almost 3 weeks and gave me very good understanding of the form. The huge part of this process was continuous assessment of the form and its refinement, which took way more time than modelling itself. It was a bit like working with the clay, constantly looking for the best look and feeling. As there weren't really any milestone steps, it was hard to document that process, therefore I'm describing it so briefly in spite of amount of time it took. By carefully adjusting all the surfaces I think I managed to achieve a good stance well-balanced,eye pleasing result. I was surprised how small nuances could affect the quality of whole form.



Face
One of the most recognizable visual features of each vehicle is its face, where headlights act as eyes and grill as the mouth. It has a huge affect on how we perceive a car - it may seem angry, sad, indifferent, happy, vicious, sly, proud or naive. Due to the use of electric engines, which do not need much cooling, the vehicle doesn't need any grill. I got an idea to put the headlight there, that would act as the 'mouth' of the vehicle.
As it would be hidden behind the layer of translucent material covering the whole body of the vehicle, it would only show up when turned shining. When it comes to 'eyes', I wanted to give them very friendly (but not freaky!) yet simple character. I created some variations that were mostly focused on circular shapes. Circular light have already been proved in automotive industry to have very kind character and have been used in many iconic cars such as VW Beetle and Mini Morris. By going in the similar direction I wanted to refer to those iconic cars. I chose an option with line-circle lights which create an effect similar to widely open pupils - a cute look. I also wanted to add more life to the vehicle, which lead me to an idea of making the 'eyes' animated. The vehicle could have couple of different expressions showing different states. Most of the time it would remain in neutral state, but when passing a person it could cheerfully wink at him or her. It could also express anger when someone comes late for the appointed ride. And when having a 'productive' day, driving a lot of people



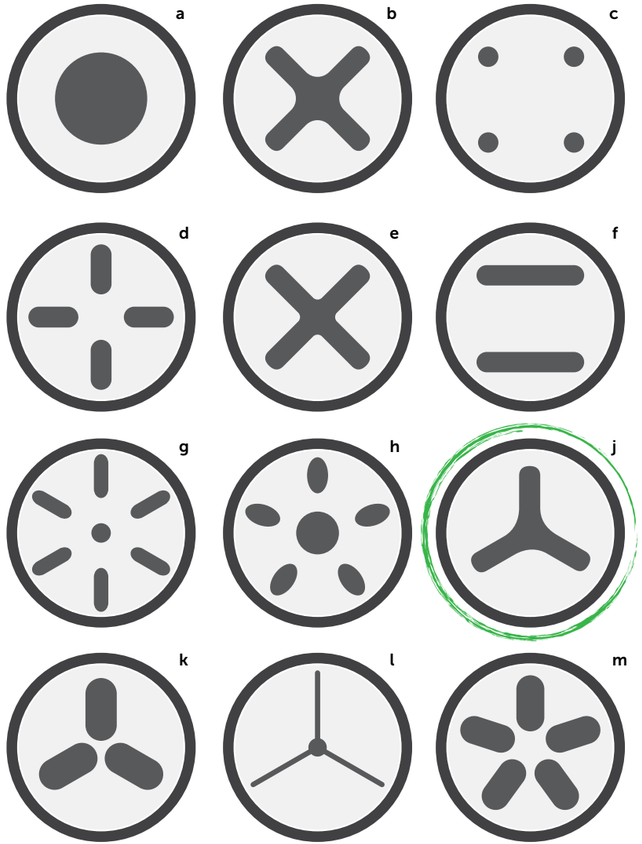


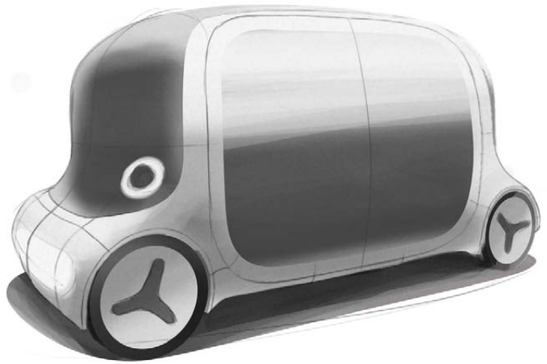
during the day, it could show it's great happiness for doing a good work. After returning to the base it could fall asleep. Allowing the vehicle to express emotions would reinforce the relationship with its users. It would also add a sort of wild-life observatory aspect - cabs would seem like some living creatures, cruising on the streets, that have their own character and emotions. Thus they would become more humane and could be even empathised with - something we can hardly do nowadays with any man-made product.

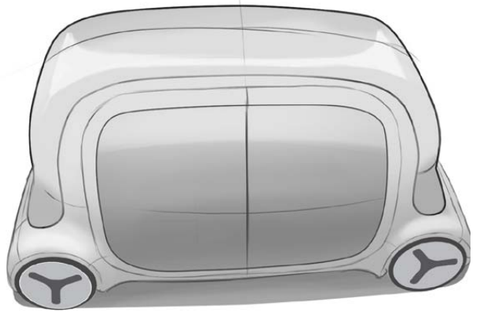
Back
As I went with quite symmetrical form of the vehicle, the back is not that much different from the front. However, as many times noted to me by others, it needed to be clear where is the back and where is the front of the vehicle. I have already carefully designed the side profile to make that difference visible, yet when looking straight at the back, that difference was almost unnoticeable. That's why I decided that the lights should clearly indicate that difference. Any circular shapes, even if red, seemed more like bloodshot front 'eyes'.

Double-circle lights didn't carry that feeling, but seemed inconsistent with the overall design. That's why I decided to go with X-shaped lights, which were clearly different from the front and were jokingly carrying a message 'the vehicle ends here'. As all the living creatures have only one 'face' that expresses emotions, I decided that the back lights of the vehicle won't be animated.

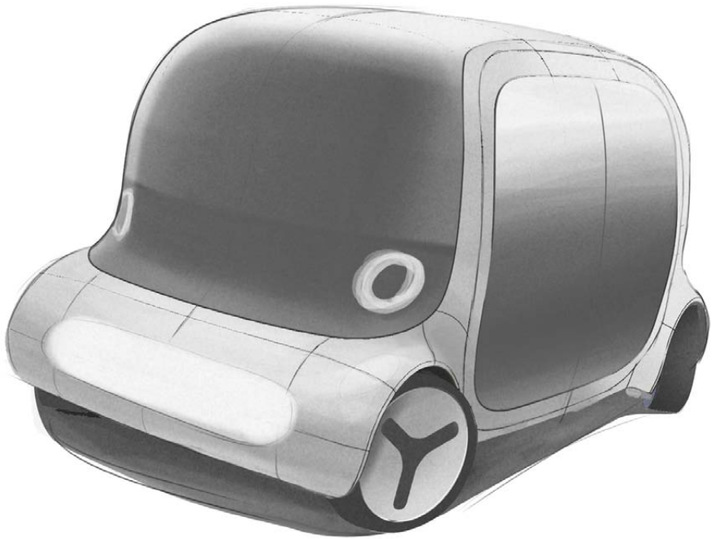
Wheel design
Just as with exterior design, I was looking for a very simple wheel rim design. It should carry the same feeling as the rest of the vehicle. Wheels would carry advanced technology inside, combining electric motors, breaks and elements of suspension. I wanted to hide all this complexity from users eyes. I didn't want to make them look very light, as it would be only a delusion (not humble). I already had some ideas when ideating the exterior of the vehicle, yet I didn't pay enough attention to this detail to make a conscious decision. Therefore I drew all ideas had using Illustrator - by equalizing the quality of sketches it would be easier to make a fair judgment. I liked options j and k the most. Eventually I decided to go with simple three-arm shape (j), that nicely kept integrity of the wheel - k didn't seem to create a strong core of the wheel. The plate would be made of the same material as vehicle body, but the core would be made of metal to create visual stiffness of the wheel.
I didn't focus much on the thread of the tire - I just created a very simple pattern, that would look believable. Tire-technology might see some improvements in future, but in this project I thought it was irrelevant to go deeper into this topic.

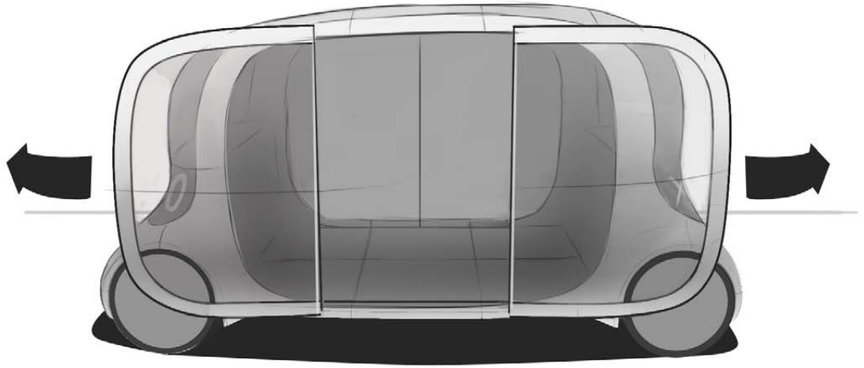


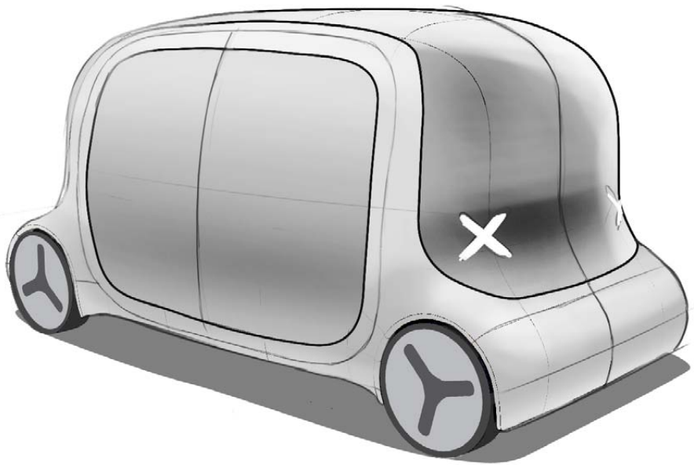


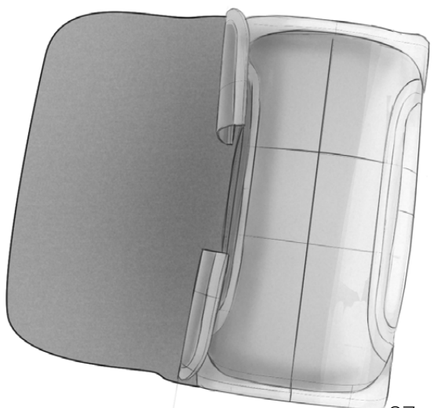


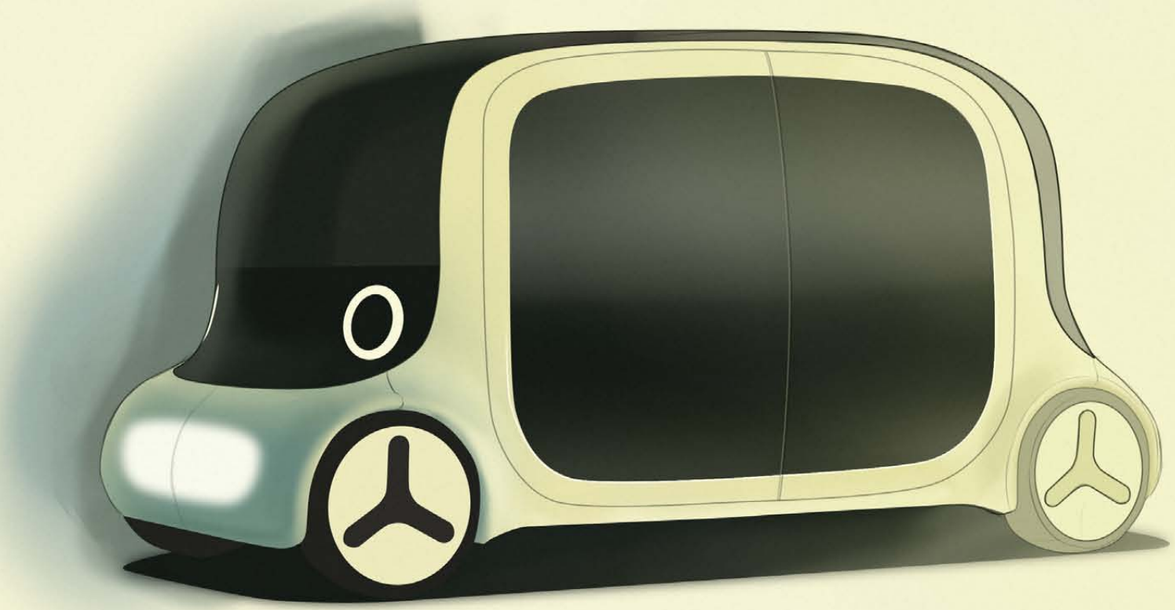
Basing on the 3d models and the vehicle 'face' ideation I was able to create much more refined sketches of the exterior design. I made the form look soft from all angles to maintain friendly, simple character. I extruded the inner wheel arches slightly from the form and wraped them smoothly inside, adding a nice yet minimalist detail. At this point the form felt well-defined and mature. I still needed to design the whole interior.

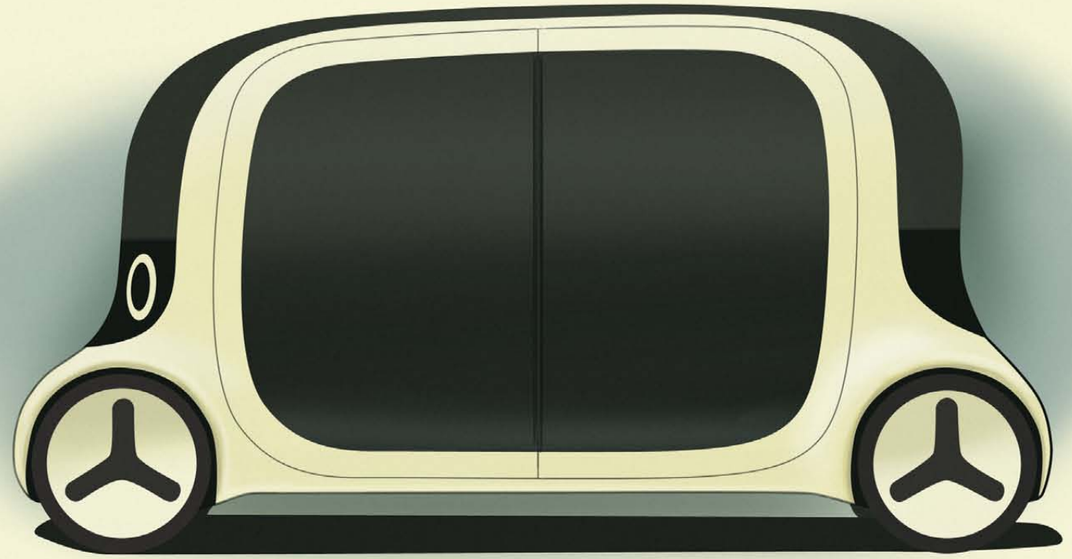


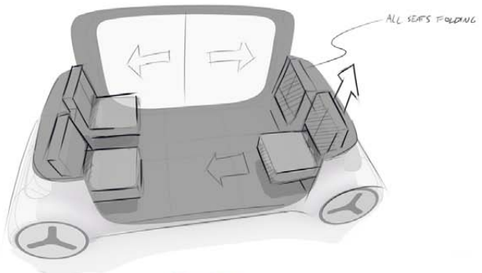












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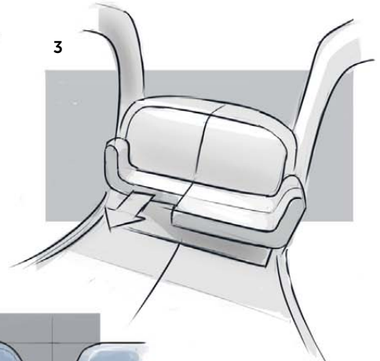

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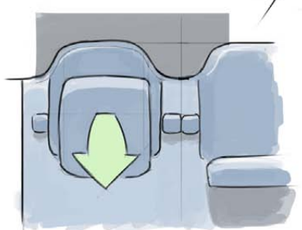

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8.4 Interior design

The biggest challenge that I was about to face with interior design was how to combine feeling of cosiness with the folding seat system. At first I started generating ideas of different ways the seats could open and close. I was really tempted by the idea of seats that instead of rotating on a hinge would simply slide out when needed (1,2). That would allow creation of very simplistic looking seats. But a plain seat didn't seem comfortable enough - it needed armrests, allowing passengers to keep their elbows supported. Thus came the idea of sliding seat/armrest (3). I had doubts though, if there was enough space in the vehicle for sliding 40cm long seats. Checking dimensions of my 3d model proved, that indeed such solution would not fit, unless I would increase the length of the vehicle by almost 1m, which would force a complete redesign of exterior - a price I couldn't afford to pay. To fit the constraints given by external dimensions ,I had to go with folding seats using a hinge (4,5,6). Being hardly satisfied with any of the ideas, I decided to think about other aspects of the interior for a while. I felt that there should be some sort of interface, that would support users communication with the vehicle. As already stated in the service touch point development part, I wanted to avoid any physical interfaces in favour for more natural voice communication. And usually when we talk with someone, we'd like to see the other persons face. After all, no one likes talking to someones back. That gave me an idea - the vehicle also had eyes inside of the vehicle that would look at user when communicating with him. A psychological factor of feeling observed would also prevent passengers from vandalizing the interior (like writing something with a marker, leaving garbage or empty coffee cups behind). I created a set of such possible 'eye' displays. Options with eyes and mouth seemed a bit freaky and childish. I chose version that seemed unthreatening and coherent with the external face of the vehicle. I placed it on the door frame, where it would be easily visible.

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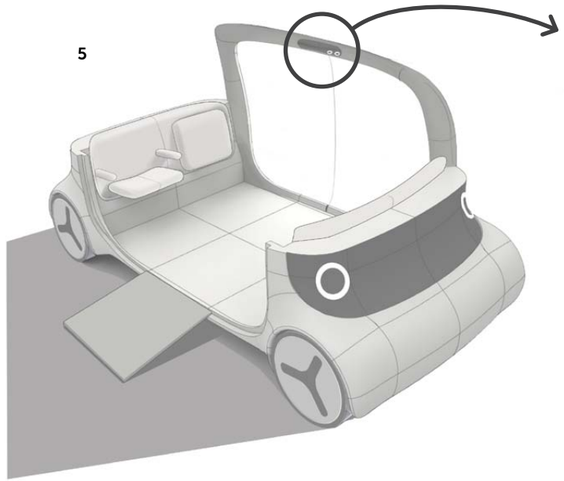

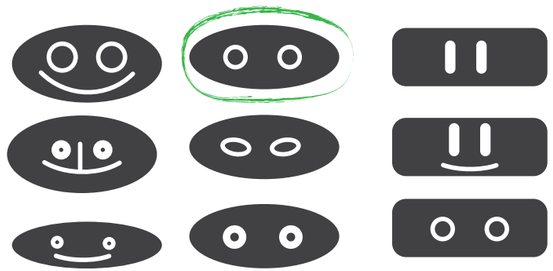

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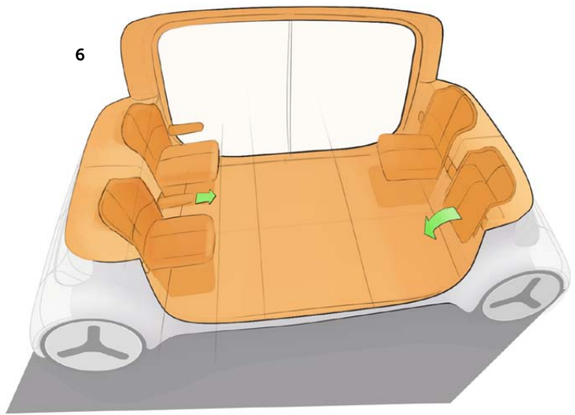

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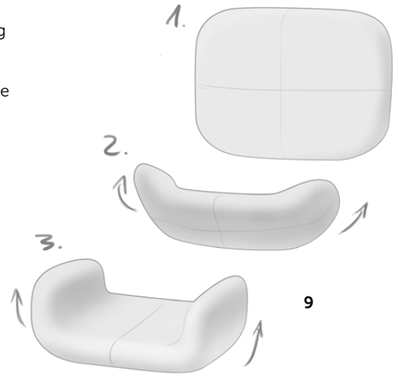
I also visualized the way interior would look like when lit by the light-emitting windows (8). The mellow colourful light would create a very relaxing, peaceful atmosphere that would allow people to relax. It also brought me to deciding, that upholstery should be in eitherwhite or light grey colour, so it would reflect the light without affecting its colour, thus maintaining uniformity of ambience. If the seats were orange (like on sketch 6) and the emitted light was green for example, the resulted reflected light would be unpleasantly brownish. It wasn't an easy decision, because in daylight conditions, when windows are transparent, the colourful interior seemed to be much more cosy than the white one, which could be perceived to have hospital character. The pleasant nighttime ambience was of bigger importance for me in this concept. Perhaps such issue could be fixed with color-changing properties of upholstery, but I didn't want to add too many futuristic feature, as at that point I had quite daring idea for dealing with seat-armrest folding issue. They could be made of intelligent polymer foam, that is flat when the seat is closed, but opens, in a flower petal manner, with sides folding upwards to create soft armrests (9). Of course, the seat would also have to be reinforced to support the weight of a human. Such feature would be visually pleasing and would surely reinforce the user-friendliness with its organic character.

When it comes to the shape of the backrest, at first I was opting for more simplistic uniform shape like on sketch no. 5, but after doing first 3d tests, I came to conclusion that was increasing the visual weight of the interior. That's why I decided to go with accented backrests for each seat (10), which aside from making the vehicle look lighter, was also a clear indicator visible from outside of how many people can fit in the vehicle.
I also added a dark-grey mat on the floor, which would make the dirt brought by shoes less visible



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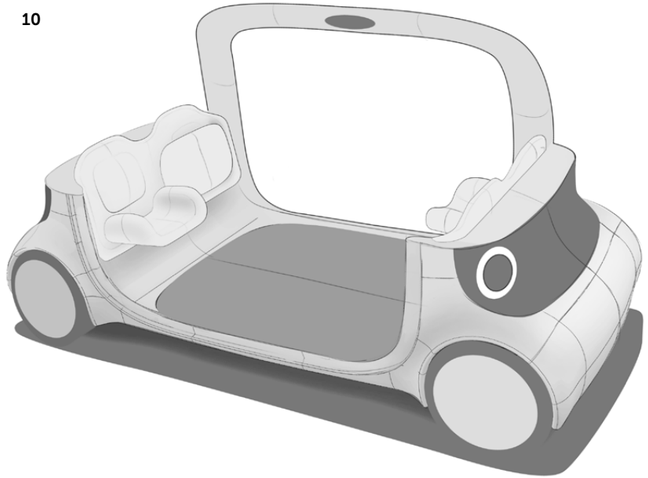
10



8.5 Materials

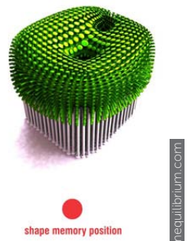
When it comes to the choice of materials, I tried to envision materials that would influence the feeling, character and usability of the vehicle. Due to very conceptual nature of the project, I did not look deeply into engineering aspects of the vehicle. Therefore I won't argue neither for, nor against any specific materials and manufacturing techniques. Instead I will mostly focus on describing the properties of the materials especially relevant for user experience and sustainability.

Soft body cover

Instead of using sheet-metal, the entire body of the vehicle would be covered with a soft silicone-like material, that would have self-healing properties. It would be also completely water- and stain-repellent, which would minimise the need to clean the vehicle. And what's most important, it would be recyclable, so that after many years of use it could be safely disposed. Such material would not only support long life cycle of the vehicle, but it would also support the feeling of safety. It would be easier for us to accept a self-driving vehicle cruising on our street that is covered with soft, skin-like material rather one that is made out of cold metal.

Light emitting glass

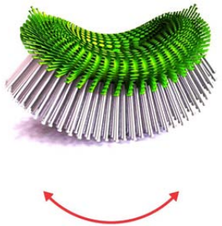
All windows of the vehicle would include double-sided light-emitting, transparent layer. It could emit light in the night, creating the a mellow atmosphere both inside and outside the vehicle. During the day it could reduce it's transparency to block the sunlight from heating up the interior or to increase the feeling of privacy of the passengers. It's would also be covered with highly water-repellent coating, so that neither rain, ice or snow would stick to it.



arrromequilibrium.com

Intelligent polymers

Their shape-changing capabilities could allow to create seats that change their shape from flat to U-shaped when opening. If such transition wouldn't be achievable solely with shape memory, it could be supported mechanicaly.



arrromequilibrium.com

composites.com

Ultra-light eco composites

Composites allow to tremendously reduce the weight of vehicles while maintaining great stuctural strength. Sadly, nowadays most of composites are hardly recyclable or reusable. I bielieve that this problem will be solved in future, with composites made of natural, biodegradable fibers, which won't harm the environment when the life of the vehicle ends. Such material would be used for making the lightweight and strong frame of the vehicle.

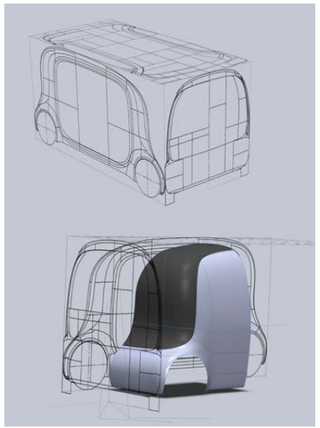
Nano-coating

By applying layer of dirt- and water-repellent nanocoating on surfaces of the vehicle, it could remain clean for extended period of time. Even spilling a coffee inside would not be a problem, as it would simply drain into dirt containers hidden underneath the vehicles floor. Such coating would also have anit-bacterial properties, making the interior more higenic.

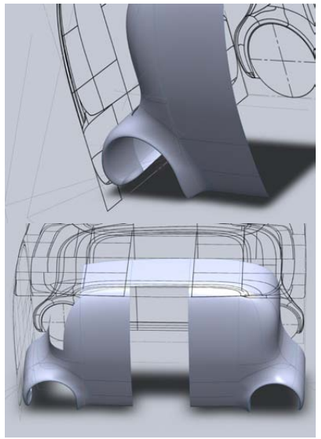
revewet.com

8.4 Final modelling

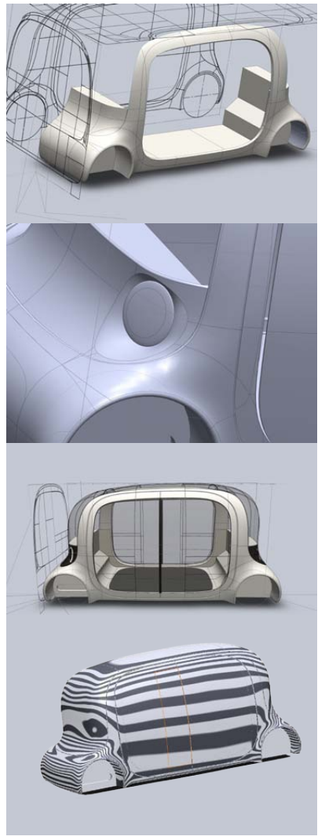
After designing all elements of the vehicle I could proceed to creating a final 3d model. As guideliness I used slightly corrected projections of the most refined 3d test model that I have made 2 weeks before and sketches. The experience gained by doing first 3d versions proved to be extremelly helpful in solving all the modelling issues, allowing me to make quick progress.



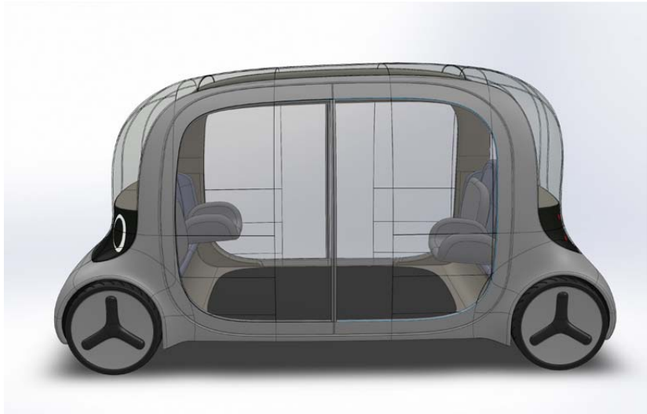
Again, I used a bit different method of creating surfaces that would allow me to acheive flawless transitions in problematic areas. As before, I started modelling half of the front, then half of the back and then smoothly joined them together. Unsurprisingly some small issues started occuring, like the



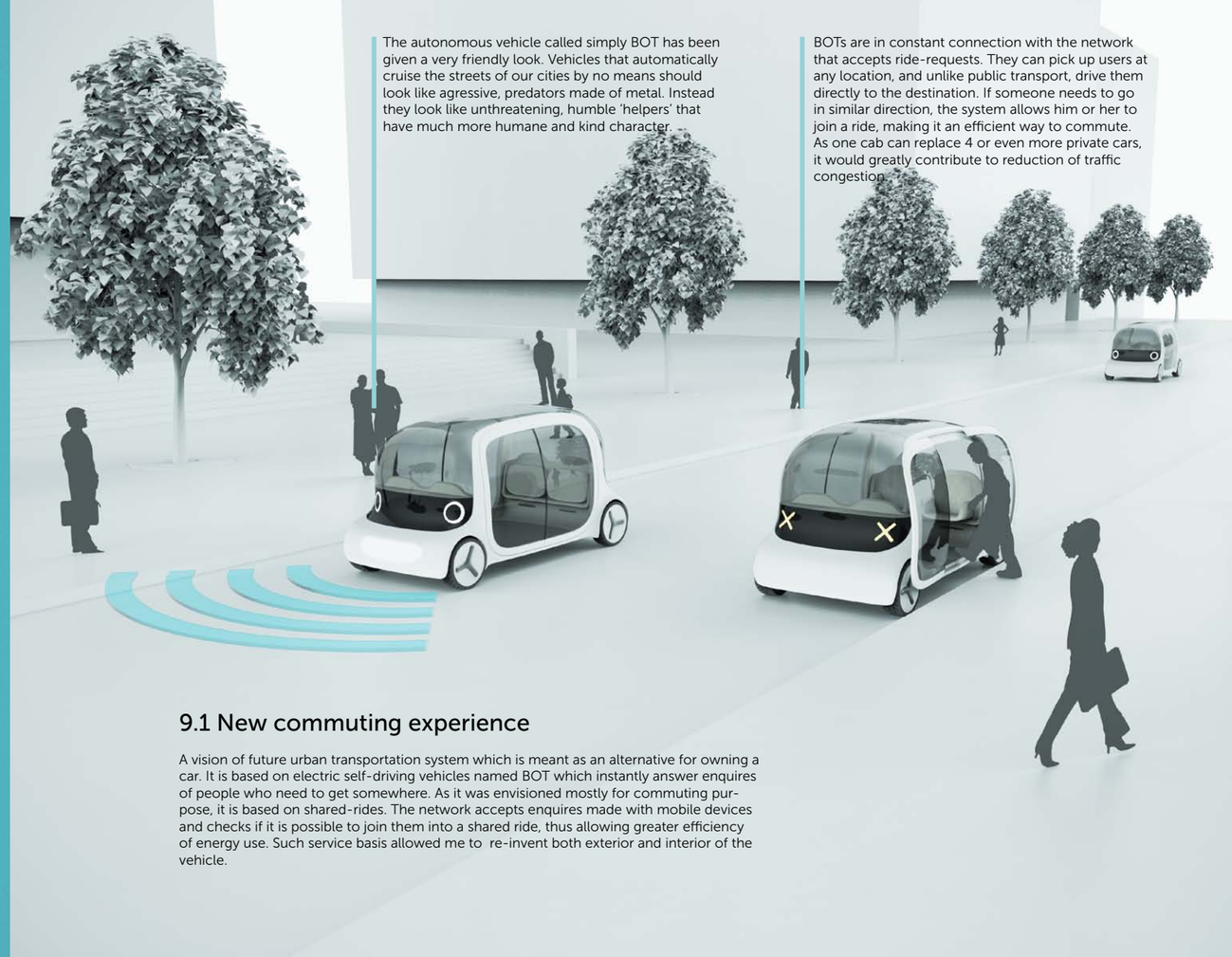
smoothnes of the surface around the wheel. Solidoworks is perhaps not the best software for acheiving top-quality automotive surfaces, and fixing some areas was indeed very cumbersome. Eventually I managed to consequently fix the problems, however it did considerably extend the amount of time I thought was needed create entire thing. I needed to be able to knit all loose surfaces into solids, so I could later use the model for 3d rapid prototyping.
I also paid extra attention to the reflections of the surfaces which are an idicator of surface-quality. By using zebra-stripe tool I was ensuring that there are no tangency breaks and everything is smooth. Again, it took me



some time to fix minor issues. Creating main body first as a one block, and only then splitting into separate bodies (windshields, doors) was necessary to achieve a uniform shape. I modelled the seats separately and by making a special slot for them in the interior I was able to seamlessly fit them inside. I used ergonomic data that I kept from 2nd year lectures when defining dimensions of the seats (backrest height, seat depth, seat height, angle bewteen seat and backrest). The seats are slightly tilted backwards, so that passengers wouldn't slide out of them while the vehicle accelerates or slows down. I did not go as deeply into details as to create hinges an model technical parts, as it would not be relevant at such, only conceptual stage. The goal was to make it look good, not to solve the engineering issues. It took me around 1 week to create the model, yet I did some minor adjustments after doing first test renderings. The final model was a result of a lenghy process of perfectioning small nuances just as fine-tuning the overall form, which I wanted to look pure and simple, but not simplistic.



9. Outcome

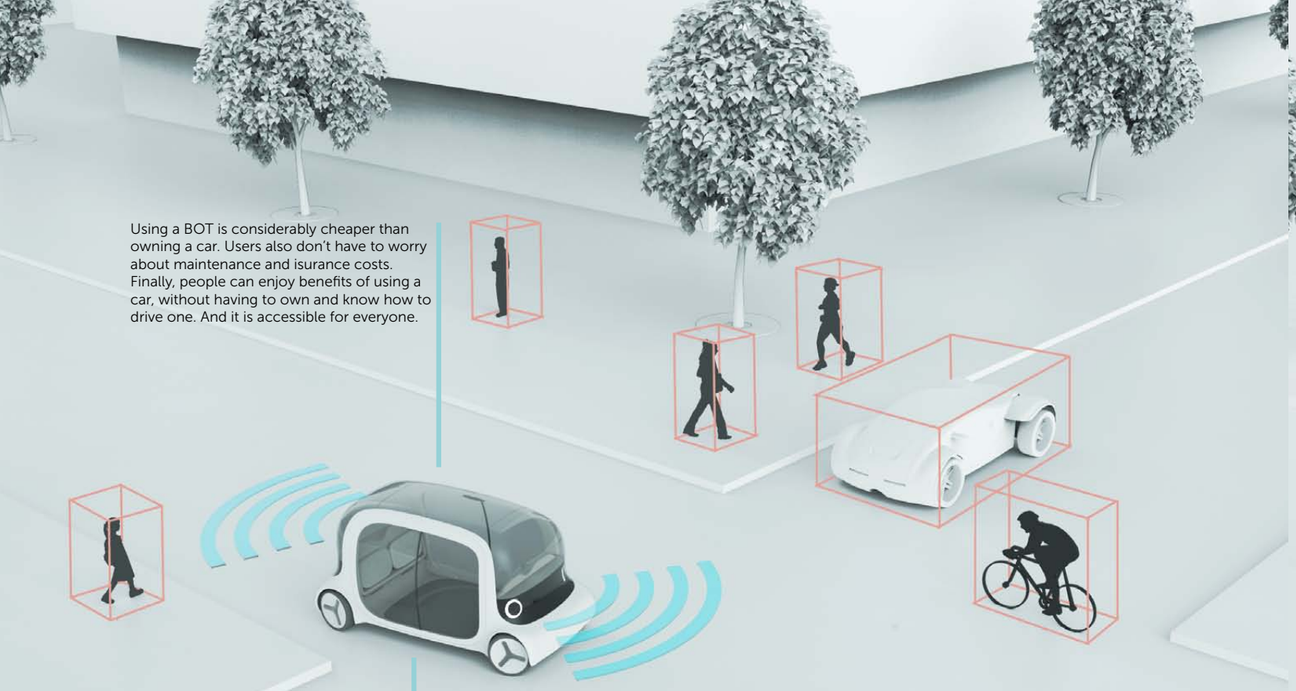


The autonomous vehicle called simply BOT has been given a very friendly look. Vehicles that automatically cruise the streets of our cities by no means should look like agressive, predators made of metal. Instead they look like unthreatening, humble 'helpers' that have much more humane and kind character.

BOTs are in constant connection with the network that accepts ride-requests. They can pick up users at any location, and unlike public transport, drive them directly to the destination. If someone needs to go in similar direction, the system allows him or her to join a ride, making it an efficient way to commute. As one cab can replace 4 or even more private cars, it would greatly contribute to reduction of traffic congestion.

9.1 New commuting experience

A vision of future urban transportation system which is meant as an alternative for owning a car. It is based on electric self-driving vehicles named BOT which instantly answer enquires of people who need to get somewhere. As it was envisioned mostly for commuting purpose, it is based on shared-rides. The network accepts enquires made with mobile devices and checks if it is possible to join them into a shared ride, thus allowing greater efficiency of energy use. Such service basis allowed me to re-invent both exterior and interior of the vehicle.



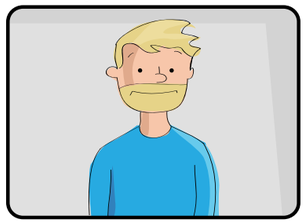
Using a BOT is considerably cheaper than owning a car. Users also don't have to worry about maintenance and isurance costs. Finally, people can enjoy benefits of using a car, without having to own and know how to drive one. And it is accessible for everyone.

BOT uses numerous sensors to navigate itself on the streets. It senses all moving objects in 360 degrees radius and uses AI to drive safely. Self-driving technology, unlike manually controlled vehicles, doesn't put constraints on the users - they can be under-age, blind or even intoxicated, and still easily move around urban environments.

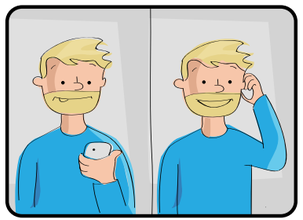
BOT also has features that enhance accessibility. A ramp automatically slides open whenever a person on a wheelchair or a parent with a baby stroller wants to get in.

Unlike public transport, BOTs are much more personal way to travel. Not only they take you directly to your destination, removing the problem of the last mile, they also will wait for you - no more freezing in cold after missing your bus. They also reduce the need for parking space in the city centre as their hubs are in the suburbs. Their activity dynamically adapts to changing requirements, driving only when needed.

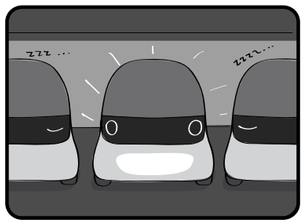
9.2 Storyboard



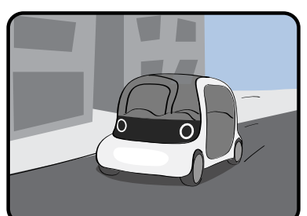
This is Mikko. He's 27 years old, and he just became a user of bot cab system.



First he scheduled his commute rides through an app. He could also do it with a phone call.

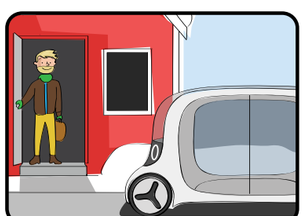


It's early morning, BOT wakes up to serve people.

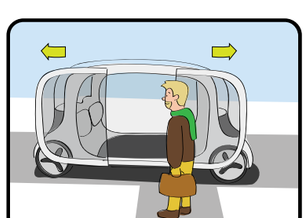


It drives to locations given it by the system. Now it's going to pick up Mikko.

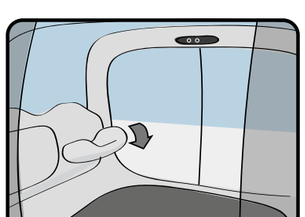
Just when it's about to arrive, it sends notification to Mikkos mobile device.



It stops just in front of Mikkos house, so he doesn't have to walk far.

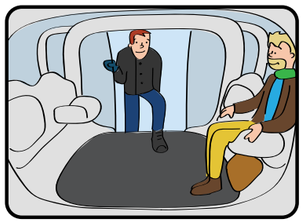


The doors open automatically for him.

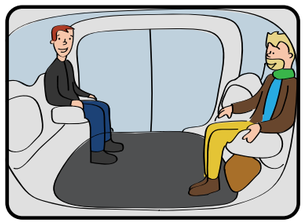


The seat unfolds for Mikko to seat on.

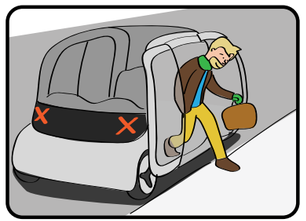
Bot cab recognizes and meets Mikko with a cheerful voice.



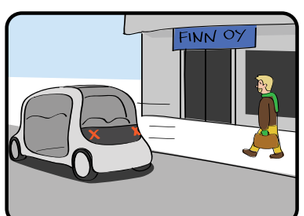
On the way, bot cab stops to pick up another commuter.



Being introduced by the vehicle to each other, it's easy for them to start conversation



The vehicle drops Mikko off just in front of his workplace.



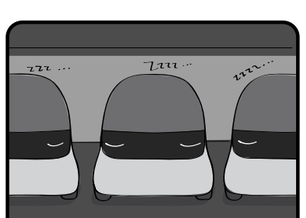
BOT goes away to respond other enquiries.

When it's time to go home, Mikko notifices system with one click that he needs a ride.

And again he get's a notification when his ride is about to come.

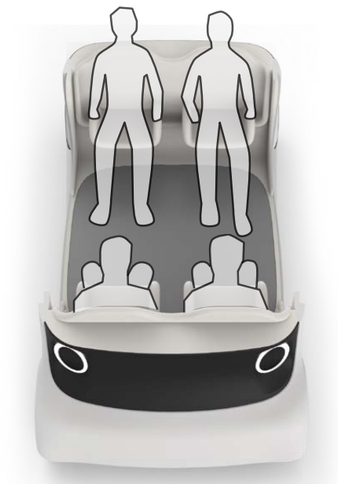
In the night time the vehicle glows with colorful light.

Inside, the mellow light creates perfect atmosphere to relax after work.

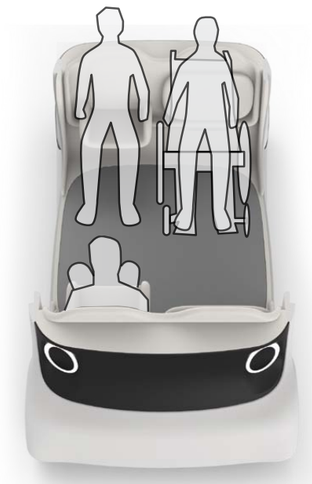


When no one needs rides any more, BOT returns to its base for a well deserved recharge.

9.3 Use case examples



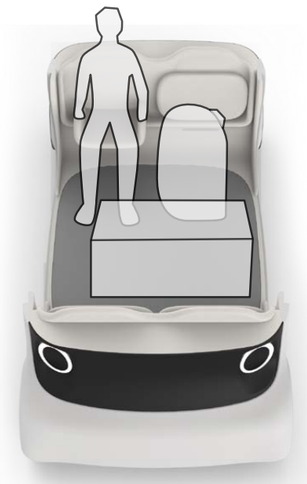
Maximum capacity of 4 passengers



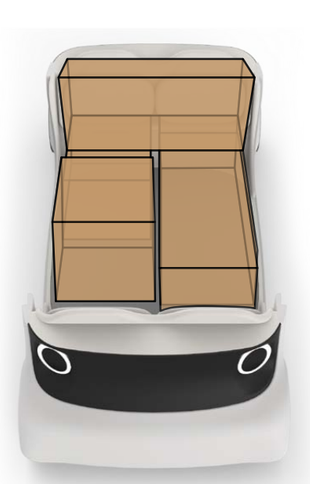
Enough space for person on a wheelchair

Easy for parents to travel with children

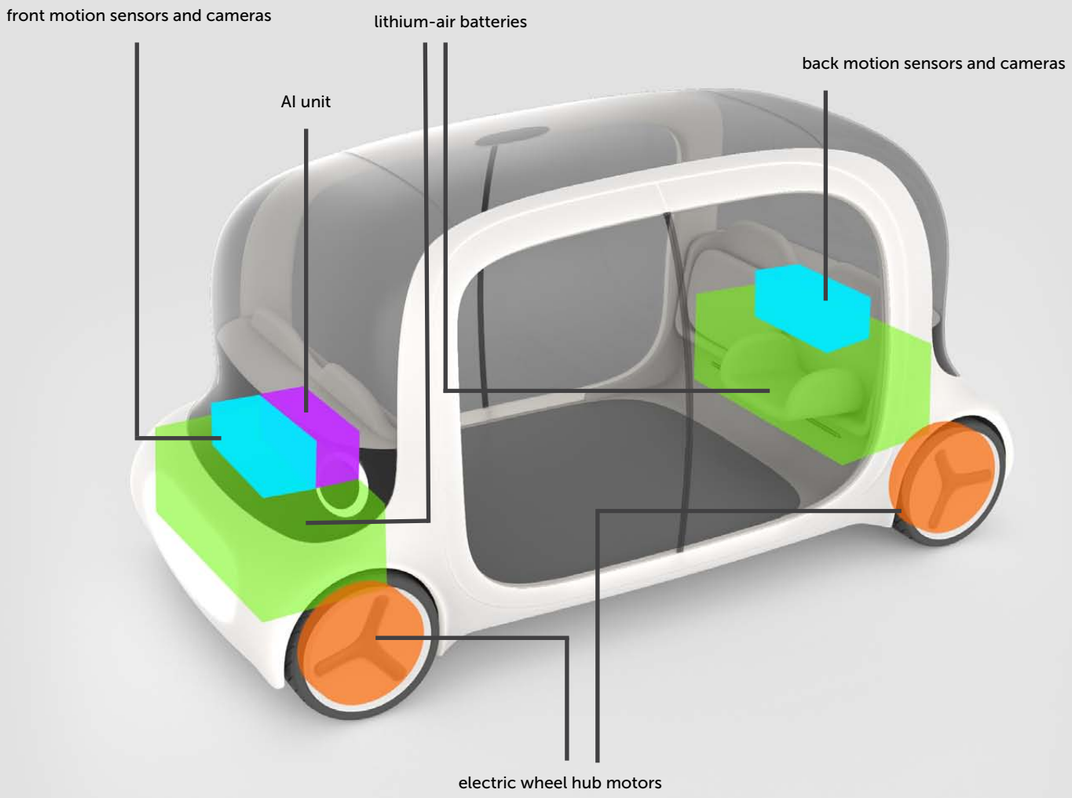
No problem with taking a dog

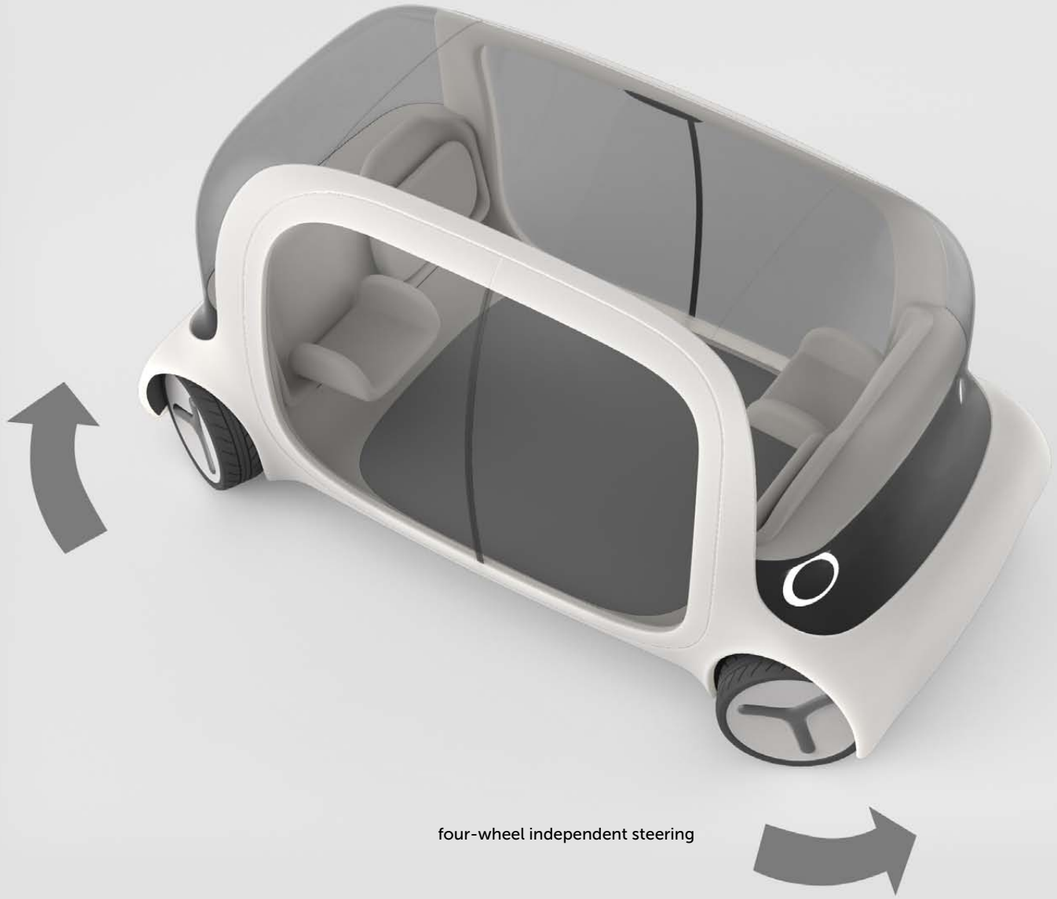


Great way to get to the airport with lots of luggage

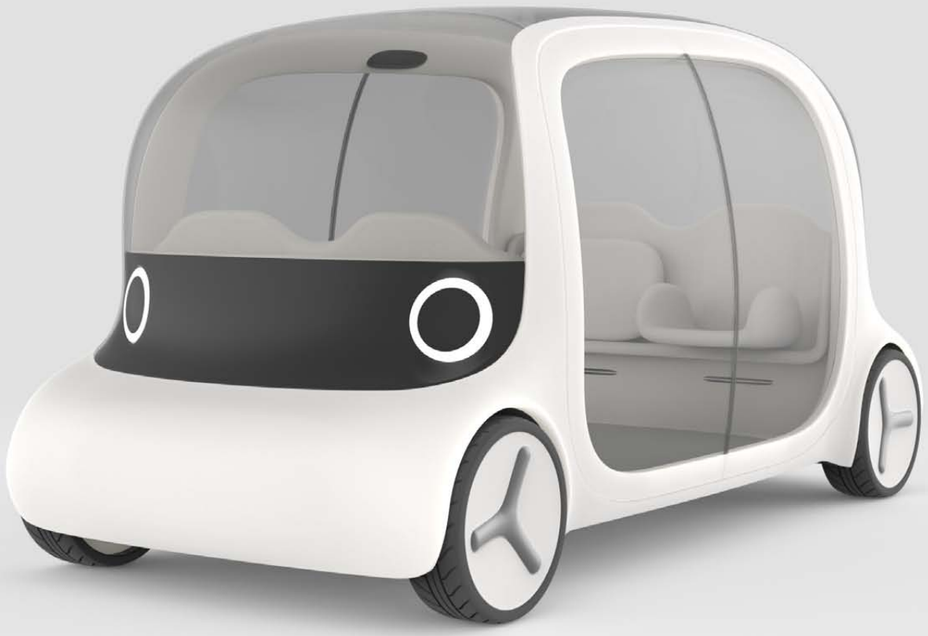


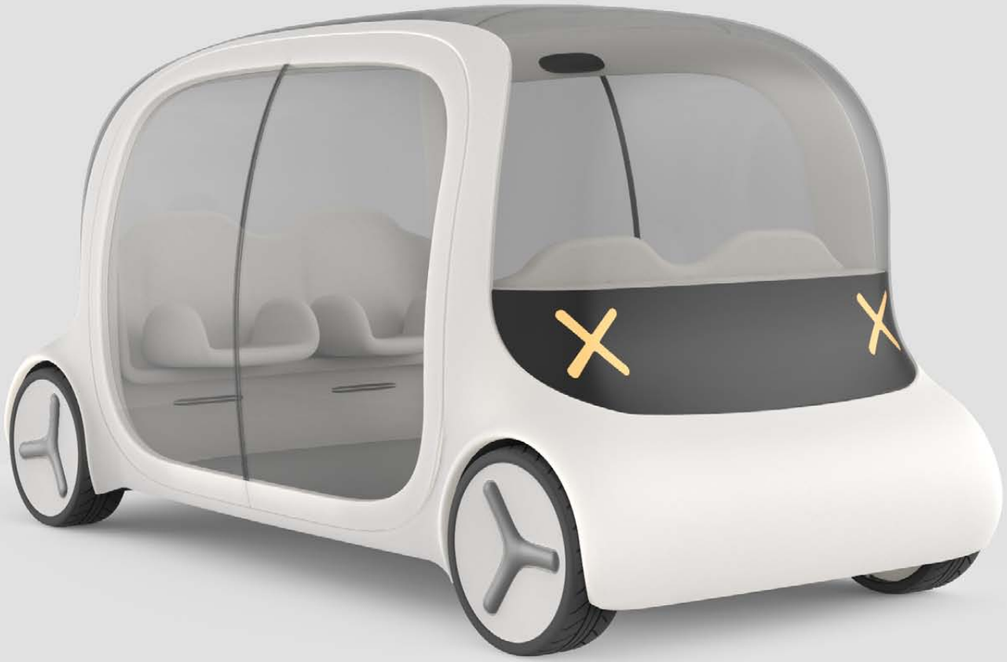
Potential of transporting big boxes, for example when changing appartments or buying furniture/ home appliances (however not meant for commercial transportation services)


front motion sensors and cameras
lithium-air batteries
back motion sensors and cameras
AI unit
electric wheel hub motors

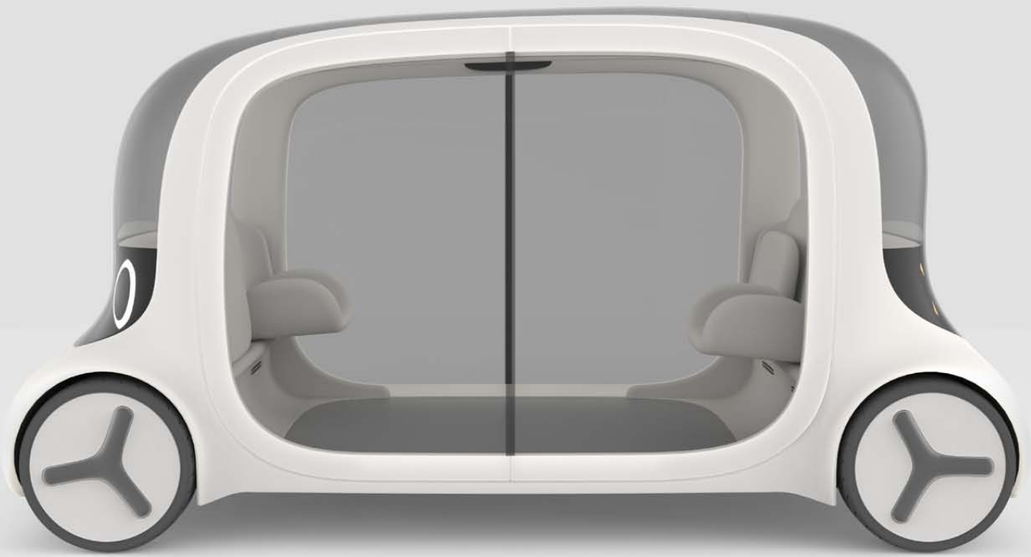

four-wheel independent steering

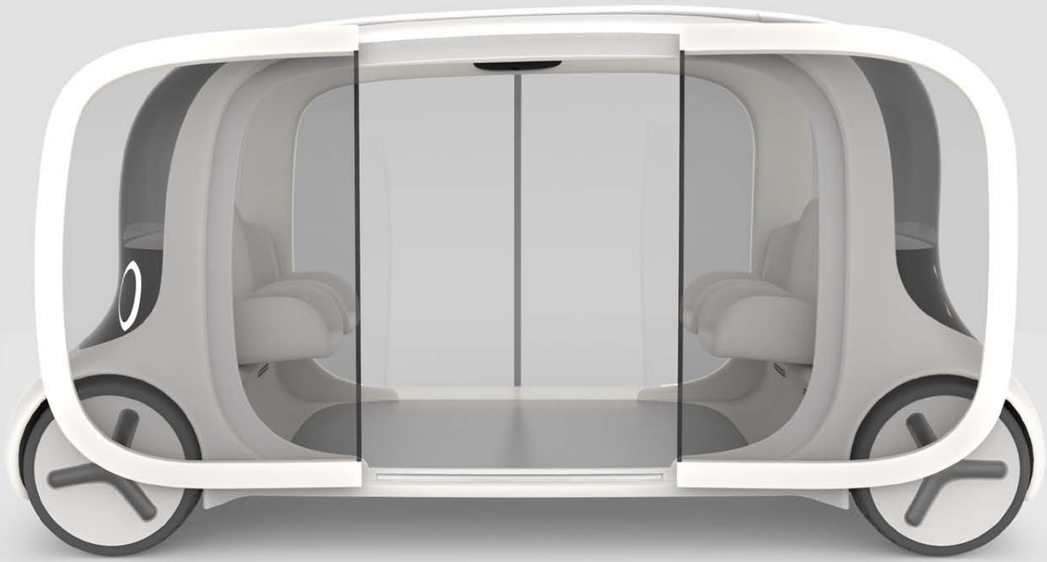
BOT





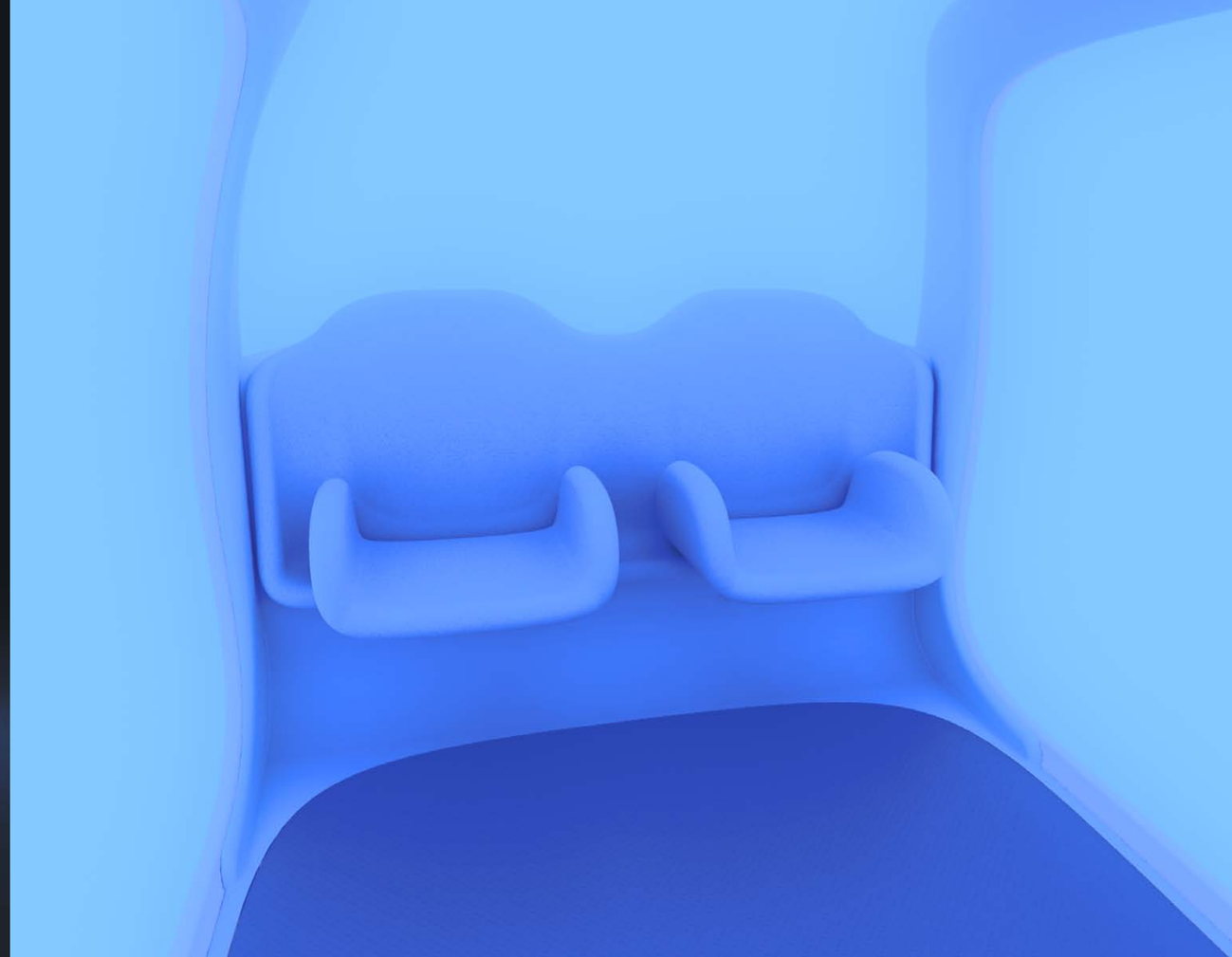
Doors



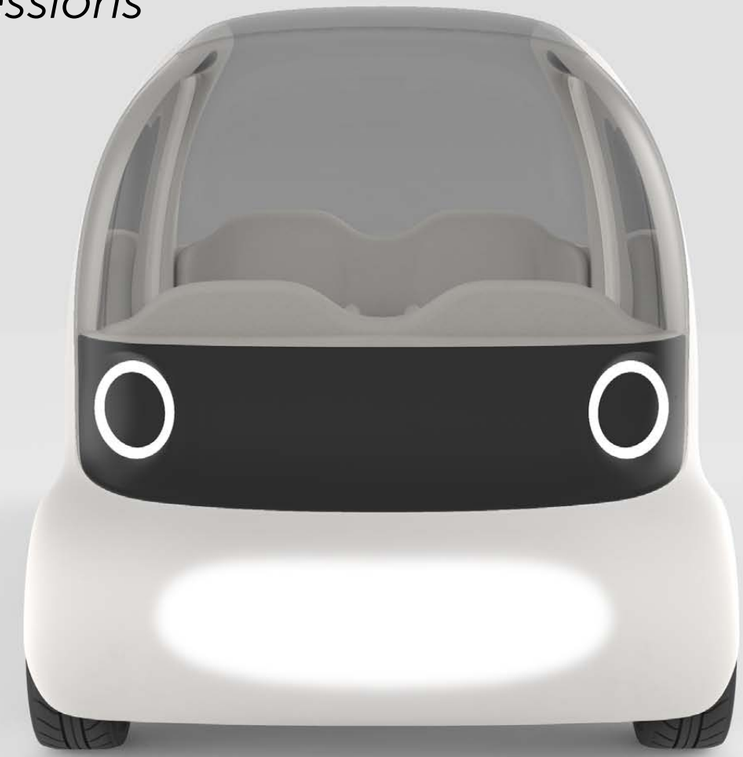


Interior

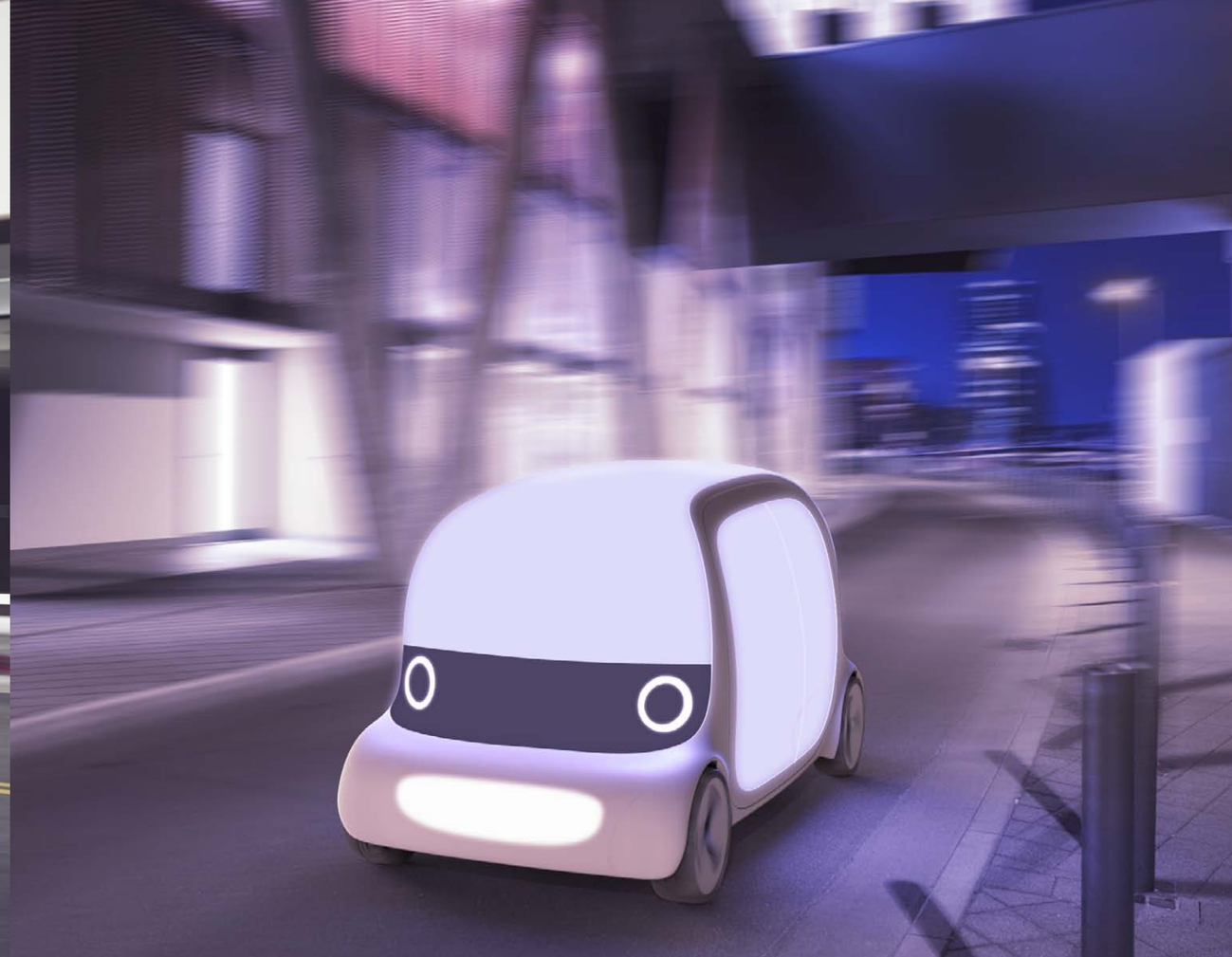
Nighttime illumination



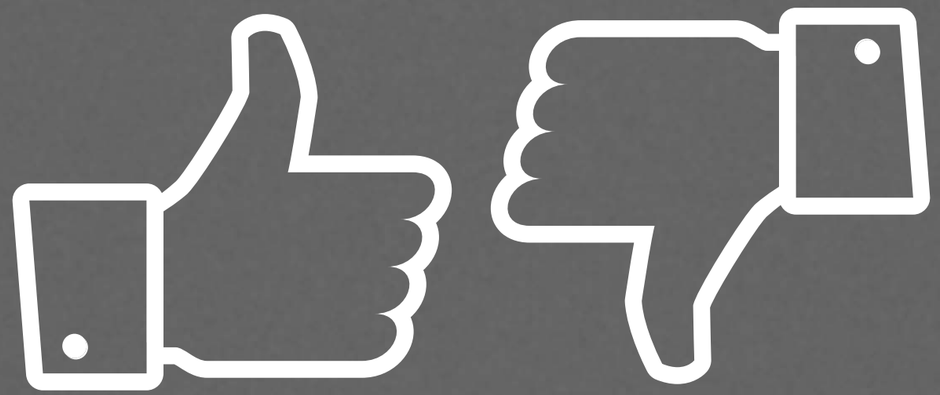
Expressions




CAFFE



10. EVALUATION



10.1 The outcome

I'm quite satisfied with the outcome of the project. I managed to come up with some fresh ideas and break out of patterns set by car industry and public transport solutions. However, I do not feel that the project is finished. I consider the result only as visualisation of an idea, that could inspire someone to start a real development, meaning that my project has only potential to be a first step of a long lasting process. The assessment could focus on two separate aspects - firstly, if the concept of the transportation system is good, and secondly, if the industrial design is good and whether it truly answers the needs of envisioned transportation system and most importantly - needs of people. To be honest, I don't feel competent enough to say if the concept of autonomous ride-sharing cabs would be successful -that is the question to urbanists sociologists and economists, who with help of computer simulations would be able to say if it could work. However, I think that it's already some kind of success that I manage to imagine a solution different for the ones currently considered.
When it comes to vehicle design, I feel that I have accomplished the aims and goals which I set for myself (at the beginning of the process). The final outcome combines very companionable character, with some great, yet simple usability features. Its looks were meant to express specific emotions and adjectives. If someone questions the design language, it will be only because of personal preference, as it is well balanced and clearly built around the chosen values. There are, however, some areas that could still use some refining, such as the back of the vehicle, which doesn't look perfect from some angles. The interior could also use more work, as it seems a bit unfinished.

Another thing that needs a word of comment is the conceptual nature of the project. The moment I started working on this topic, I could not predict what would be the result. I wanted to find a good solution for the problem, and it occurred to me, that sticking to currently available technologies would be too limiting and would force me to make some big compromises. Besides, any solution to such a big-scale problem takes years to develop, test and implement - if I had envisioned a solution for 2015, for example, to have it really happen by that time, the development should have started already a few years ago - meaning that my project, no matter how much feasible, would be already overdue. By aiming at 2030, the project should not get outdated anytime soon and hopefully will encourage discussion now and in the years to come.

10.2 Process

For most part of the project, I had very steady and good pace of progress. However, I did not avoid mistakes. At the very beginning of the project I was too focused on small, personal means of transport (which are already available on the market), assuming that they could solve the problem - because of that my research was prematurely limited. Eventually I found it to be a dead-end, and had to revise my findings and change my goals. It was already late January when I truly realised the potential of autonomous vehicle technology. Deciding to go in the direction of more service-oriented system which would use self-driving vehicles seemed to be the right step to take, but it tremendously increased the complexity of the project. Had I made that decision earlier, I would probably have chosen different literature that could give me deeper understanding of the issue of urban transportation. Sadly, that was not the case. The vehicle design process was also delayed by my first unsystematic approach. I did a lot of sketches before deciding on the feeling, functionality and the package, which turned out to be a waste of time - it was more like shooting in the dark and hoping to hit the right target. It was only when I created a proper moodboard, figured out the package and decided on aesthetic direction, that the project started actually going forward.
Again, valuable time, that could have been spent on deepening my knowledge and greater development of the service, was wasted. I also feel that I should have done proper, systematised interviews, to have more direct insight into attitude of people. I had some inspiring conversations, but I made a mistake of not taking any notes from them, that I could add to the text to support my points. These management problems became clear

to me only by the end of the project. I estimated that I have spent over 500 hours on this project working late hours, also on weekends and holidays, yet I'm sure I could have gotten a better result if I directed my efforts more wisely. Complexity of the problem was a bit overwhelming for me and I felt rushed to make some decisions so that I could finish the project on time, but there is a saying: more haste, less speed. Seeing the final result, I would change some decisions concerning the industrial design part of the project.

The process was also a learning path for me. It's been the first time I ever did such a big research about the problem I was going to address. Reading books and taking notes affected my mind-set and decisions I have made - in a positive way. This project made me realise what kind of issues I'd like to deal with in the future. It was also a great practice for my design skills, especially sketching and 3d modelling. I learned the importance of systematic approach to design, which is crucial in order to get generally consistent result. To conclude, I'm fairly, yet not completely, satisfied with the final outcome.

Thanks

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