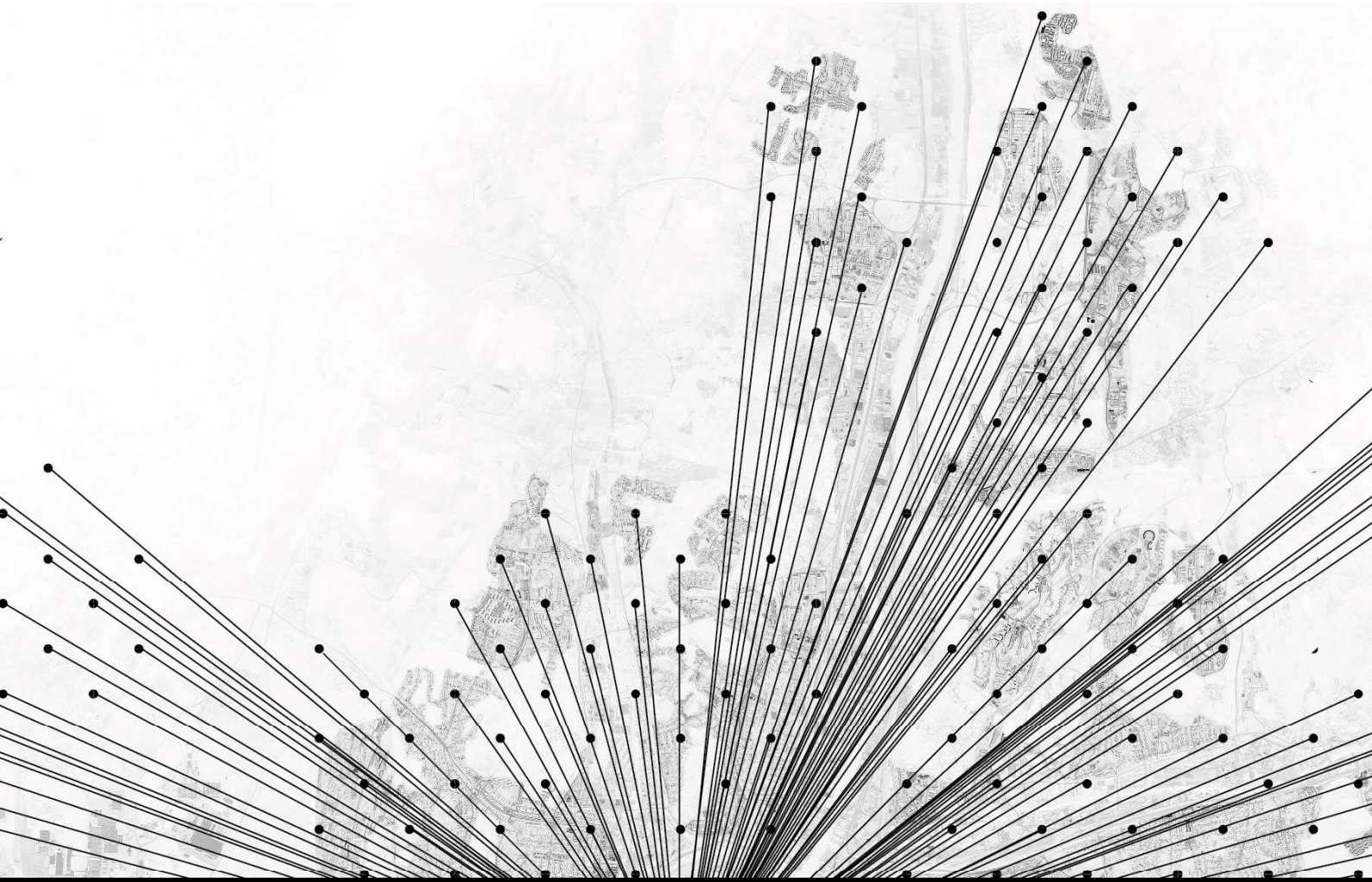
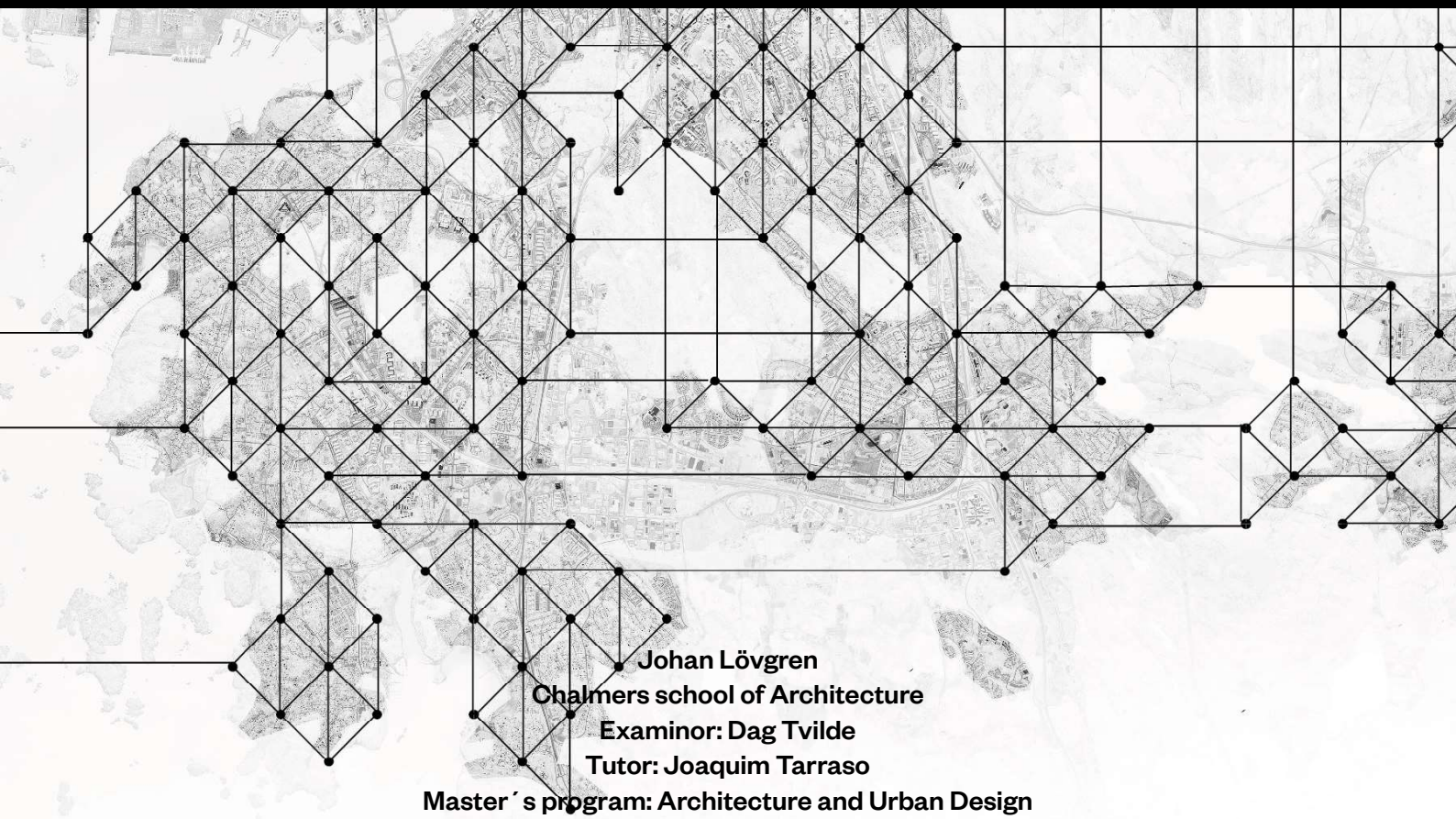


THE IMPACT OF AUTONOMOUS MOBILITY IN URBAN PLANNING



Johan Lövgren
Chalmers school of Architecture
Examinor: Dag Tvilde
Tutor: Joaquim Tarraso
Master´s program: Architecture and Urban Design

The Impact of Autonomous Mobility in Urban Planning

-Relating to the future of Urban Mobility

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Keywords: Automation, Mobility, Urban planning, Social sustainibility, Selfdriving vehicles.

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Chalmers University of Technology

The Impact of Autonomous Mobility in Urban Planning

-Relating to the future of Urban Mobility

ABSTRACT.

The idea of the driver less vehicle is no longer a part of the science fiction realm but it is in fact very real. Within 2-3 decades most researchers, car manufacturers, investment banks and tech-companies estimates that the car fleets of the western world will be fully autonomous, meaning that neither human drivers nor supervisors will be needed when transporting either a person or goods from point a to b. Like the Internet transformed the way we use and share information, the automation of our mobility system has the possibility to completely disrupt the way we move and use our cities.

The way we move has been basically the same for the last hundred years and have shaped the way we plan our cities. This new technology has the potential to disrupt the way we move completely and to start looking at how we should relate to this shift is important. Being heavily researched by many other fields of professions the urban-planning and architecture community have so far largely ignored this possible transition. To start speculate on how these changes could affect our cities and how we should relate to them are necessary.

By investigating these new modes of mobility and their possible implications, in relation to Gothenburg, this thesis is exploring how these new technologies could effect our cities and how we should plan for the future city of hyper mobility. What would the city look like where the private car is gone, the need for parking is removed and where a transport system rapidly can take anyone, anywhere at any time?

ACKNOWLEDGEMENTS

I want to thank Joaquim Tarrasso for tutoring and great engagement throughout this whole process, this project would not have been possible without you. Dag Tvilde for great input and for asking the right questions.

I also want to thank my family, friends and the support i have had from the slack.

ABOUT THE AUTHOR

Johan Lövgren has a Bachelor's degree in Fine Arts from Umeå School of Architecture.

"Through out my studies i have always had a great interest in how we move and how the possibility to move effects how we behave, use and perceive our surroundings. Being part of the last generation who knows what life was pre-internet i find disruptive technologies fascinating. Not the technologies it-self but the possibilities and risks that it brings. As it seems we might be close to a similar shift to the Internet, though this time not in moving information, but physical objects. To speculate in how this could effect our cities and how we can make it good seemed like a good idea . "

READING INSTRUCTIONS

1 - INTRODUCTION, describes the purpose and framework of the project.

2 - BACKGROUND, frames the project within the topic of autonomous mobility.

3 - ANALYSIS AND PROPOSAL, in 3 scales

- **3 .1 City scale**
- **3.2 District scale**
- **3.3 Buildingscale**

4 - CONCLUSION AND REFLECTIONS, reflects on the process and result of the project

5 - REFERENCES

TABLE OF CONTENT

INTRODUCTION

STARTING POINT.

The city consists of people and the connections between these people is what makes up the structure of the city. The possibilities to travel within the city defines how these connections are made. What happens when the way we travel within the city changes? Like the Internet disrupted the way we send and share information automated vehicles has the potential to disrupt the way we move in the city completely. How is the mobility system of today defining Gothenburg as we know it and how could a alternative Gothenburg look like if the logics of these connections are changed?

PURPOSE.

Technology is about to change our cities forever. And change is needed. But how do we make sure that the changes that comes are for the better? As Melvin Kranzberg puts it, technologies are what we make it and to start speculating on how we as a society should relate to autonomous vehicles is necessary for it to become a positive thing. The Internet has changed how we communicate and share information forever. Yet it didn't turn into the Utopian vision that was present in the beginning.

The purpose of this project is to start thinking, and speculating on what the possible effects of this new technologies could be and how we as architects, Urban planners and citizens in general can turn it in to something good. How it will turn out is unknown and up to us, and to have a discussion about it before it is already here is important.

THESIS QUESTION:

-How can we rethink Gothenburg with a new mobility system?

SUB-QUESTIONS:

- How does the mobility system of today function and what is the consequence of it?

-How do we utilize the changes to come into something good?

-what are the link between segregation and mobility.

"Technology is neither good nor is it bad nor is it neutral."

-Melvin Kranzberg

AIM.

This Thesis aims to start the discussion on how we as urban planners and architects should relate to autonomous vehicles. To know for certain how these new technologies will play out is impossible but the fact that it will have huge impact is fairly certain. To start speculating on the different scenarios, risks and possibilities is essential if it is to benefit us all. By looking in to where it seems to be heading, how the mobility system of today works, and the consequences this has lead to this thesis aims to propose an alternative to the current situation. Dealing with different modes of mobility in relation to social issues such as segregation the aim is to produce a positive vision of how this technology can help Gothenburg become a better city for all its residents.

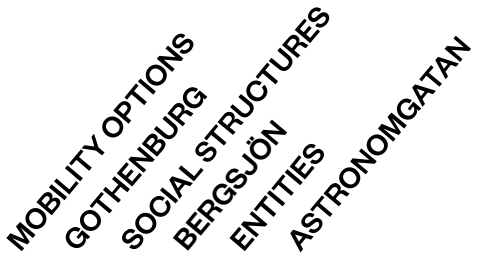
DELIMITATION:

As this project becomes a future scenario each assumption made is a possible error and for each assumption added the result becomes exponentially more likely to be completely wrong. Therefore i have chosen to limit the exploration of technological improvements to the field of mobility and do not in any greater extent discuss how automation might effect other areas of society.

METHODS

LITERATURE STUDY MAPPING SKETCHING PROPOSAL

PROCESS



CONTEXT

RESEARCH THROUGH DESIGN

ANALYSIS DESIGN

THEORY

STRATEGIES CONCEPTS VISION

BACK GROUND

Definition Of Autonomous Transportation.

With an Autonomous Vehicle (AV) I mean a vehicle that can transport a person or a goods from point A to B without any manual input from a driver. The vehicle uses a combination of different technologies such as cameras, radar, laser and GPS to gather data which an AI system then processes and decides how the most efficient way to get to point B will be.

Why Is This Going To Happened.

There is many reasons for promoting automated mobility. Reduced traffic accidents, increased mobility and possible beneficial effects on the environment etc. But the main reason the technology is moving forward at the current speed is foremost economical. According to a report produced by Morgan Stanley the savings that could be made for the US economy alone, if the entire vehicle fleet would be at level 4, is at 1.3 trillion dollars per year or 8% of US GDP.

To put in perspective this is as much money being spent on Health and social care or the entire Financial and insurance sector which is the third biggest part of the us economy beaten by only the expenses of governing and the real estate sector.

These savings would come from reduced amount of accidents, fuel savings and productivity gains from autonomous transportation to name a few. Another factor which speaks for this technology is the fact that the hardware needed to build a autonomous car is fairly cheap. To equip a car today with the technology needed would add a cost to the car of about 10 000 USD. And since this is technological equipment the price is likely to drop rather quickly as time passes on.

History.

The idea of the AV has been around for almost as long as the car itself and early experiments dates back as far as to the 1920s. Yet no attempts has so far been successful. Some have failed due to the difficulty of the task, and some due to massive needs in infrastructural investments. It is not until the early 2000s that any major progress has been made. A considered milestone is the US military founded competition DARPA, first held in 2004. DARPA, which is 150-mile course in the Mojave Desert, is an open competition where the challenge is to create a robot that drives the entire distance without human interaction. With a lot of media attention and a price sum of a million dollars it has become a showroom for this specific technological development. The 2010s is when the real advancements has been made and the topic has become mainstream. Today basically all the car manufacturers are today working on creating an AV.

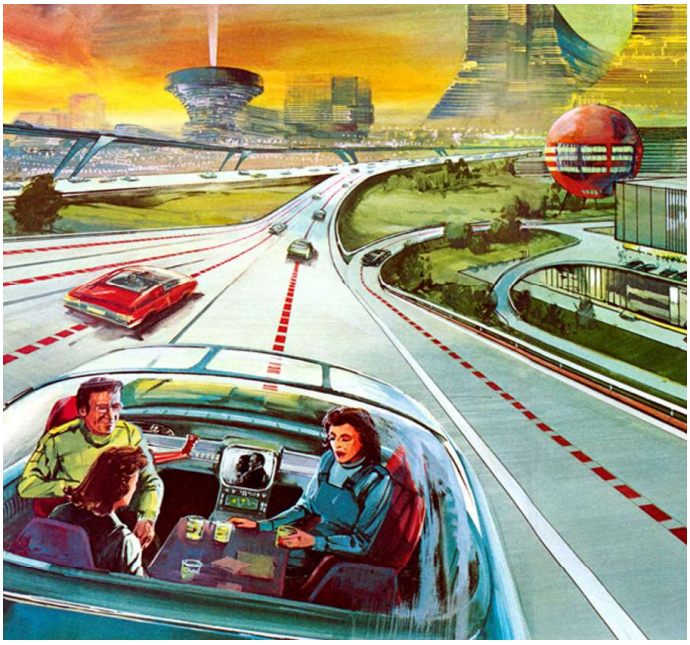


figure 1

Where Are We Today.

Today more or less every car company have projects which tries to make autonomous vehicles. Volvo for example is planning to put 100 cars, that are autonomous on highways, on a few designated roads in Gothenburg by 2017. And Tesla already has highway autonomy functions in their Model S cars. But these kind of projects are not limited to the automobile industry. Companies such as Google, Apple, IBM and Cisco systems are now also in the race for creating an fully autonomous vehicle and at the moment it seems like Google is in the lead. With more than 1.5 million miles driven on normal roads, under supervision of humans, and with the financial backing of Alphabet it seems likely that they will be one of the first to bring a fully autonomous vehicle on the market. According to Google they expect to have the first self driving cars on the streets by 2020. Though there are still a lot of issues that has not been solved yet and these are merely forecasts autonomous cars might be here sooner than we expect.

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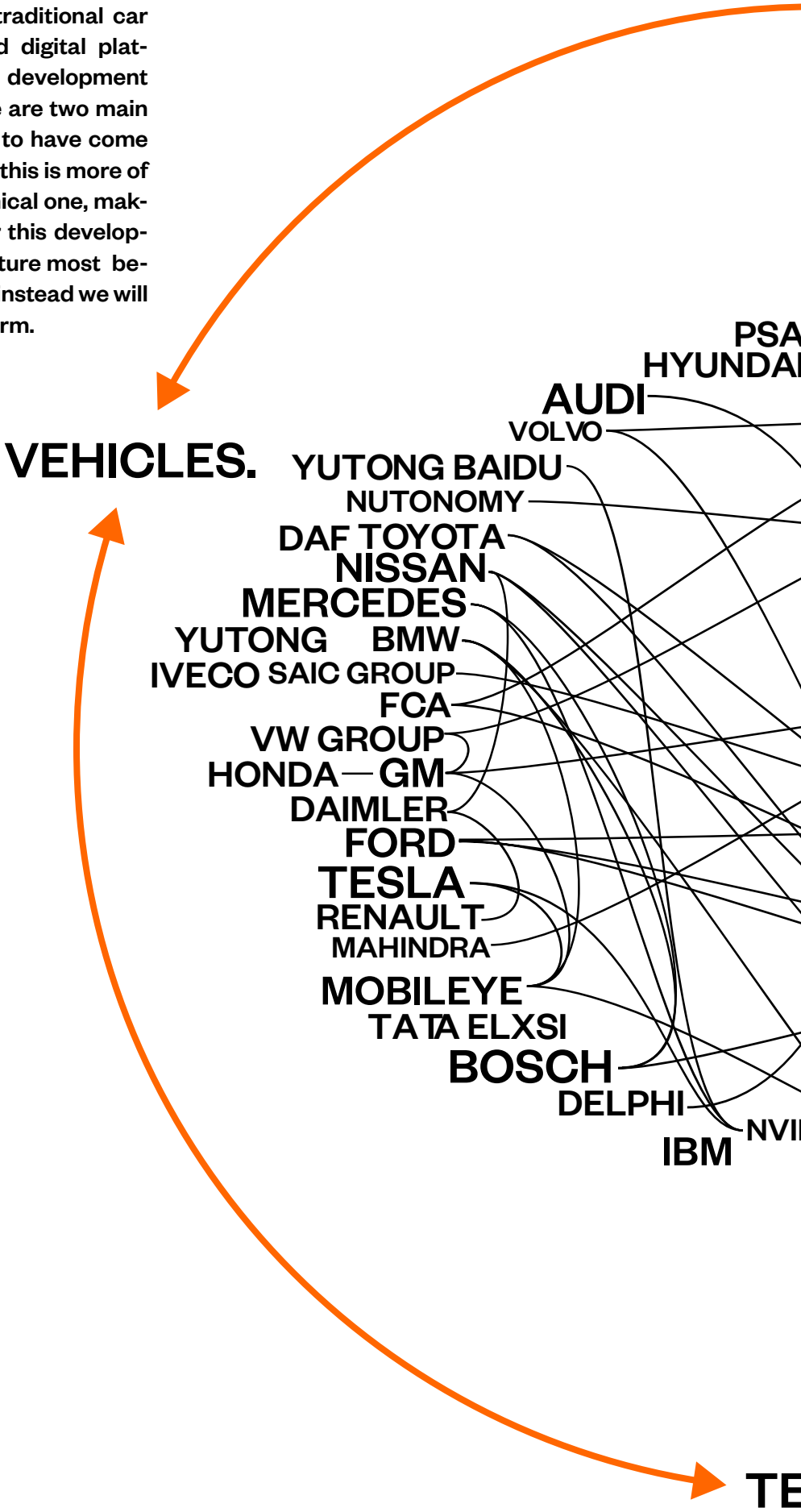
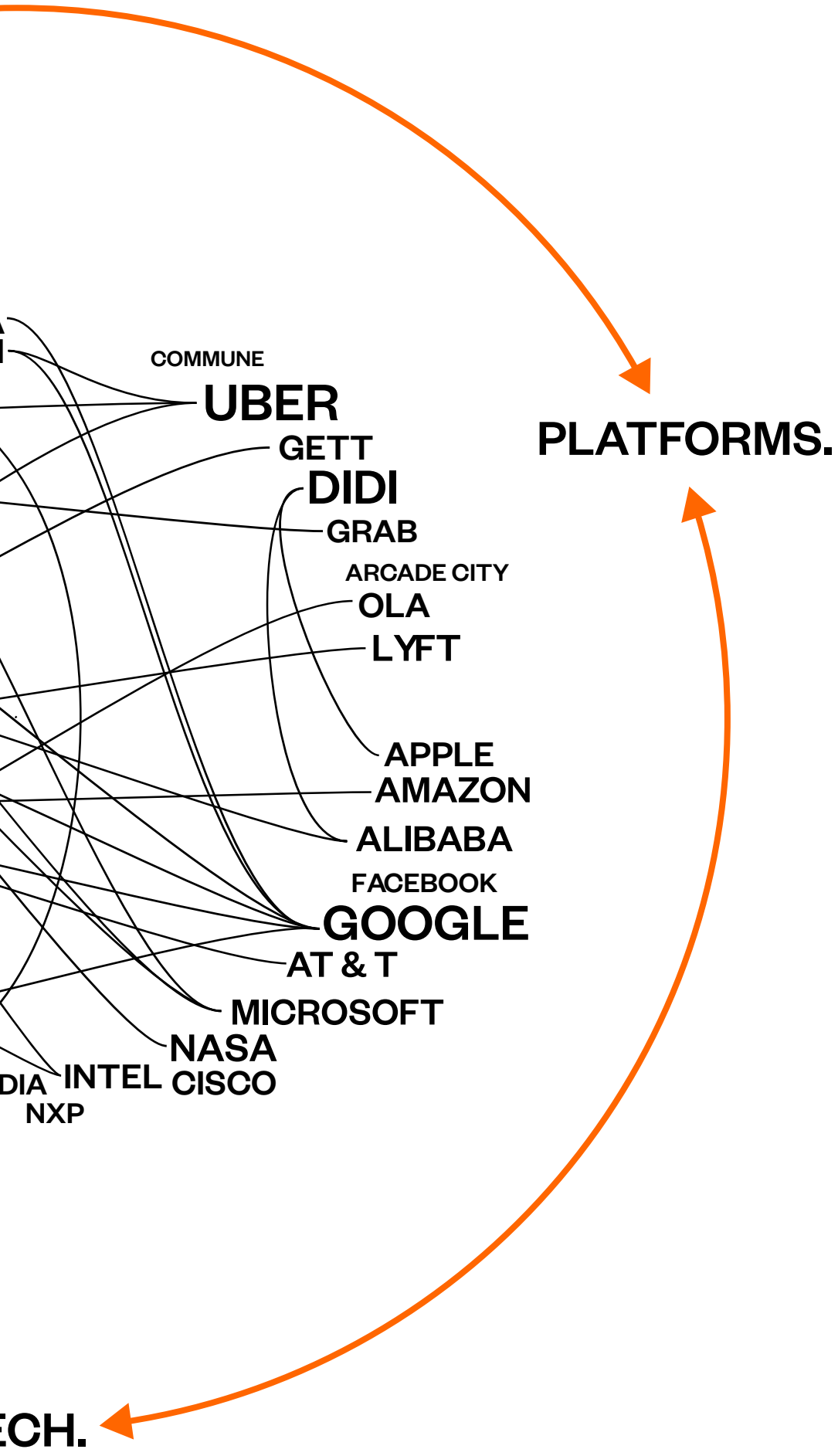
ACTORS.

The actors currently in the race to produce a fully autonomous vehicle is not only the traditional car manufacturers. Tech companies and digital platforms are also deeply invested in the development of an fully autonomous vehicle. There are two main reasons for these new type of actors to have come into the race. The first is the fact that this is more of programming problem than a mechanical one, making tech companies more suitable for this development. And the second is that in the future most believe that we will not buy a vehicle but instead we will buy mobility as a service from a platform.

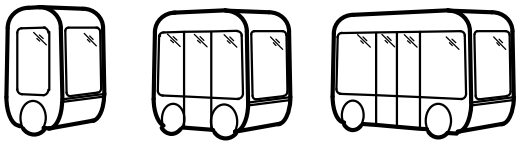



COMMUNE
UBER
GETT
DIDI
GRAB
ARCADE CITY
OLA
LYFT
APPLE
AMAZON
ALIBABA
FACEBOOK
GOOGLE
AT & T
MICROSOFT
NASA
CISCO
INTEL
NXP
PLATFORMS.
ECH.

VEHICLES.

The most obvious actors to be present in the development of an AVs is naturally the current car manufacturers. Yet in general they have not been promoting this as much as on might think. There are two main reasons for this. First of all the problems to be solved is not a mechanical one and rather a technical one making other companies more suited for the task. The second reason is the fact that a fully autonomous car might not be beneficial for them. As most people expect autonomy to lead to the death of the private car, due to extreme drops in taxi prices, this would mean less sales for these companies.

For most car companies the strategy is to gradually produce a completely Autonomous Vehicle starting with Autonomy for tasks such as parking and highway driving and then gradually move towards full Autonomy. Since they already have a production line and need to keep sales up, to introduce the technology makes sense.



VOLVO

COLLABORATIONS: Microsoft, Uber

STRATEGY: Volvo has attracted a lot of attention with the announcement that they will have a fleet of 100 cars for testing on normal roads in Gothenburg by 2017. These cars would be cars only driving on certain highways but with regular drivers. They are also providing Uber with cars that are being used as Autonomous taxis, but with human drivers, already.

WHEN: 2020.

Mercedes-Benz

COLLABORATIONS: Bosch, Nvidia

STRATEGY: Mercedes has been working on Autonomous cars since 2015 and claim to have fully autonomous vehicles in production by 2030. With their focus on buses and private cars. Like Volkswagen, Mercedes is also working on autonomous cars in steps meaning that they start with highways and then go for more advanced driving further on.

WHEN: 2030.

COLLABORATIONS: Nvidia, Mobileye

STRATEGY: Tesla is probably on of the best known car companies working on autonomous cars. With many of their models already having autonomy on highways. Tesla is mainly focusing on the private car market but has also plans on developing a ride-sharing service when the technology is ready. A large advantage for Tesla is the fact that they already have a large fleet of semi autonomous vehicles already on the road. Since Ai needs to be taught to drive having a large fleet already deployed means that the amount of data that can be used to improve their system is much bigger than any other companies. Only Google has a similar capacity.

WHEN: 2021.

COLLABORATIONS: GM, Gett

STRATEGY: Volkswagen is since a couple of years active in producing a autonomous car. Unlike google for example Volkswagen is not trying to go for level four autonomy straight but is working on getting their one step at the time. Starting with self-parking. Interestingly many car companies which traditionally has been competitors are now working together telling something how important this technology is.

WHEN: 2025.

COLLABORATIONS: Delphi

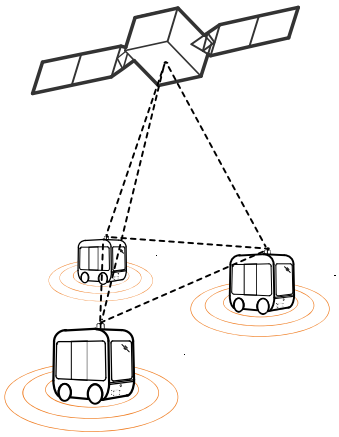
STRATEGY: Audi is like many other car companies sees the way to autonomous cars as a thing that will happen gradually. With level 2 technology already in their cars Audi claim that by 2018 they will have cars on the market that can handle 70-80% of the driving. But the fully autonomous av is not expected to arrive in another ten years.

WHEN: Late 2020s.

TECHNOLOGY.

A new type of actor which is in the race to create a AV is the more traditional tech companies. The main reason for these new actors being interested in this is that the main issues to be solved is technical problems. Most are not planning to built their own cars. For the most part these actors is trying to create the brain for the AVs in various ways together with existing car companies.

For those actors that do intend to build their own vehicles the focus lays on the fully autonomous vehicles and not at doing step by step as most of the car producers. This is because the main change is gonna come at full autonomy and to get into the highly competitive car-manufacturing business today is not their aim. These actors want to sell mobility and not Vehicles.



COLLABORATIONS: BMW, Mobileye

STRATEGY: Intel is the worlds biggest manufacturer of computer chips and processors which are both vital components in the AI brain of an AV. Together with BMW and the Israeli software company Mobileye they are working on delivering a fully autonomous car.

WHEN: 2021

COLLABORATIONS: Continental

STRATEGY: IBM is one of the major companies that are today working on the concept of smart cities. For Ibm the concept of AVs is as a part of the public transportation system. The 3d printed mini bus Olli is a public on demand transport service with the capacity to take up to 12 people. Based on their cloud AI system Watson, in combination with centralized human supervision, the mini bus would be called with smart phone and on site can verbaly interact with its passengers.

WHEN: Ready for use now.

COLLABORATIONS: Nissan

STRATEGY: Nasa, or the American government, has been active in progress of autonomous vehicles for a long time. They where the initiator of the DARPA challenge which can be considered as a important milestone in the pursue of a level 4 vehicle.

The reasons for this are many but both for space missions and military use autonomous vehicles comes with many benefits.

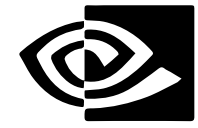
WHEN: Already in use to some extent

Microsoft

COLLABORATIONS: Volvo, Toyota, Nissan

STRATEGY: Unlike for example Google, Microsoft have no intention of creating its own autonomous vehicle. Instead Microsoft is aiming at integrating their software into the vehicles. As the time for commuting will no longer require any attention payed to the road the use for software will increase and this is where Microsoft see their business opportunity. With Programs like azure cloud, office 360 and the windows operating system could be the interface on the future of AVs.

WHEN: -



NVIDIA.

COLLABORATIONS: Tesla, Mercedes, Baidu

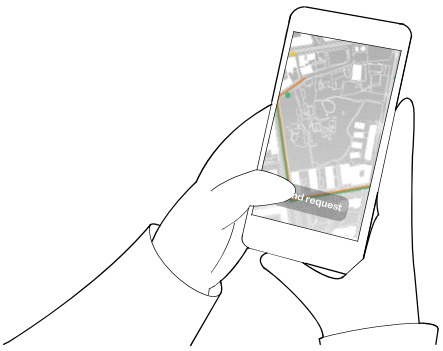
STRATEGY: Maybe most famous for producing hardware for PCs. Nvidia is a big supplier of both hardware and software for autonomous vehicles and other AI technology. No intentions of creating their own AVs but will be a large provider of the technology.

WHEN: 2021

PLATFORMS.

The platform providers are also them working on creating an AV in various ways. Like the tech companies they are not looking at moving towards an AV step by step but are going for a finished AV straight away. Also for the reason that it is when they can remove the driver and just sell mobility as a utility they find it really interesting.

As mobility becomes a service that you buy instead of a Vehicle you purchase what is important is to have a large user group ready. And all these a´companies have that in common.



UBER

COLLABORATIONS: Volvo, Hyundai, FCA

STRATEGY: Uber is the biggest ride hailing app on the market and is the biggest ride hailing app in over 100 countries. Uber is one of the companies pushing hardest in the race for autonomous cars. Together with Volvo, Hyundai and FCA, Uber Is working on the development and already has a testing fleet, still with human drivers supervising, on the roads in USA.

WHEN: 2021

lyft

COLLABORATIONS: GM

STRATEGY: Lyft is a ride hailing platform and is the main competitor to Uber in the west, mainly in USA. They have teamed up with GM which will provide the cars using lyfts platform for their future autonomous taxi service.

amazon

COLLABORATIONS: Ford

STRATEGY: Amazon is not directly involved in creating a autonomous car but is heavily invested in the race. For amazon the AV is seen as a natural step in their delivery service. Being one of the most advanced companies when it comes to automated logistics it comes as no surprise that they are part of the automated mobility race.

WHEN: -

Google

COLLABORATIONS: PSA, Hyundai, Toyota, FCA, Ford, Bosch

STRATEGY: Google is at the moment one of the companies that has gotten furthest with their autonomous car project. With more than 1.5 million miles driven on normal roads, under supervision of humans, Google seems to be the companies that is closest to deliver an fully autonomous vehicle.

Google is usually considered to be one of the four giants of the internet. Together with apple, amazon and Facebook they are by far the biggest players of the digital realm of the western world. Just like Googles and Facebooks digital business models, where their service is free of charge and what they make money from is the data that you as a user provide, is likely to be similar in a mobility service. Where the price of the trip is reduced due to the extraction of data.

WHEN: 2020

滴滴

COLLABORATIONS: Apple, Alibaba

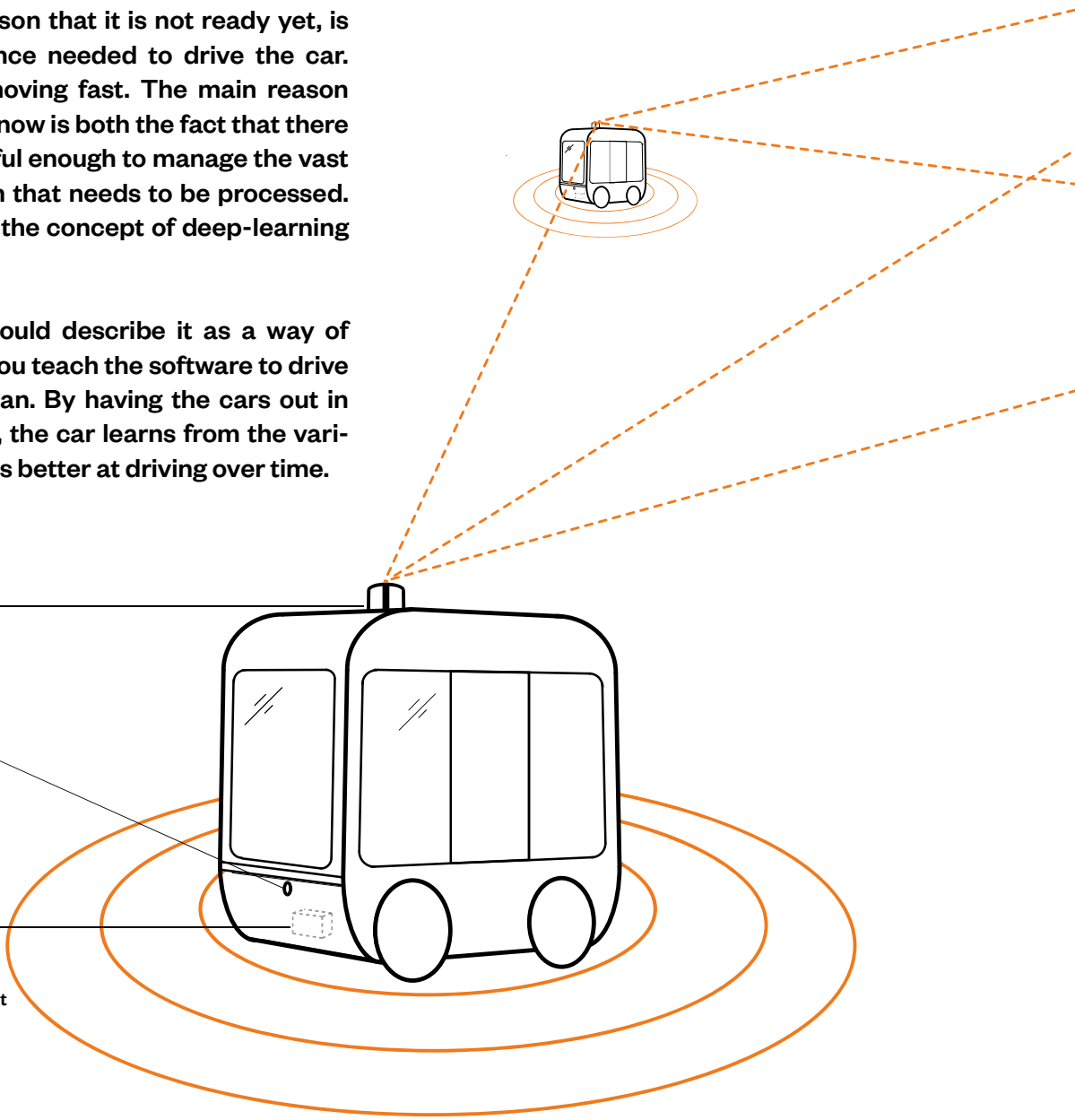
STRATEGY: DIDI is the main competitor to Uber in china and recently managed to buy Ubers part of china. Only recently they have started to venture into the autonomous car market. But with apple heavily invested in the company they will likely have access to apples autonomous car program.

WHEN: 2021

HOW DOES IT WORK?

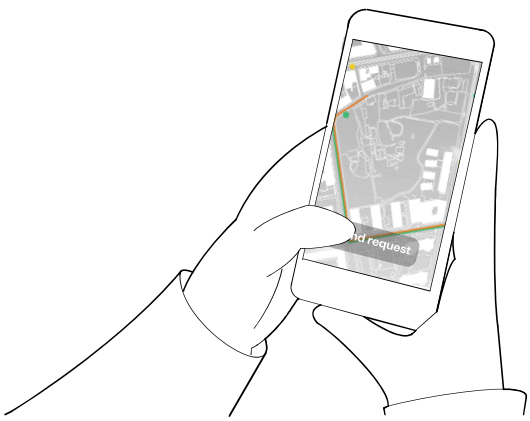
AVs will use a series of technologies in order to work. Most of them already existing. The biggest issue still, and also the main reason that it is not ready yet, is the Artificial intelligence needed to drive the car. Yet the progress is moving fast. The main reason that this is happening now is both the fact that there are computers powerful enough to manage the vast amount of information that needs to be processed. But another reason is the concept of deep-learning programming.

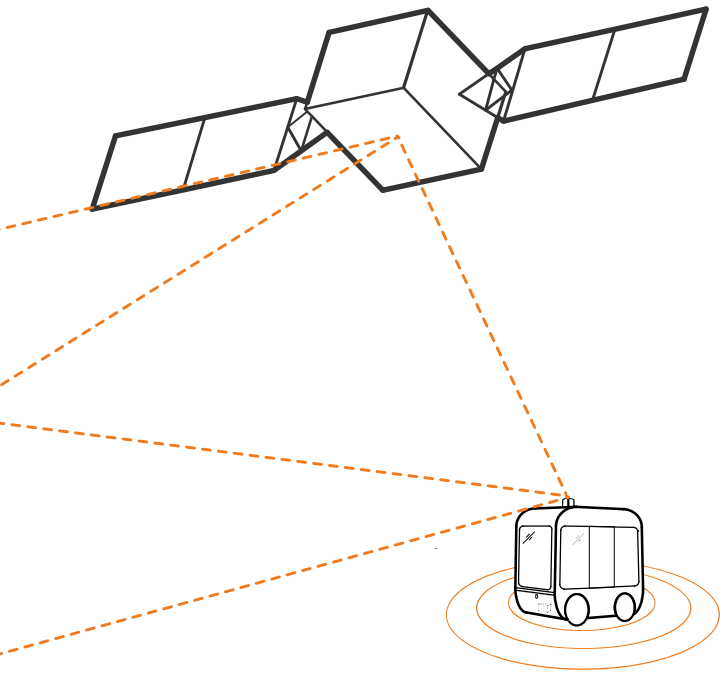
Very simplified one could describe it as a way of programming where you teach the software to drive very much like a human. By having the cars out in traffic, gathering data, the car learns from the various situations and gets better at driving over time.



USER PERSPECTIVE

As a user of AV based mobility service you would order a ride through your phone. Providing the information of from where you wish to go and to which destination. In response you would get a estimated waiting time and a specific location designated to you. Within minutes the AV would be at the station ready to take you to your destination. Depending on where you are going and time of day you might get to use a ride-sharing service, bus, tram, taxi or a combination several.





BENEFITS

Of an autonomous and electrical vehicle fleet:

-SAFER
-LESS POLLUTION
-LESS CONGESTION
-LESS NOISE
-CHEAPER
-MORE ACCESIBLE
-LESS CARS
-LESS PARKING
-MUCH MORE EFFICIENT

NETWORK EFFECTS

As the vehicles become autonomous they will no longer act as single units on their own but instead they will work as a network. Making the flows of traffic much smoother, possibilities for re-routing if certain areas are congested and relocation of empty vehicles to spots more likely to be need of assistance. The bigger the fleets the better they also work, as the service and resilience gets better the bigger the network of AVs gets.

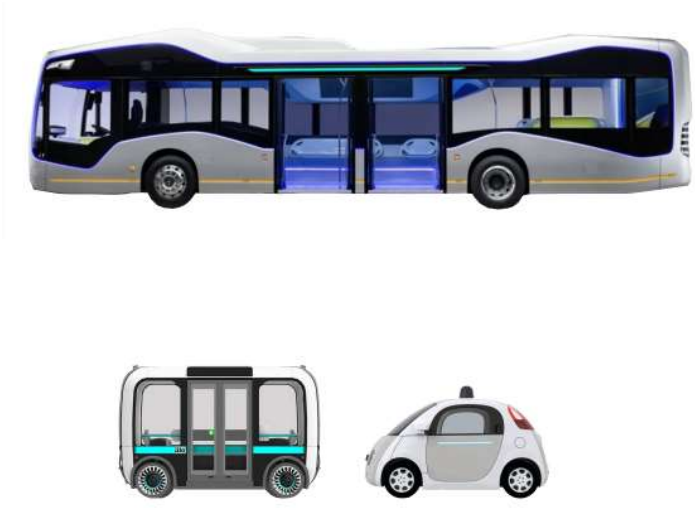


figure 2

AVs IN RELATION TO CURRENT MODES OF MOBILITY.

Automation will have effects on all modes of transportation. Yet the most significant impact will probably be on the smaller vehicles. As the cost of the driver is removed, taxis will become both cheaper and more efficient than having your own car. Most likely reducing the number of private cars drastically. Public transport will become cheaper and more efficient as well, but in relation to smaller vehicles the difference will be less imminent. New modes will likely appear such as ride-sharing and the public transport network will be more diverse than it is today.

MOST LIKELY EVOLUTION OF AREAS OF TRANSPORT TO BE AUTOMATED

STAGE 1:

Main highways gets autonomy.

Why:

-Easiest kind of traffic
-minor adjustments to infrastructure
-Long drives mean big savings from autonomy

Main effects:

-Freight traffic gets cheaper, mainly being used between major transportation hubs.
-Public transportation like buss also gets cheaper.
-Long distance commuting by car increases.

Problems:

-More parking needed.
-Cheaper long distance transportation.

When: Within 5 years

STAGE 2:

Public transportation becomes automated.

Why:

-Easier to get autonomy on specific routes.
-Tram especially easy.
-Not entire infrastructure needs adjustment.
-Not as much interaction with humans.

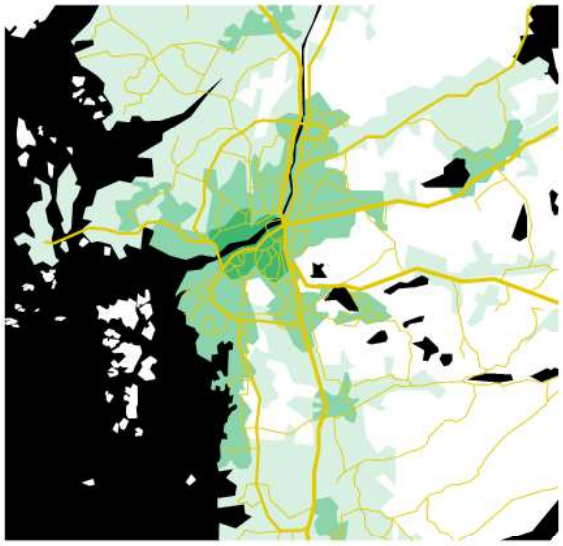
Main Effects:

-Size of each vehicle can be reduced/adjusted.
-More frequent departures.
-Increased express lines.
-Reduced level of car use.

Problems:

Mainly benefits

When: 5-10 years



STAGE 3:

Entire city available for autonomous transportation.

Why:

-inevitable

Main Effects:

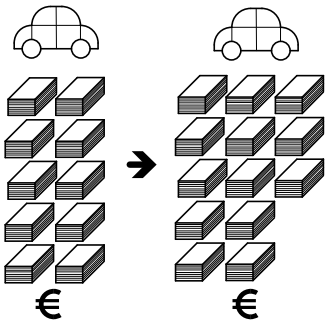
-Possibly huge increase in traffic.
-Personal transportation available to new groups.
-complete disruption of mobility as we know it

Problems: Regulatory matters could prevent traffic increase and congestions but risking to increase segregation for outer areas if for example car tolls are heavily implemented.

When: 10-15 years

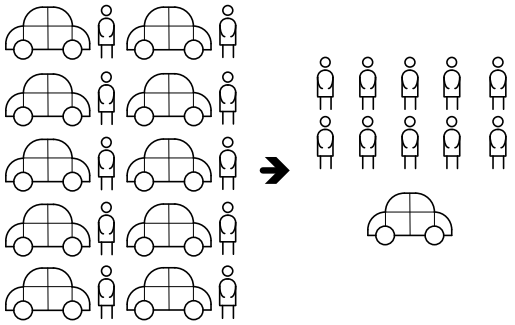
MOST LIKELY EFFECTS OF AUTOMATION.

INCREASE VEHICLE PRICE



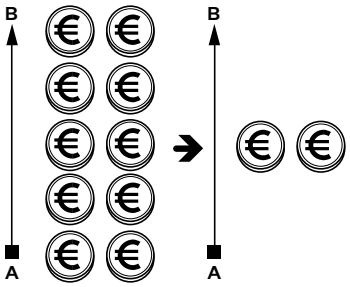
The price of an autonomous car will most likely go up slightly, but not to much. Today the equipment for autonomy lands at around 20-30 thousand euro. This might seem like a lot but considering that it could potentially replace 3 taxi drivers it is not.

SHARED OWNERSHIP



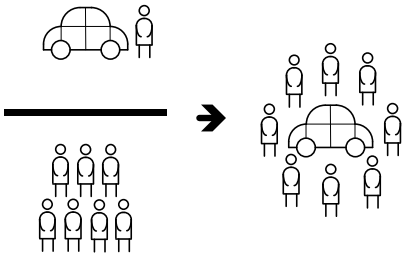
As the price of a taxi, or similar service, gets cheaper and the service better than having your own car the incentive to have your own car disappears. This means that more people could share the same vehicles.

REDUCED PRICE PER TRIP



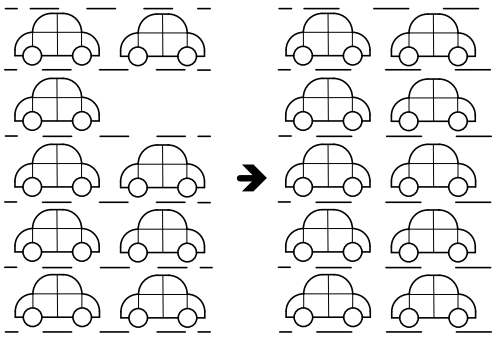
By removing the driver from the equation and sharing the vehicles the price per trip will be reduced greatly. When taking a taxi the price is mainly for the driver. But the same goes for public transport. Västtrafik spends almost half of its expenses on employees today.

NEW USER GROUPS



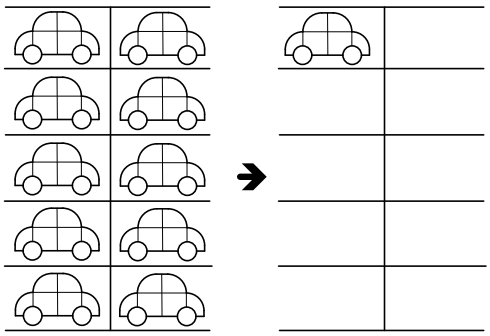
As the price of mobility goes down it will become accessible to new user groups. Youths and elderly that today might not have the possibility to use taxis for example will now have that possibility. This would most likely increase the amount of users as well.

NUMBER OF CARS ON THE ROAD



As more people have access to better and cheaper mobility it is likely that there will be more traffic. Not a radical increase but still a slight increase should be expected. To provide good alternatives to motorized transport is important.

NUMBER OF PARKED CARS



Even if we will see more cars on the road the number of parked cars would drop radically. Today the average car is parked for more than 90% of the time. With shared ownership this could drop radically and the fleet of cars would be greatly reduced.

NEW TYPES OF MOBILITY

Just like with the Internet, to predict how a fully autonomous vehicle fleet will look like is impossible. Possibly there are new ways that we will travel that will seem obvious then yet impossible to anticipate now. But there are certain emerging system that are very interesting to look at. Ride-sharing is one of them.

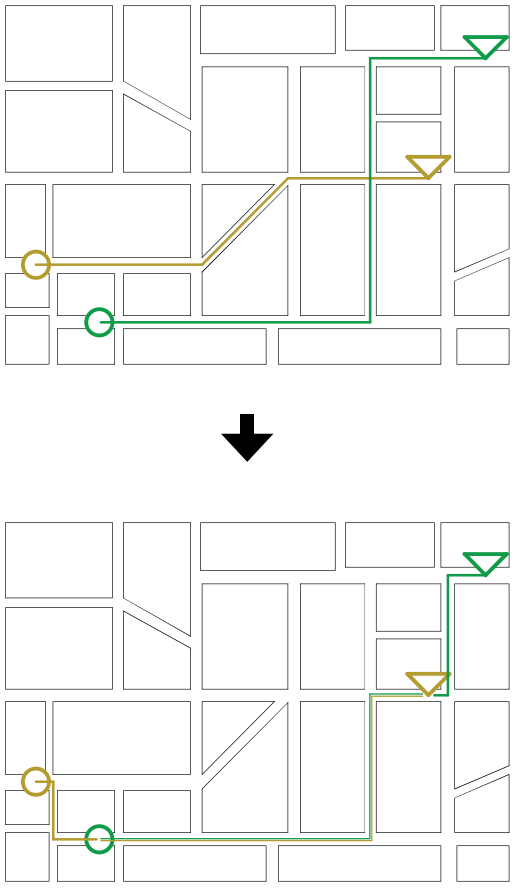


figure 3

The Prototype car Olli, from IBM is planned to be used for ride-sharing. with the capacity to take up to 12 people this would fill the gap between a buss and a taxi. Based on their cloud ai system Watson, in combination with centralized human supervision, the mini bus would be called with smart phone and on site can verbally interact with its passengers.

RIDE-SHARING

Ride-sharing works very much like a mix between a taxi and a traditional buss service. Ordered like a taxi from your phone, the vehicle comes to your location for the pick up. As you go towards your destination the car can switch route as it goes, taking a short detour in order to pick up another passenger going to the same or a location along the way. This type of mobility is already in use by for example Uber .

Ride-sharing gives almost the service of a taxi but with many of the benefits of Public transport. In a study made by OECD/ITF (2015) simulations where made on the city of Lisbon on what the results could be with introducing different modes of AVs to the public transport system. Lisbon being about the same size as Gothenburg works well as an example. The study finds that if you where to keep the subway, but replace all the buses and cars with a ride-sharing system you would:

-see an increase in travel volumes by 8%.
-the average waiting time would be cut by -85.6%
-the average travel time would be cut by -13.0%
- a decrease in the amount of parked cars -94,4%

To remove the buses completely is the main reason that there is an increase in the travel volumes, so to do that is probably not the best idea. Yet this study shows that there are huge benefits to be made by adding a ride-sharing service to the public transport system.

References:
ITF / OECD (2015)
Burns, L-D. Jordan, W-C. Scarborough, B-A. (2013).

RIDE-SHARING AS PUBLIC TRANSPORT.

It is important that this new technology benefits all parts of society. And in order for it to do so in an fair way it should be as a part of the public transport system. To add a ride-sharing service to the existing network would be beneficial for the city. It also makes sense since these kind of networks really benefits form being large to make it public would benefit all.

RIDE-SHARING IN RELATION TO LINE TRAFFIC

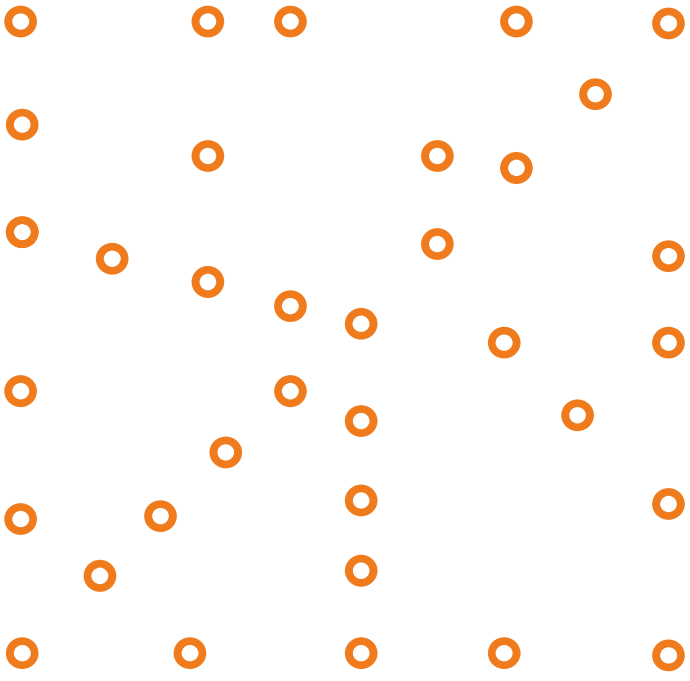
What is interesting with a ride-sharing system in relation to line traffic is the way it changes the hierarchies of the city. Any line system dictates certain values to nodes in the network. The end station, the hub, the central station all tell you something of the place surrounding the node. A ride-sharing system on the other hand have non of these traits. The entire network is completely even and every station is just another station.

Line traffic will still be needed in the future as it is superior when it comes to capacity on highly traveled distances. A ride-sharing network would best be used as a complement, making all the travels that is not heavily enough used for a fixed line possible and also to provide service during non peak hours replacing many of the night buses that today are running with very few passengers.

A system where a ride-sharing service is added would open up for a wide variety of new connections within the city of Gothenburg and would make it possible to start re-thinking the way the city functions.

LINE-TRAFFIC

RIDE-SHARING



GOTH
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ANALYZE

In order to understand what the implications of AVs in a urban perspective one needs to first understand how the city of Gothenburg functions today. Looking both at social factors of residents, Where activities and jobs are located, what are the physical conditions and how the mobility system works today is essential to understand how these new modes of transport could and should be utilized.

The different aspects that make up a city are all connected. Social aspects in the population are a manifestation of the physical opportunities provided for a certain area. By altering the way a city functions there is an opportunity to alter the life's of its residents.

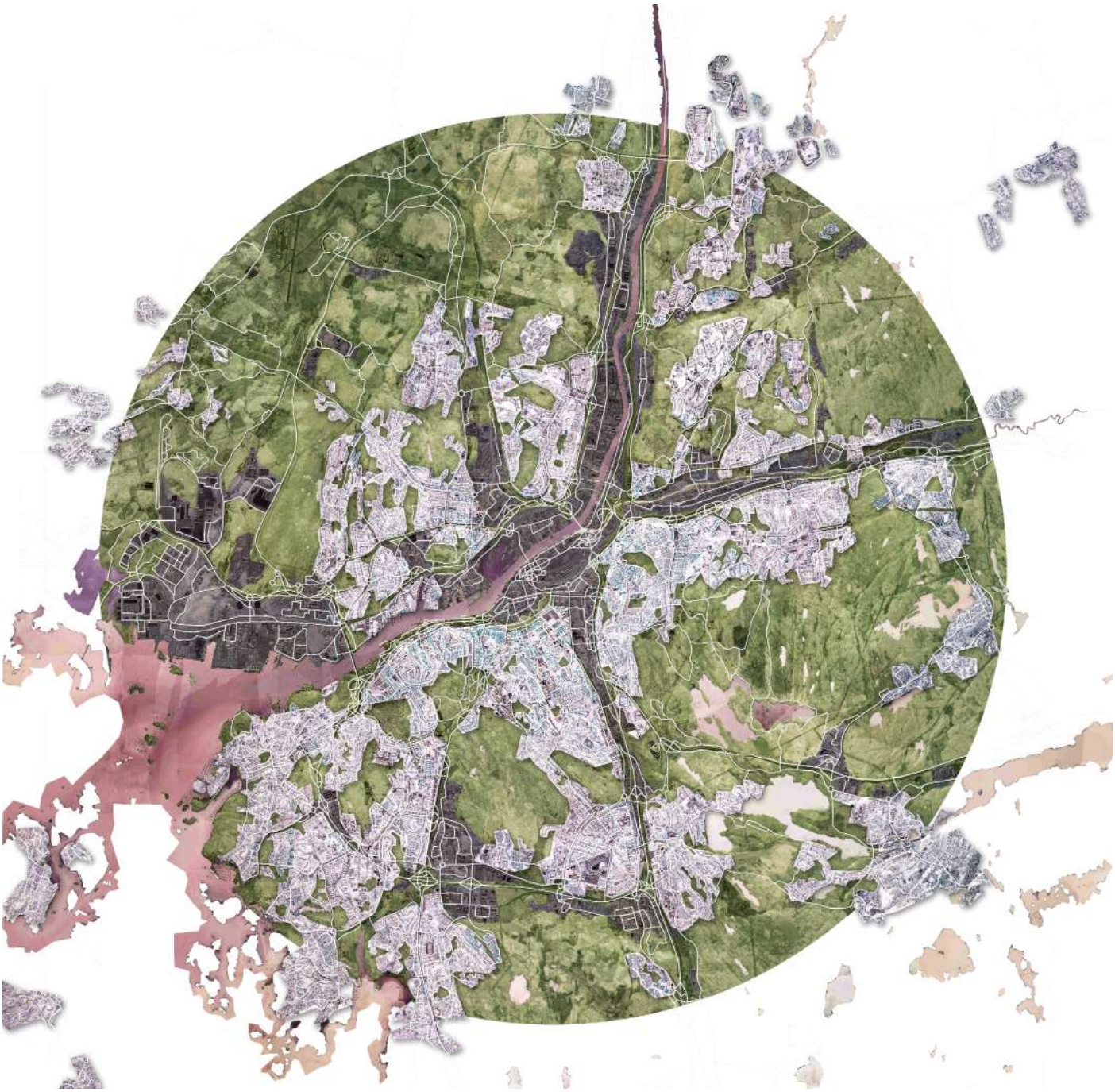
SUMMARY

Gothenburg today is a highly segregated and centralized city. With a functioning core and suburbs that are not as well off. Planned as satellites and with a dysfunctional public transport system these areas are like isolated islands completely dependent on the core and with little opportunity for any major change.

If we consider a city where the public transport system is completely changed, we could start to re-imagine how the city functions as well. The strict hierarchies dictated today by the public transport system could be questioned and new type of city could emerge

GOTHENBURG OVERVIEW

Gothenburg is in many ways defined by its many barriers. The river cuts the city in two and the industrial landscape surrounding it makes the divide even bigger. Major highways and train lines connecting the industries and harbor with the rest of Sweden makes additional cuts. This in combination with a rather difficult topography makes Gothenburg a scattered city. Like islands the different areas are often standing often creating homogeneous islands and a segregated city.



PRIMARY ROAD

INDUSTRIAL / OFFICE AREA

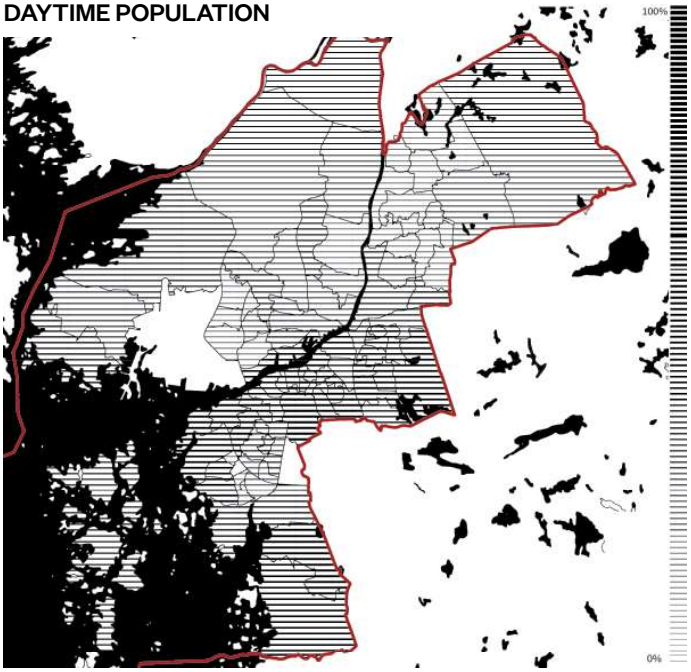
HOUSING AREA

DEMOGRAPHICHS

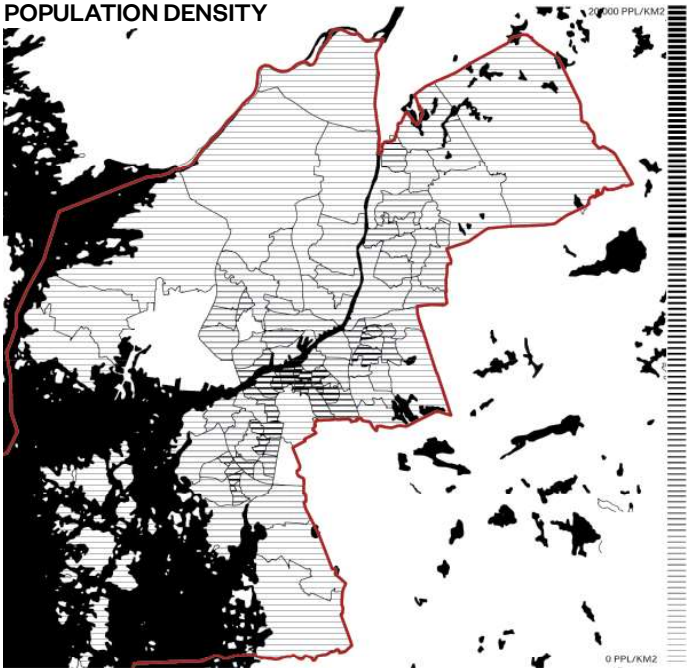
When Looking at the demographics of Gothenburg there are a few things that become clear. First of all it is the fact that there are a few areas, mainly the suburbs that are significantly worse of than the more central areas. Lower education, incomes, high unemployment rates to name a few.

The center is in contrast to these suburbs the polar opposite. Making Gothenburg a highly segregated city. Another interesting thing is the fact how unevenly the population is divided mainly during the days. Where the center has almost the entire daytime population. Leaving these suburbs for not much other use than sleeping. To deal with these kind of problems are needed.

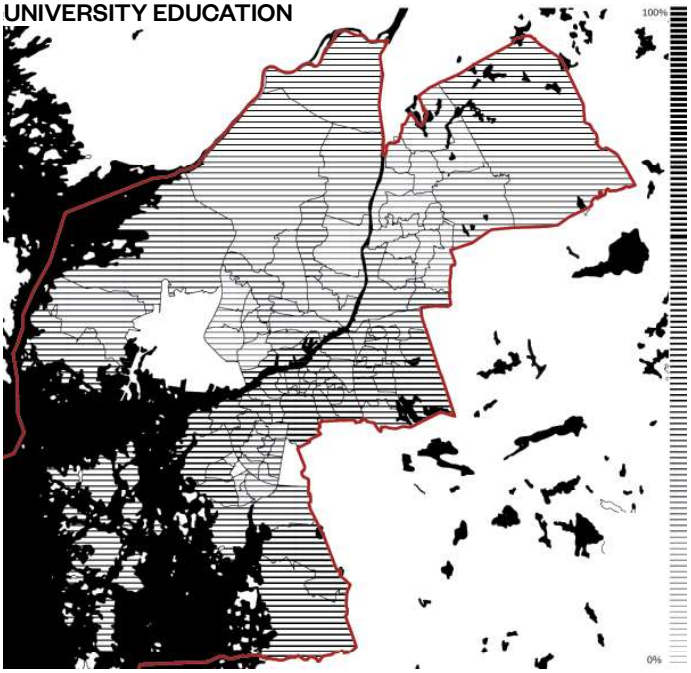
DAYTIME POPULATION

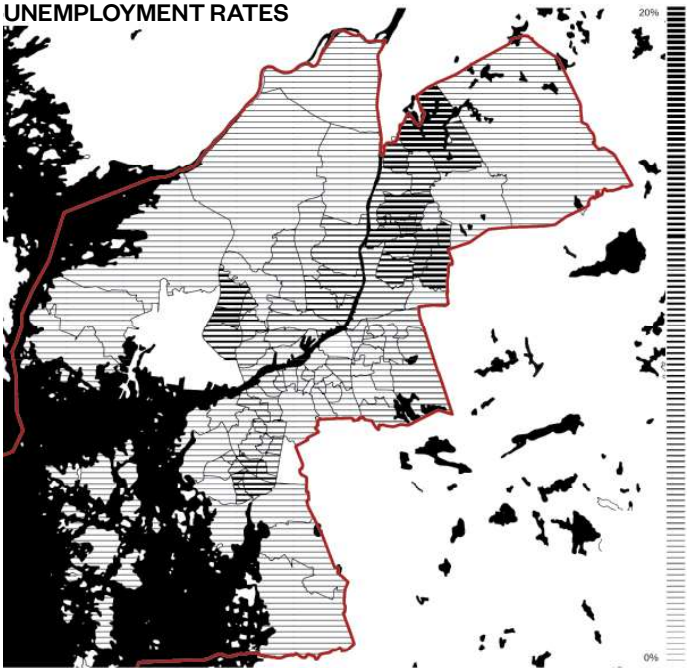


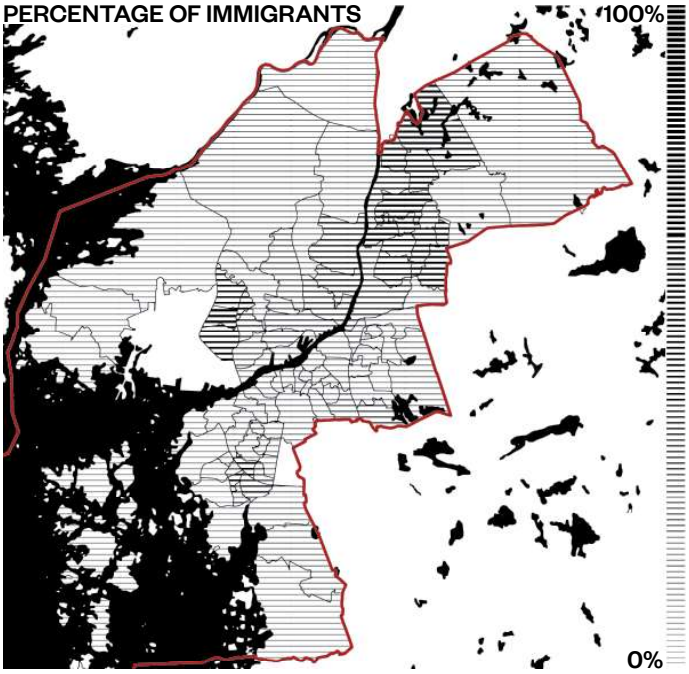
POPULATION DENSITY

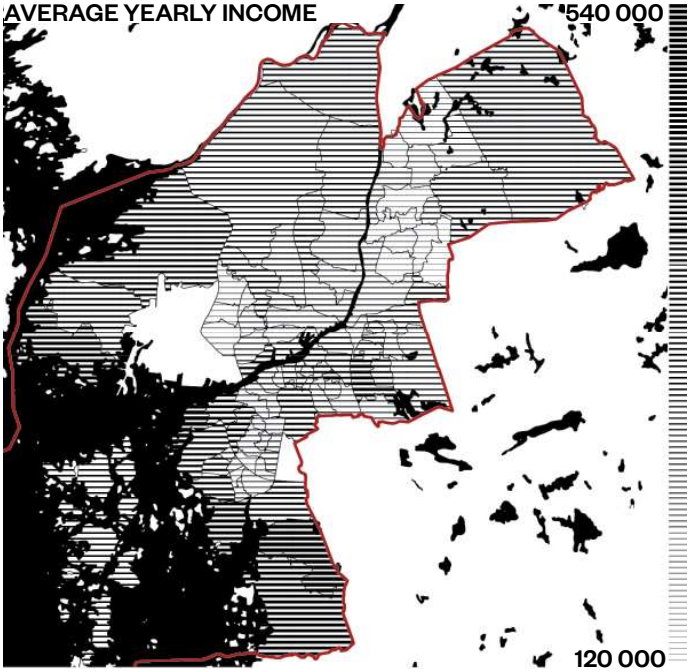


UNIVERSITY EDUCATION







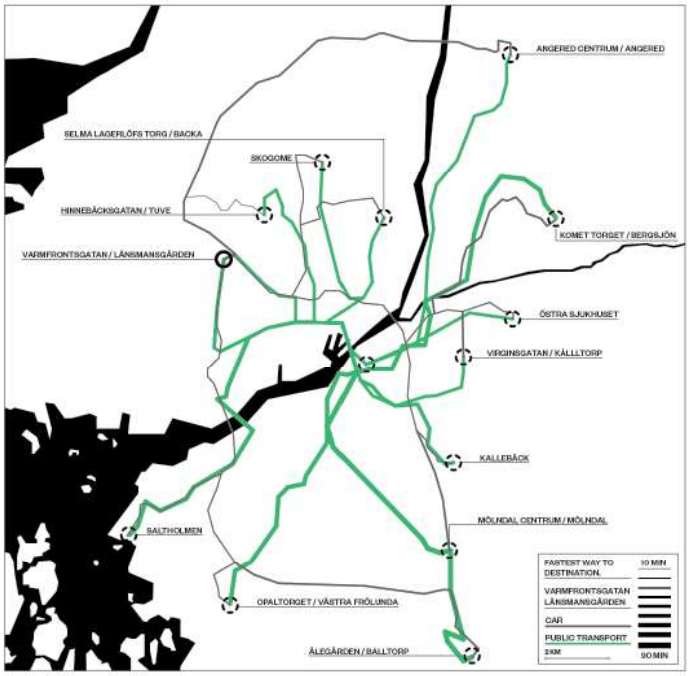


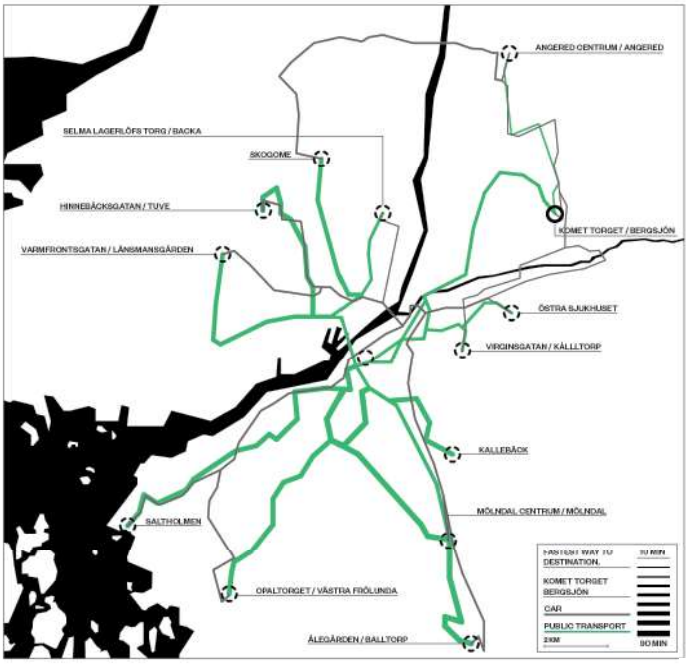
References:
Göteborgs Stad, Statistik och analys. (2016)

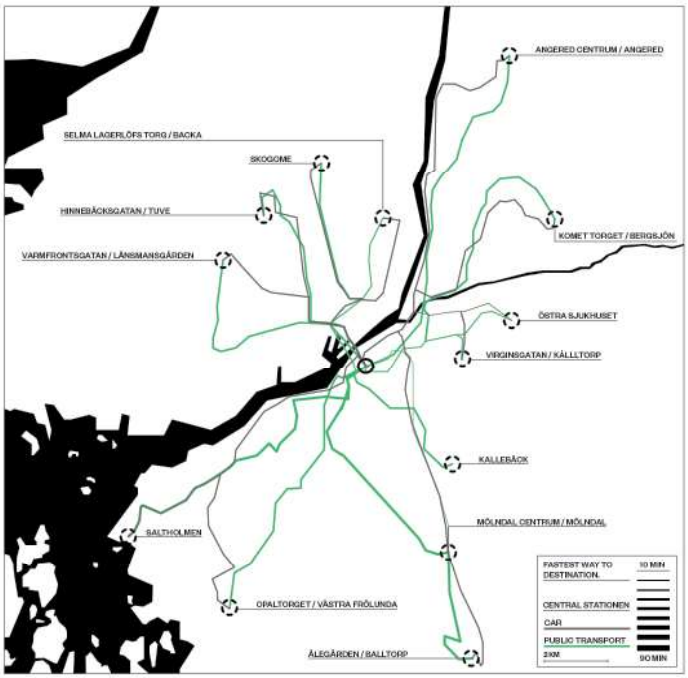
MOBILITY.

The public transport system reflects in many ways the demographic structure of the city with the areas with more problems are poorly serviced by the public transport system.

The connections within the city center are good, the connections between the city and its suburbs are also good. What is no working at all though is the connections between the suburbs. In some cases a trip that would be shorter than 2 km by car takes almost an hour with public transport. The reason for this is that you first have to go to the center to change and then go back out again. This increases the notion of these areas being like segregated islands, completely dependent on the center.

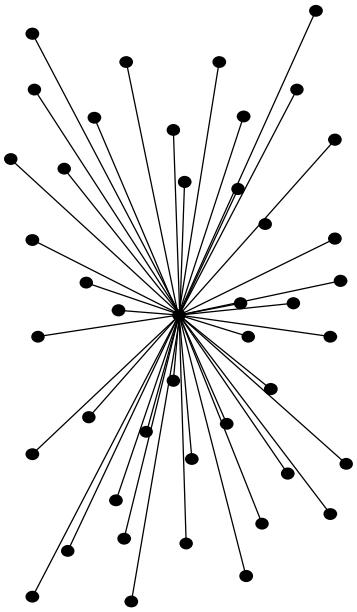






References:
Google maps. (2016)

CONCLUSION.



GOTHENBURG CENTRALIZED

Gothenburg today is a highly centralized city. With almost all the activities such as offices, shops, restaurants and cultural activities distributed in the very center of the city. The surrounding areas are largely only for living , often rid with social problems and completely dependent on the center. The mobility system inhances this fact by only providing mobility to the central parts making mobility between suburbs very difficult.

This results in long travels for the residences not living in the center and a segregated city.

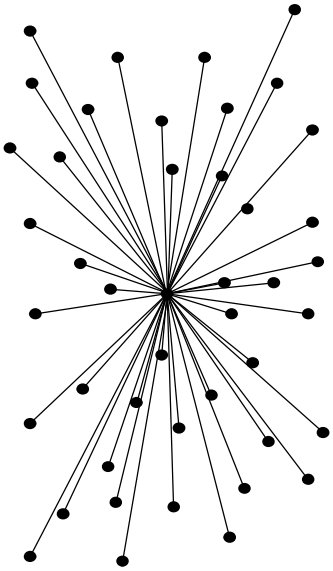
NETWORK THEORY.

To explain how a city like Gothenburg works today, and could work in the future the structure of digital networks works really well as explanation models. Gothenburg today works very much like a centralized network, used for traditional phone networks, with a central core which all other nodes are then connected to and depending on. This is true both for the mobility system and the urban socioeconomic structure and how and where activities such as work and leisure is placed in the city.

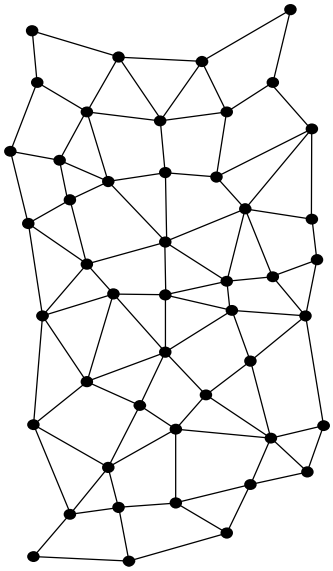
A Distributed network, Used for example in blockchain technology and in many of the cloud services, on the other hand does not have a central core. The network is instead distributed equally between all the nodes creating an completely even network collectively.

A ride-sharing service works very much like a distributed network ,in contrast to a traditional line based mobility network which works much more like a centralized one. By adding a ride-sharing service the possible ways to move within the city would be altered completely and resemble more of a distributed network than a centralized one.

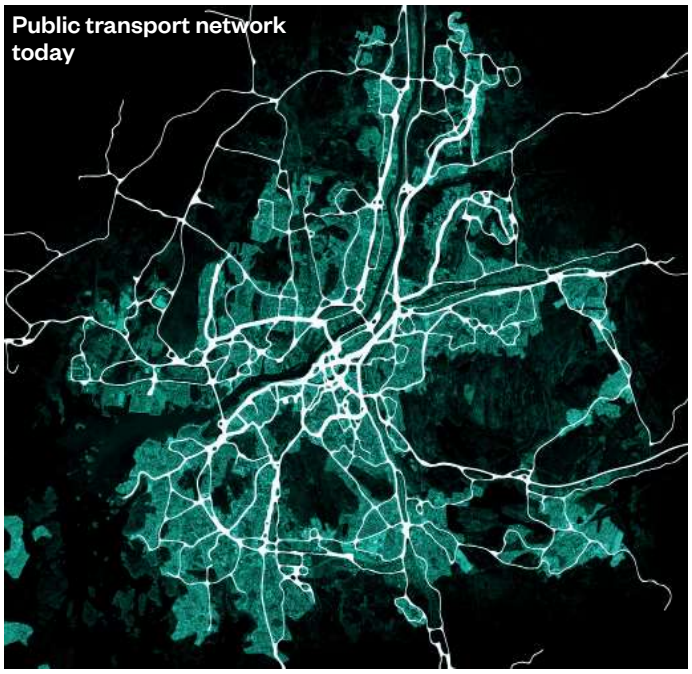
For the main lines and during rush hours traditional trams and buses would still perform a function but for the areas today completely disconnected would now be just as connected as any other part of the city. If each part of the city is equally well connected through the public transport system we could start to re-imagine what the city of Gothenburg could be.

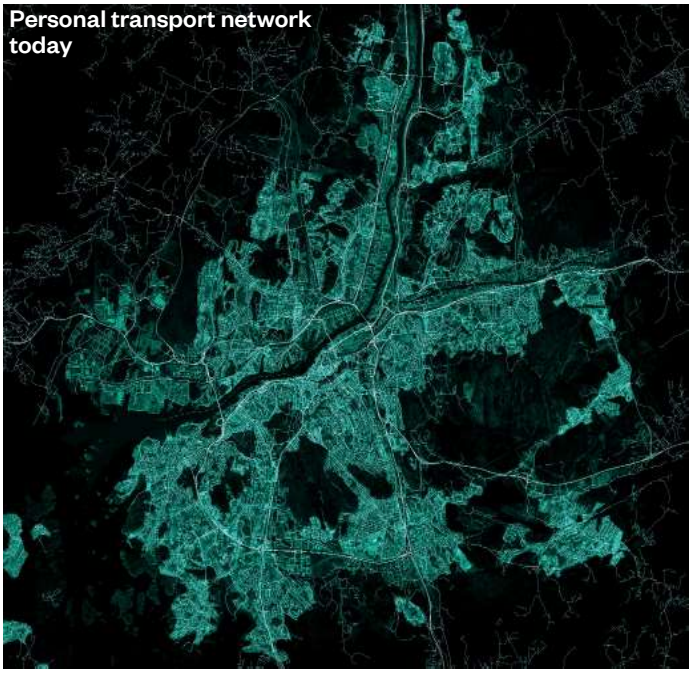


Centralized Network

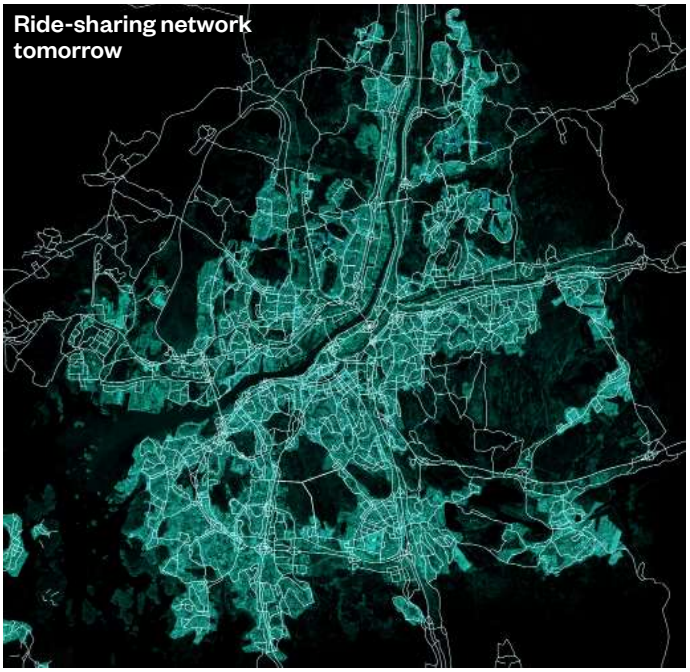


Distributed Network



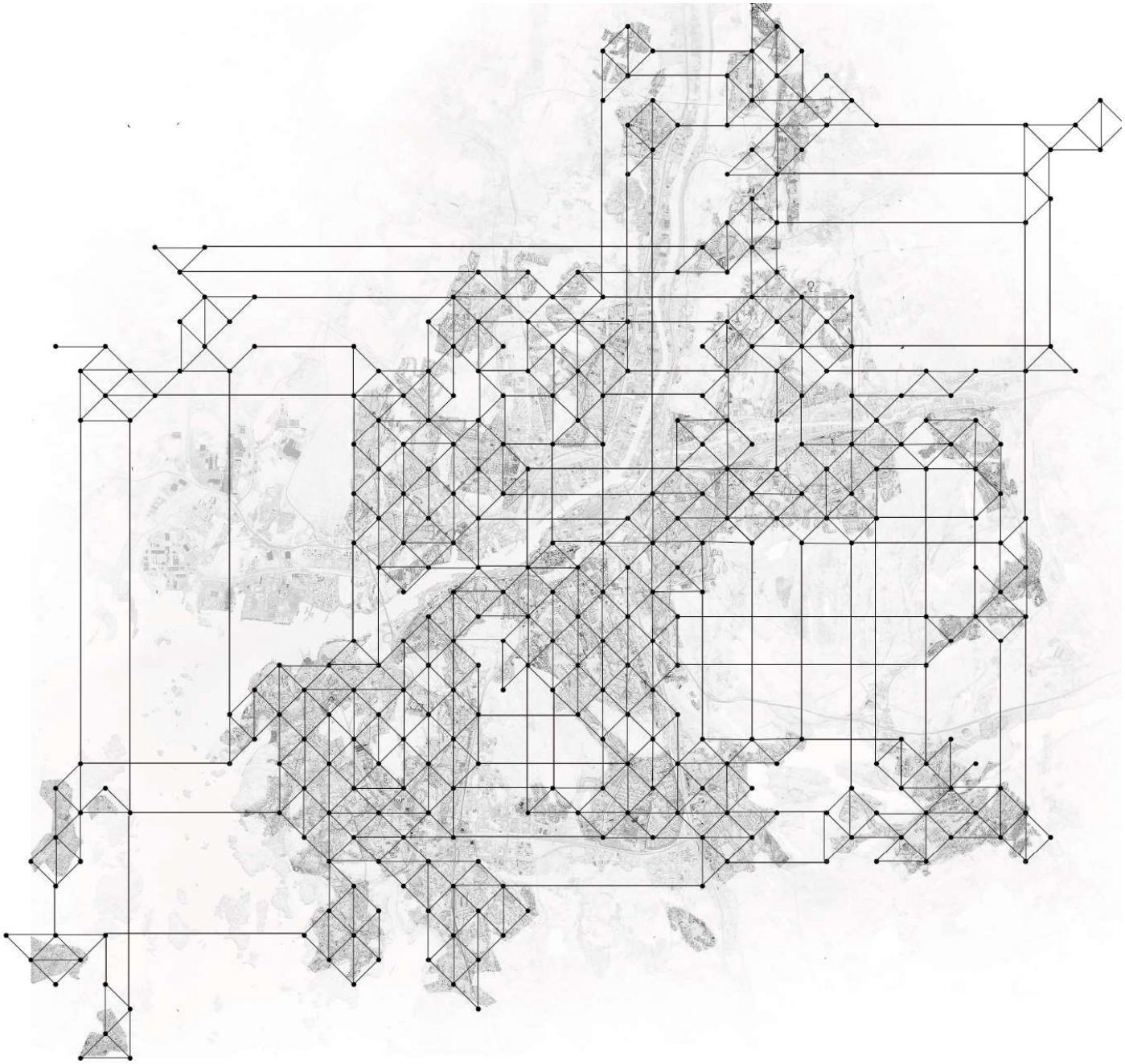


References:
Baran, P. (1962)


Ride-sharing network tomorrow

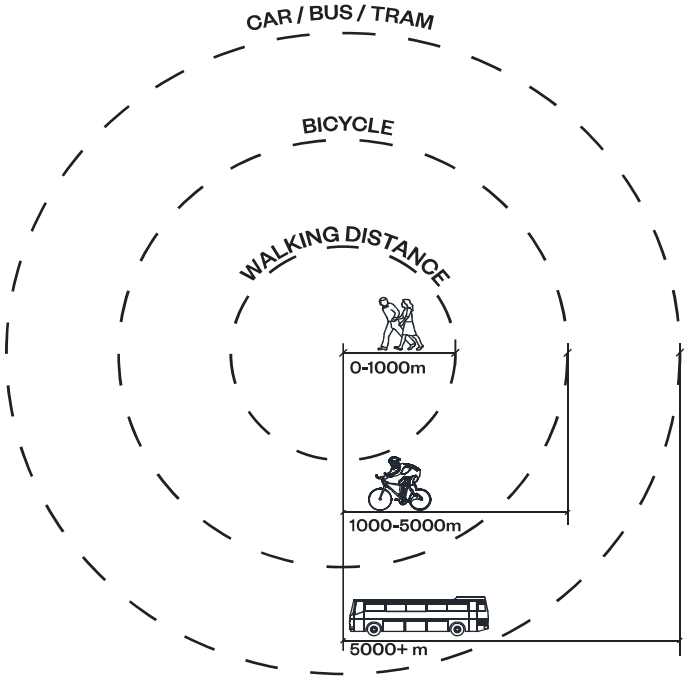
GOTHENBURG DISTRIBUTED.

If we add a ride-sharing service, as a new layer to the current mobility stack, the way people move in Gothenburg would change. If the way people can move changes we could also start imagining a change of the social aspects. In a city where everybody have access to highly functioning public transport, many of the hierarchies of the city would disappear. Functions previously placed in the center due to the easy access for everybody could now be placed at completely new locations. Just like the mobility system would be much more like a distributed system so could the distribution of the different socio economic groups and the distribution of functions. A completely distributed city wouldd be ps.



CREATE WALKABILITY.

DISTANCE AND TYPE OF TRANSPORTATION



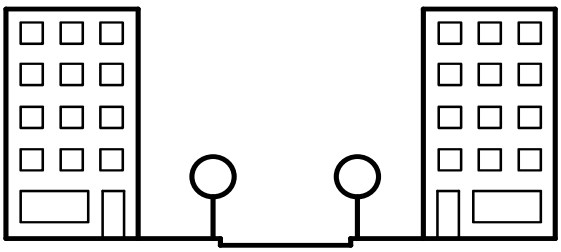
Even if the motorized vehicles will be electric and better for the environment than the current alternatives, biking and walking will still be superior on many levels and should be promoted. In order to reduce the need for motorized transportation it is important to make the city more walkable and bikeable. There are many ways to do this but one of the most important one is to have the utilities that you need for your daily life close enough to reach by bike or foot.

In Gothenburg today the suburbs often lack the utilities that people need. Not only utilities such as consumption and entertainment but also there is an underrepresentation of working places. This makes the residents in the area dependent on motorized transportation for work and this also makes the day population to low to support other activities based on consumption and drains the area of restaurants, shops and similar activities.

A Distributed city structure would make this possible for much more people than today.

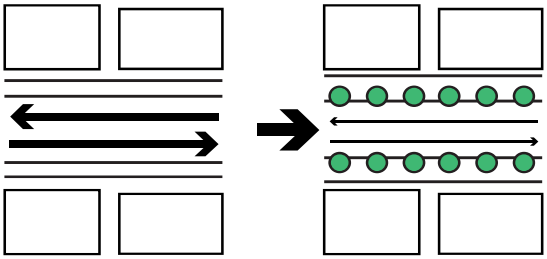
References:
Speck. J. (2013)

IMPORTANT ASPECTS IN CREATING WALKABILITY.



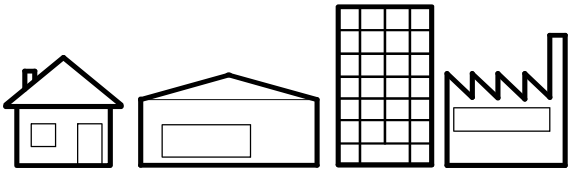
FEELING SAFE.

To minimize the distances that can be experinced as dangerous makes walking possible for more people. This is made through allowing the pedestrians to constantly walk in a mixed area where a lot of people are in motion. removing the need to walk through forest areas and monouse areas will improve the willingness to walk.



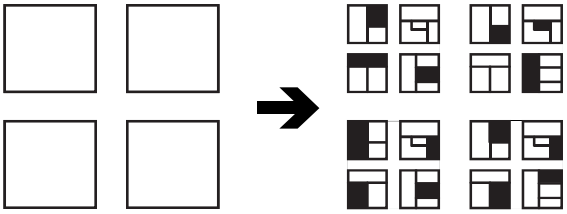
BEING SAFE.

To increase the number of pedestrians there is a need to make sure that the cars are not a threat to pedestrian. By reducing the speed and making a buffer zone between the pedestrians and the cars you can minimise the accidents and make pedestrians and bikes prioritized.



MIX USE.

In order to reduce the need for motorised transport the most commonly used functions of the city. Acces to retail, restaurants, work and housing within walking distance is needed.



VARIATION.

To make walking enjoyable there need to be a variation in the impressions during a walk. To long blooks with only on type of surrounding makes the pedestrians bored and reduce the insentive to walk.

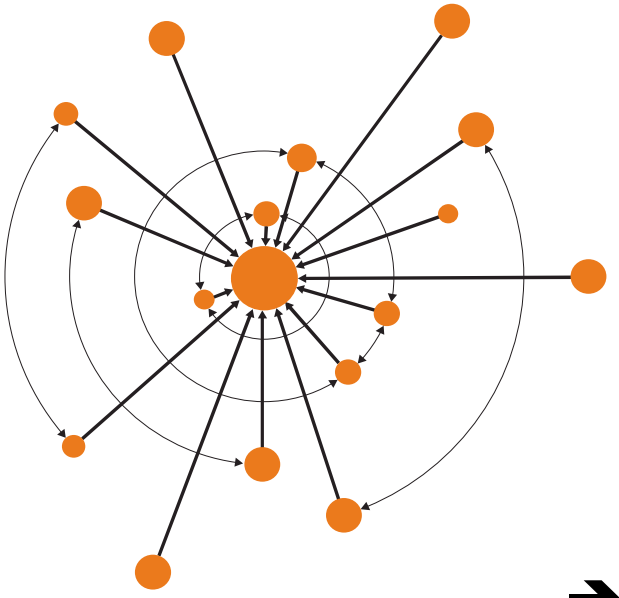
MOVEMENT PATTERNS.

Besides the fact that a distributed city is more walkable, reducing the need for motorized mobility, one of the main benefits is the fact that the flows of people commuting would be much more even. Instead of having all the population going to the center in the morning and back to the suburbs in the evening the flows would be much more spread out reducing the risk of congestion and the amount of empty AVs going out to pick people up. The problem with empty vehicles are today only present with public transport and to some extent taxi services. But a normal car does not have this problem since it stops and waits at its destination.

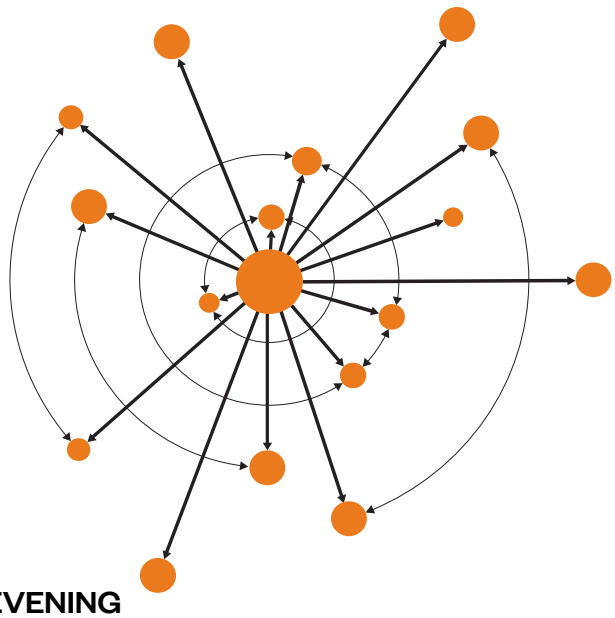
With all the vehicles being on demand services to minimize the amount of empty rides is important. In theory you could have approximately twice the amount of travel, at the same AV based transport system, with very little effect on the energy use in a distributed city compared to a centralized. Assuming that Gothenburg had a AV based public transport system and focused on creating a denser distributed city the population could potentially double without any major infrastructure investments needed.

References:
Lin D, Allan, A. Cui, J. (2013).

CENTRALIZED CITY.

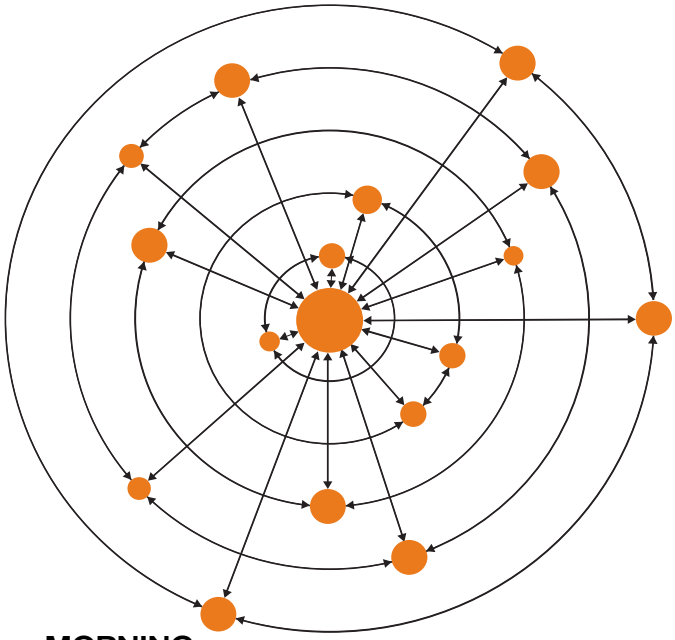


MORNING

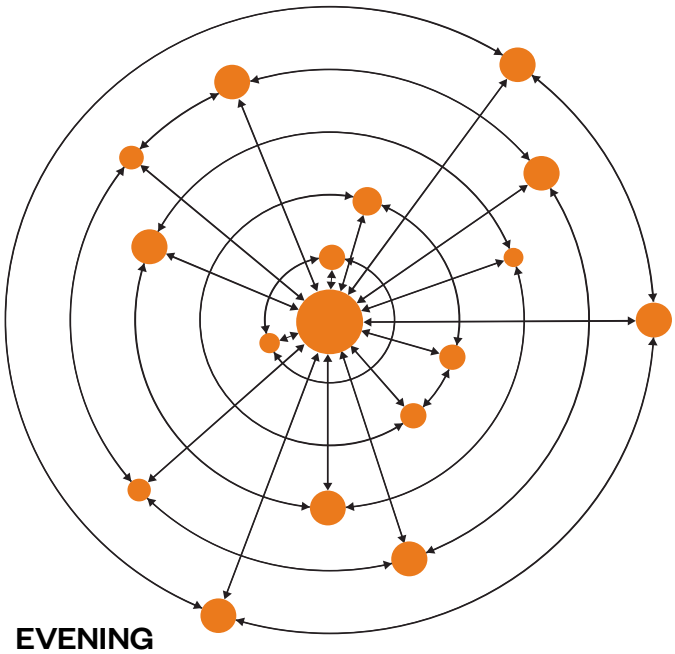


EVENING

DISTRIBUTED CITY.



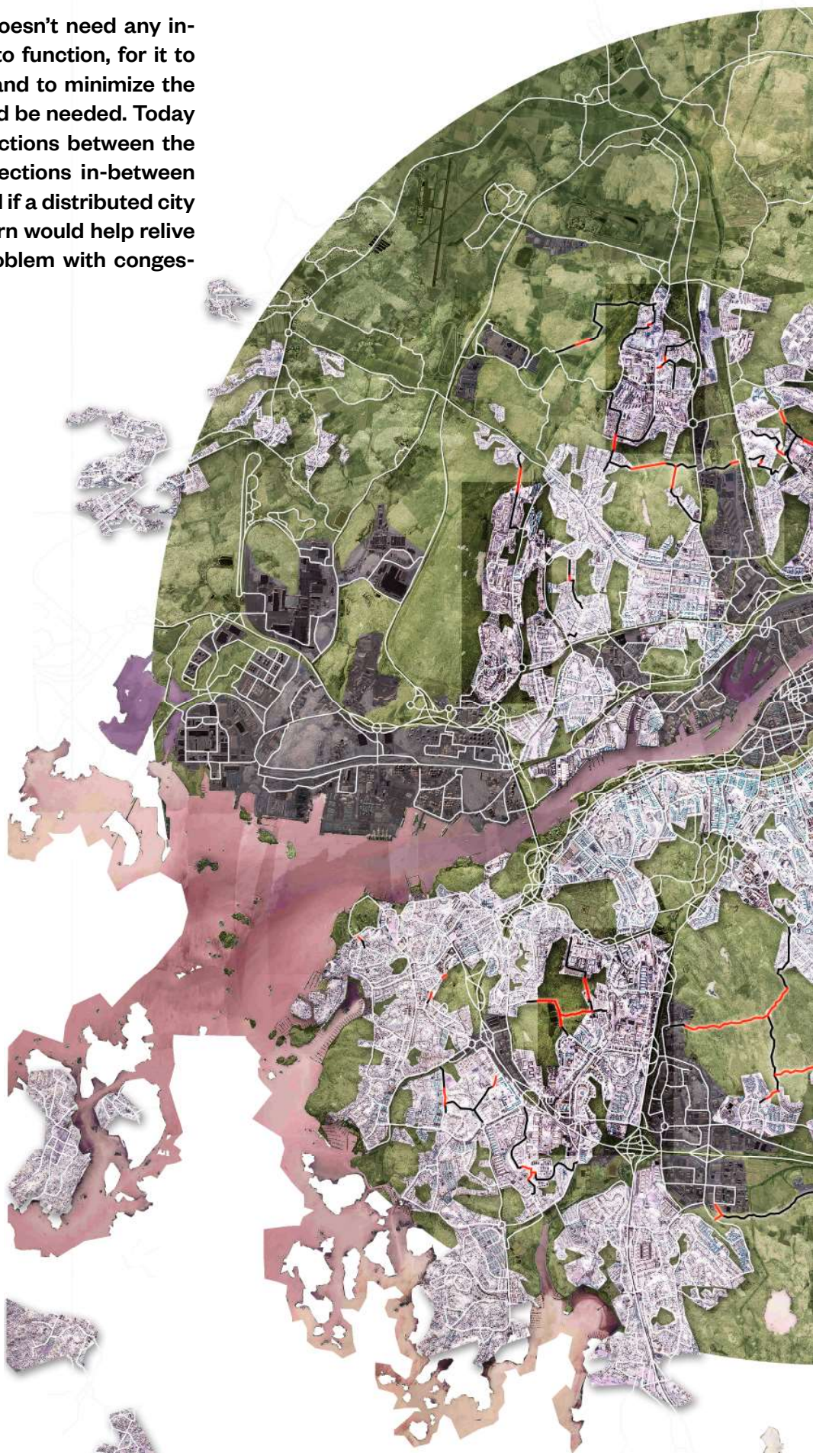
MORNING



EVENING

CHANGES NEEDED TO INFRASTRUCTURE

Even if a ride-sharing service doesn't need any infrastructure investments at all to function, for it to work well in a distributed city, and to minimize the energy consumption some would be needed. Today there are a great lack of connections between the suburbs. To invest in the connections in-between the outer areas would be needed if a distributed city would function well. This in return would help relive the center from some of its problem with congestions of today.




PRIMARY ROAD
NEW ROAD
EXISTING ROAD, Incorporated in the primary road network
INDUSTRIAL / OFFICE AREA
HOUSING AREA
BERGSJÖN / KORTEDALA

BERGSJÖN

INTRODUCTION

To understand how a more distributed city could work like and how to get there i have chosen to look closer at the area of Bergsjön. An area that follows the pattern of many other suburbs. Low incomes, high percentage of immigrants, low education levels and built as a disconnected satellites, troubled with crime and segregation.

The reason that i chosen Bergjön is the fact that i believe that these kind of areas will probably have most benefits from AVs. As the center already is well connected, the changes will not become so clear. But for an area like Bergjön the improvements could be massive. Not only would the existing routs be better but you would now have access to the entire city and not only the center.

SUMMARY

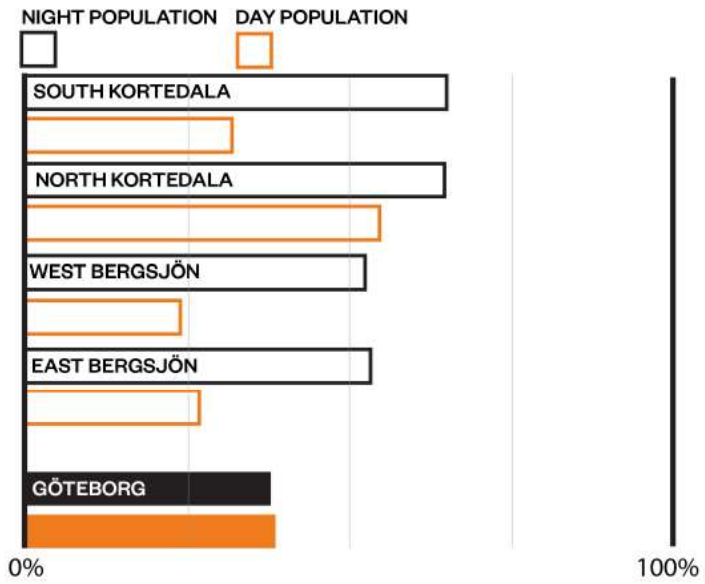
Bergsjön is an area planned for the car and is also one of the most exposed and segregated areas. Low incomes, low education and high crime rates, the area follows the pattern of many other suburbs.

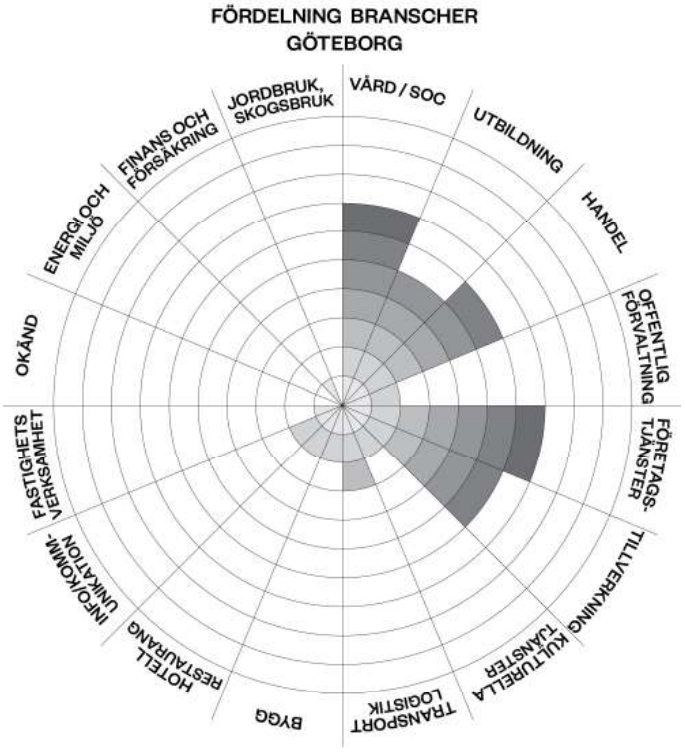
With a highly efficient, and less rigid, public transport system new kind of functions and activities would be possible to plan for in Bergsjön and. This would not happen by itself, yet the fact that parking is no longer needed opens a window of opportunity. Generic structures spread all over the city will be obsolete and to use these to realize an alternative Gothenburg would be possible.

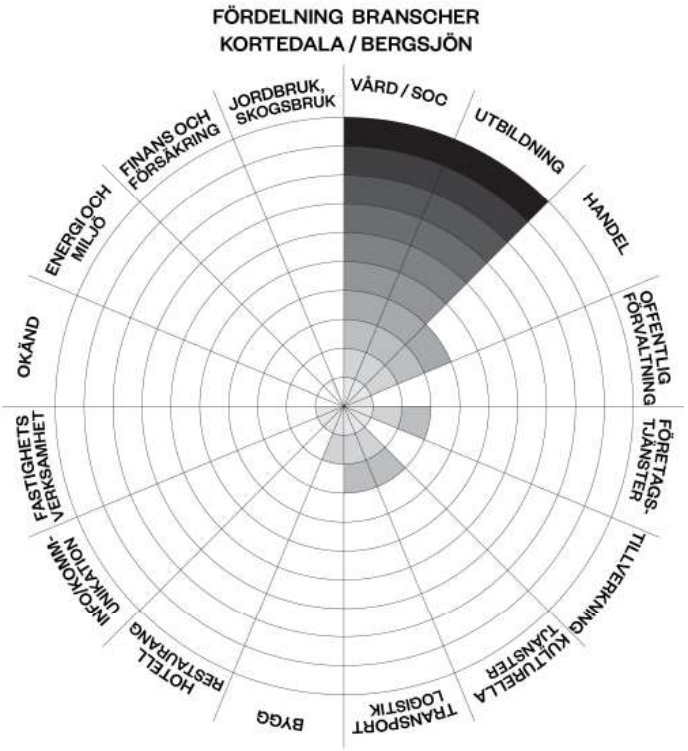
ACTIVITIES.

When looking at the distribution of activities in Kortedala and Bergsjön it becomes obvious that there is a lack of many things if you compare it with more central parts of the city. In order to enhance these areas and decrease the segregation it is important to create opportunities for these areas to have more daytime activities.

To provide spaces for jobs and private companies, associations from the local community and also public functions that are missing today is needed in order to create a more distributed city. Ideal the diagrams of Gothenburg and Bergsjön / Kortedala should look basically the same.







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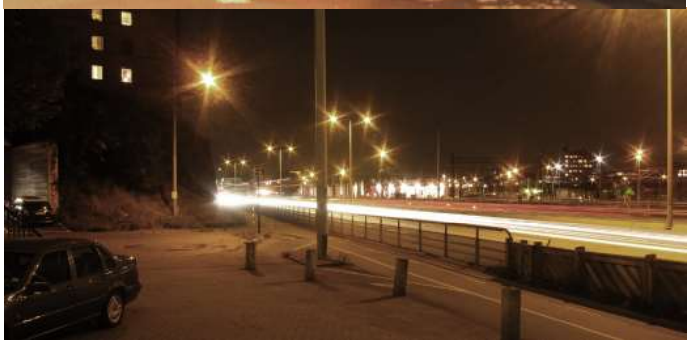


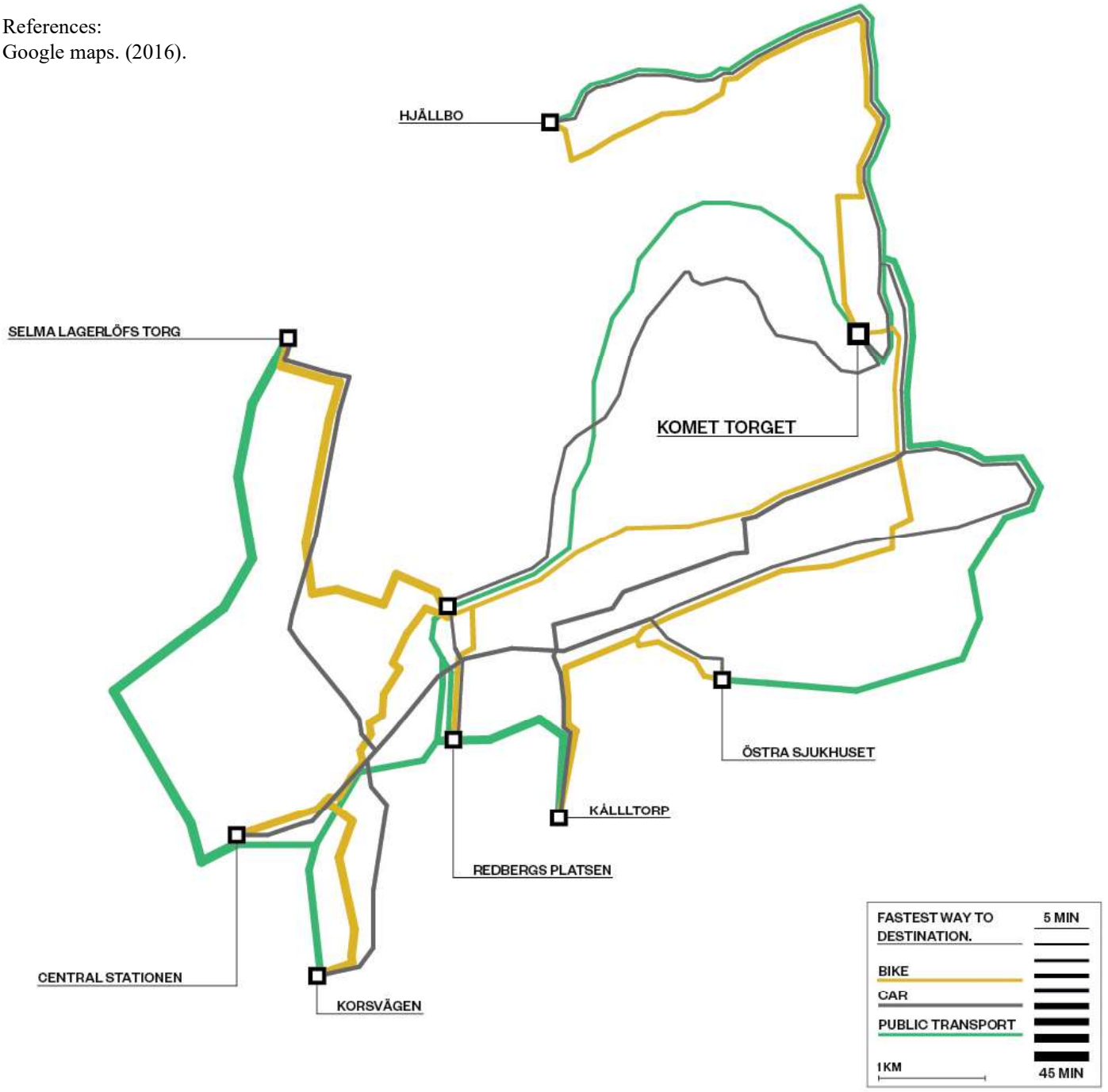
MOBILITY OPTIONS

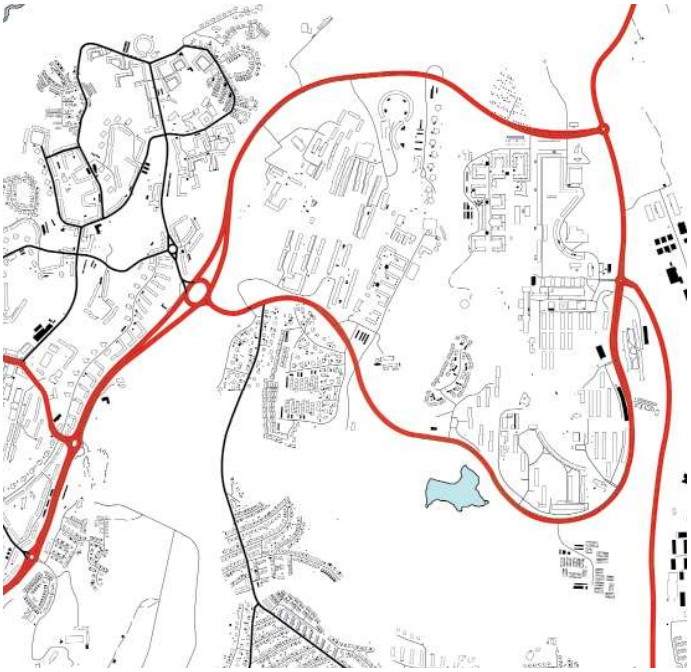
When looking at the different options to move as a resident of Bergsjön they are limited unless you have a car. And to not leave Bergsjön is not really an option for many of its residents.

Like many other suburbs the public transport works well going in to the center but to move to another suburb is very time consuming. Having to first go to the center and then back out to where you going makes it a not viable option.

To bike is not an very attractive option if you are going to the center. Both due to the topography, poorly designed bike lanes, and the fact that you cannot bring the bike on the tram makes it hard to use.

References:
Google maps. (2016).





ROADS AS BARRIERS

Looking at the roads in Bergsjön and Kortedala a few big roads stands out as major barriers, completely separating kortedala from Bergsjön. To address these barriers are necessary in order to connect Bergsjön to Kortedala and the rest of the city.

With autonomous and electrical vehicles you could start to rethink the way traffic is controlled in the area. Today the motorized vehicles are completely separated from the housing areas due to the noise, pollution and risk of accidents. As these factors are reduced or removed completely the need for complete separation of traffic and housing might not be necessary.

Just like with water in a river, depending of the flows. A road can be a barrier or not depending on the flow of the traffic. If the flows are more evenly distributed over the city the roads would become less of barriers than they are today.

figure 4

RE-USING PARKING.

As AVs takes over, the need for parking will be greatly reduced. This will leave a lot of empty generic structures open for re-use. To use these structures to compensate for missing functions in the area is what should be done.

Of course some parking will still be needed. Yet there are a lot of structures and underground parking which is not suited for anything else that could be used for that.

To create affordable spaces, for primarily not housing, is what should be done. This would act as a start towards creating a distributed city. As Bergsjön, and similar areas, Will be well connected to the entire city, not just the center, in combination with cheap space these structures could be transformed into spaces for offices, manufacturing, associations, restaurants and culture. All activities that are today missing from these areas.

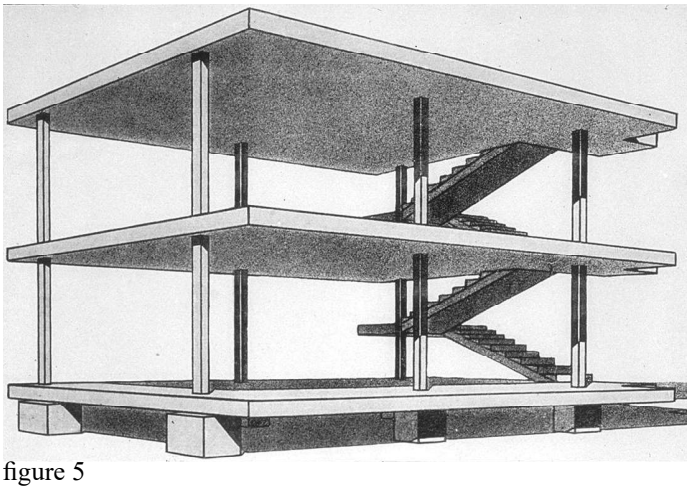


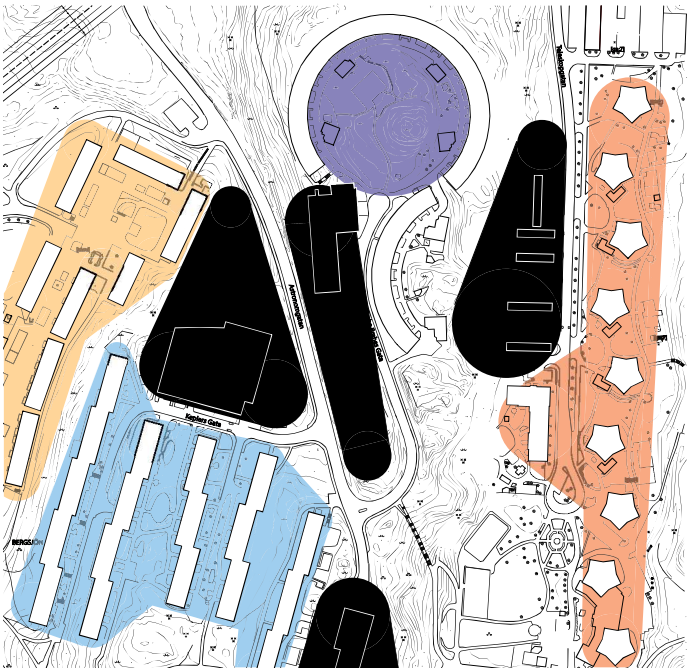
figure 5

figure 8

figure 6

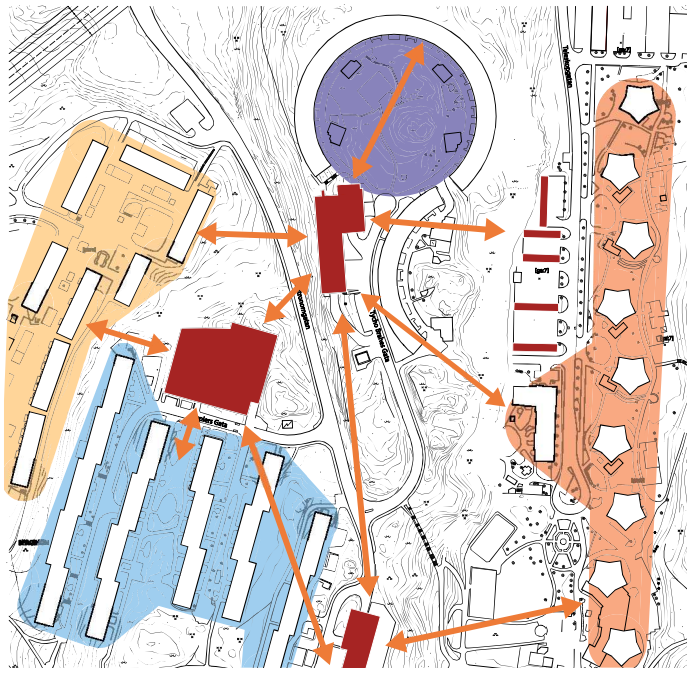
figure 7

TRANSFORMATION PROCESS



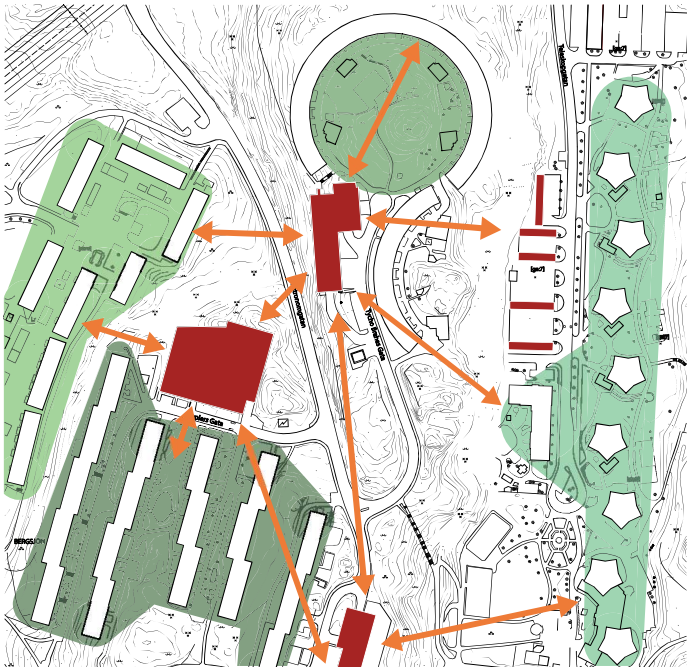
1: TODAY

Parking areas (black) are today acting as huge barriers within the areas. Waste space separating the different housing areas within Bergsjön.



2: CHANGE

By using the parking structures for places of activities instead of parking barriers the structures coould act as connectors within the area.



3: RESULT

With hubs connecting the different areas instead of separating them the area could become more like one neighberhood and have a more city like struc-

RECONNECTING NEIGHBORHOODS

The parking in Bergsjön, and many other similar areas, have been used the as buffer zones to keep the buildings separated from the roads. This have lead to the parking becoming barriers separating the different housing units from each other. Looking at bergsjön today the area is not one satellite, but in fact, also separated within the neighborhood. To use the parking to reconnect not only the entire area with the city but also within the area itself would be possible.

RE-INTEGRATING TRAFFIC.

To reconnect the interior roads are made for three reasons.

The first is the fact that as the electrical AVs will be safer and produce less noise so to have them closer to the housing areas would no longer be a problem.

The second is the fact that a ride-sharing system works much better without dead ends as the amount of possible chooses improves the system gets better.

The third is that a problem in the area today is the notion of safety. The notion of being safe increases if there are a lot of people moving in the area. Abandoned streets does not makes people feel safe.

PARKING AREA FREED FOR INTERVENTION

PARKING STRUCTURE FREED FOR INTERVENTION

AREA WITH POSSIBILITY TO RECONECT NEIGHBORHOOD.

HOUSING

PRIVATE BUSSINES

INDUSTRY

EDUCATION

EXISTING ROAD

EXISTING ROAD, (Incorporated in the primary roadnetwork.)

NEW ROAD

ASTRONOMGATAN

ASTRONOMGATAN

INTRODUCTION

There are a lot of parking structures that can be re-used in the area of Bergsjön and the facilities at Astronomgatan is just as good as any. Considering that a ride-sharing service is available the physical location is not at all as important as it is today. If enough people chooses to go here a normal bus line could be added but until there is a need the ridesharing service would make this a attractive location.

This should be seen as an example of what and how the generic parking structures could be re-used. To fill in with the activities that are missing, and not possible today due to poor communications.

SUMMARY

The area at astronom gatan is today a cut off area not suited for much activities but housing. But with a more fluid and efficient mobility system these areas would become suitable for other things. Offices, restaurants, shops and other activities that are today dependent on a central location would be possible to place in these locations.

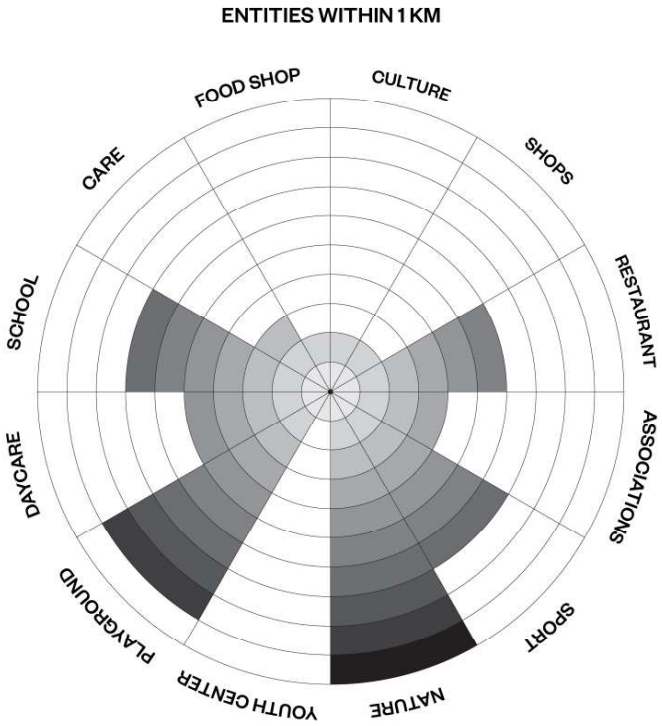
By starting with the empty parking structures, such as the ones at astronom gatan, to create catalysts for reshaping the entire area. Making them not only a suburb dependent on the center but an equal part of a distributed city .

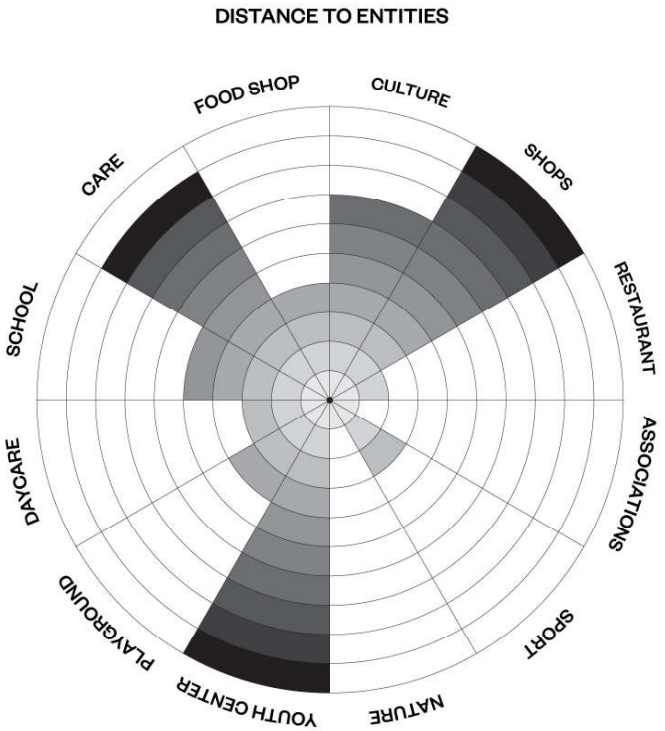
SITUATION TODAY

When looking at what kind of activities that are in the proximity of Astronomgatan a few things become clear. There is a lack of many things. Culture, shops restaurants, space for local associations, youth centers and food shops are all missing to some extent. This in combination with jobs which is missing in general in the whole area.

Shops and restaurants are very dependent on the daytime population which is probably a large reason why there is a shortage of these type of business. A restaurant for example usually needs both the lunch and dinner service to make ends meet. So to get daytime activities and jobs to the area is absolutely essential in order to make it possible for the other functions to survive.

Yet it is important to not only have the focus on that but also make sure that there are services and functions that are by, and for the people already living here.





References:
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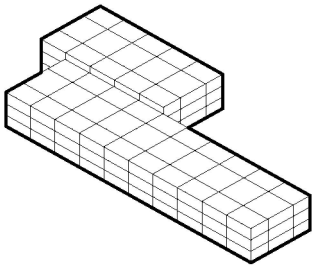
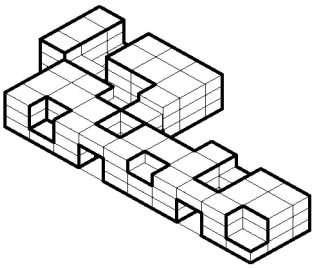
Google maps. (2016).

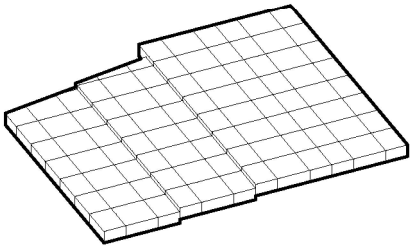
TRANSFORMING PARKING.

The two parking garages located at Astronomgatan are today, like most parking in the area, large barriers. With generic structures made out of prefabricated concrete. This serves as example of how the transition from barrier to connector could be made.

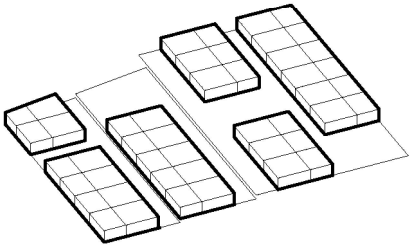
By removing slabs to let in light and adding new facades and light weight structures on top these kind of buildings could provide cheap space for various activities. This would be possible since communications would be better and the low price would act as an incentive for users to start coming here.



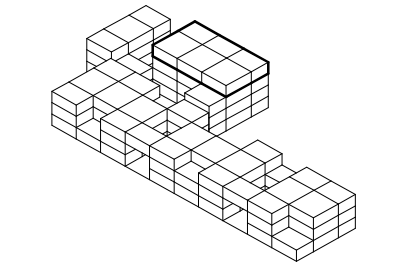


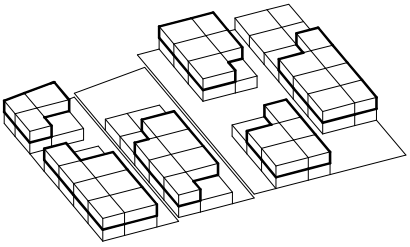


TODAY

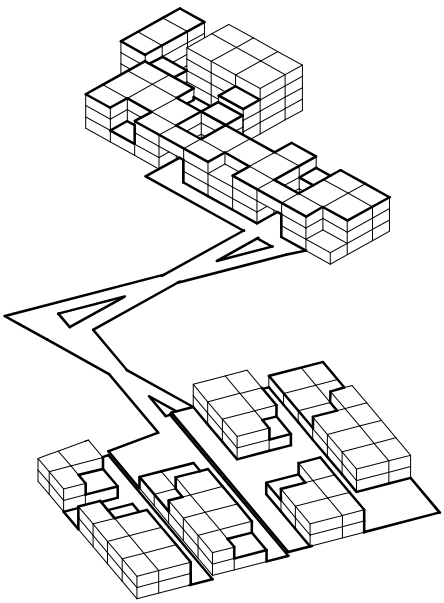


MAKING CUTS





ADD LIGHT WEIGHT STRUCTURES

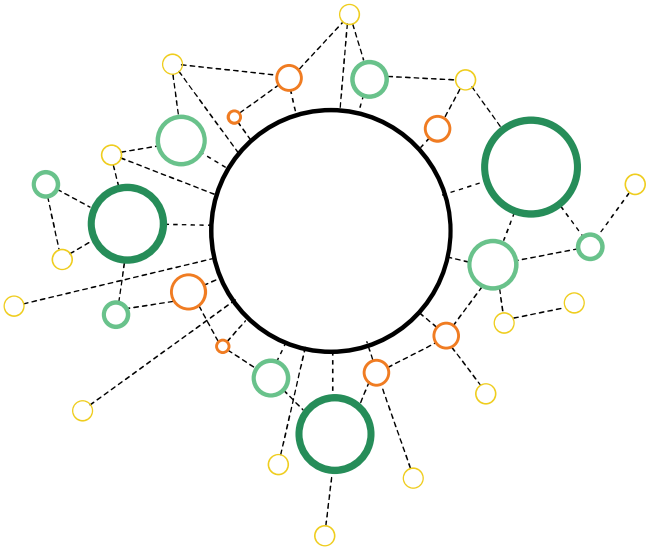


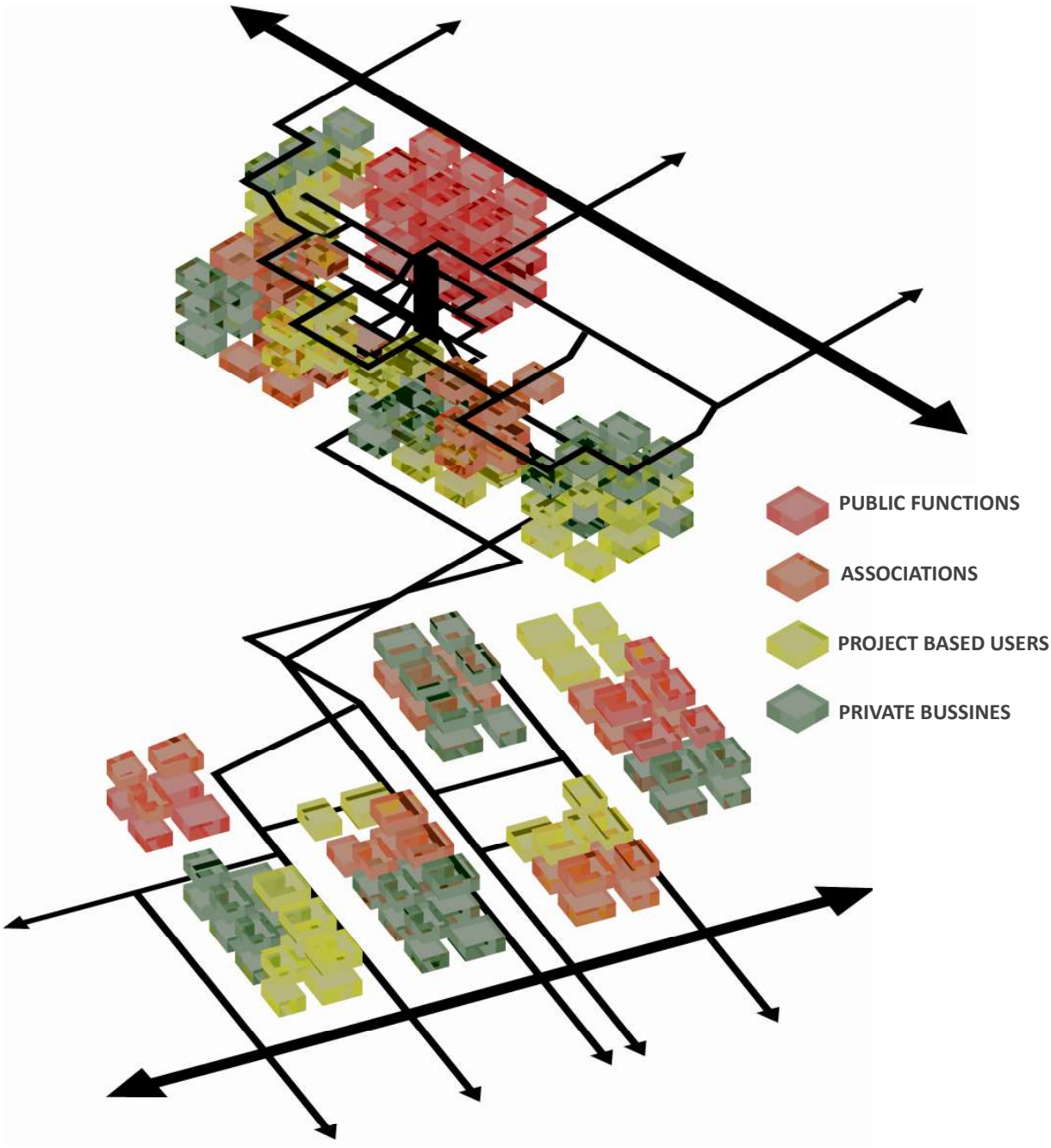
CONNECTING OUTDOOR AREAS

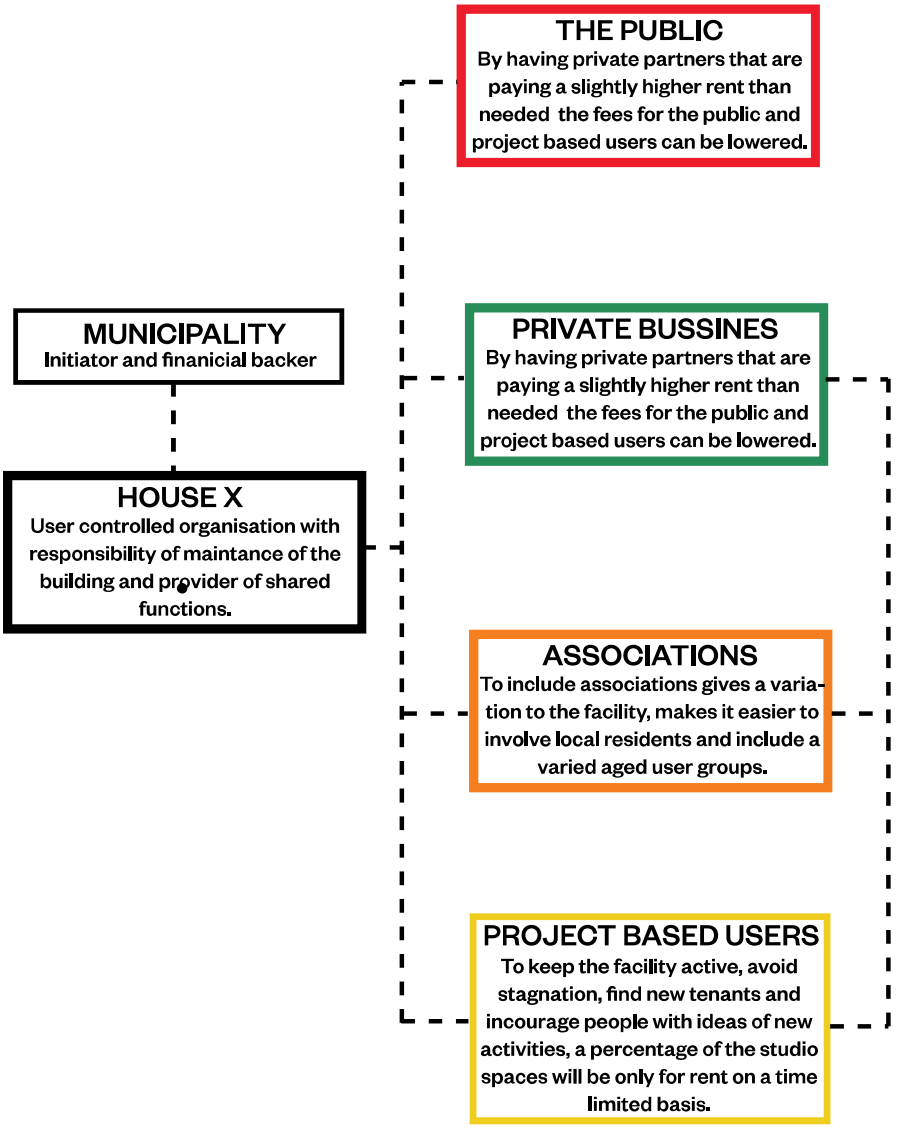
PROGRAM

To create activities for both residents of Bergsjön and from other areas is important in order to make it a functional space. Different ages, ethnicity, social background and professions. Based on the framework of Godsbanen in Aarhus Denmark this would be mixed use center focused on newly started enterprises but with public functions as well.

The core of the Hub would be a maker space run by the municipality. The rest of the spaces would be a mix of public functions, private business, associations and project based users. Diversity and collaboration would a priority.





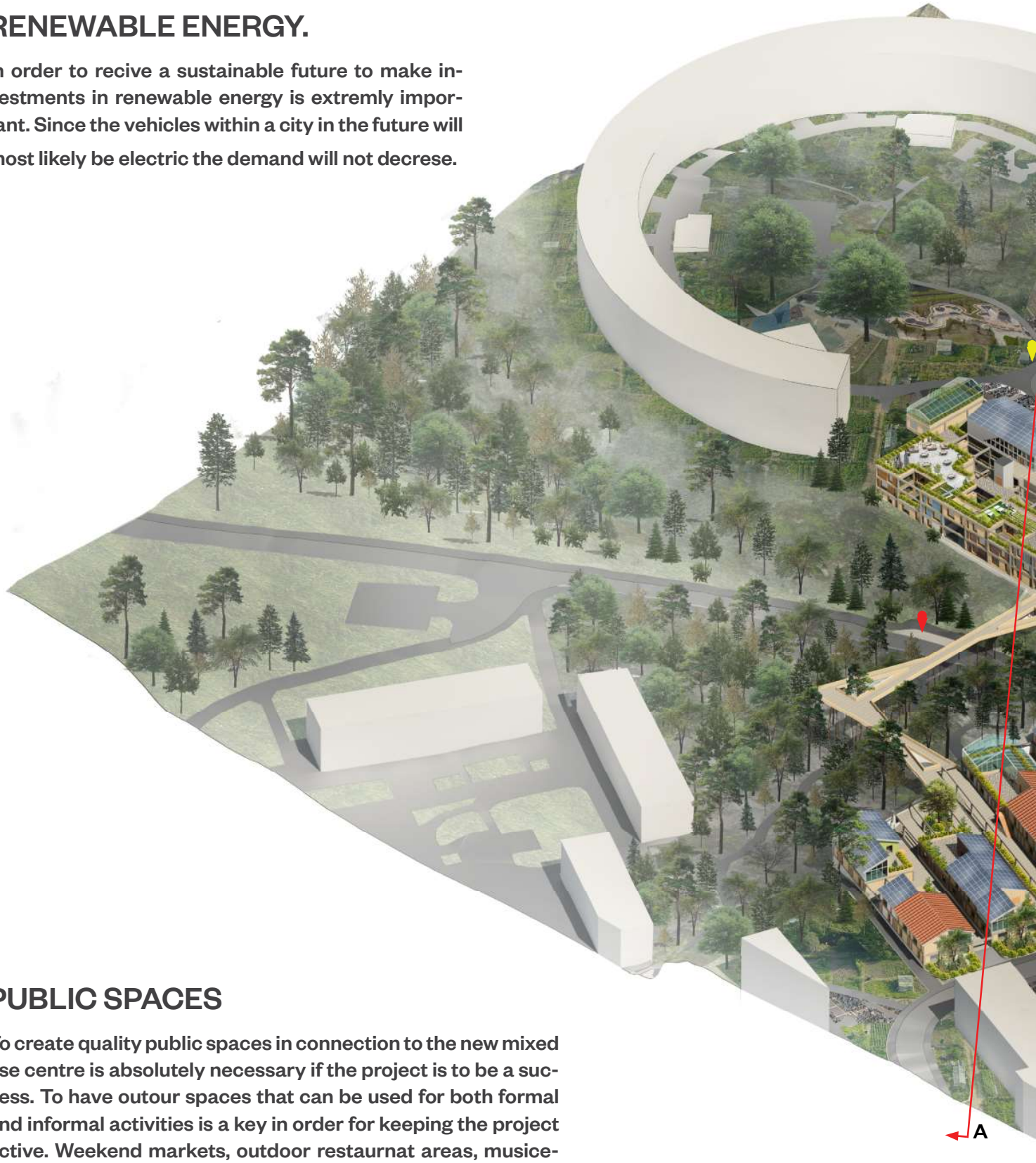


Reference : Godsbanen

Located in Aarhus Denmark, since 2009, the project of godsbanen have quickly become a culture center for the entire city. By letting various private persons, organizations and small corporations use and alter the old abandoned buildings rather freely and for a low cost the area is today one of the most vibrant part of the city. By allowing cheap space and a framework for collaboration the area was transformed from a industrial waste land to a hub for innovation and culture.

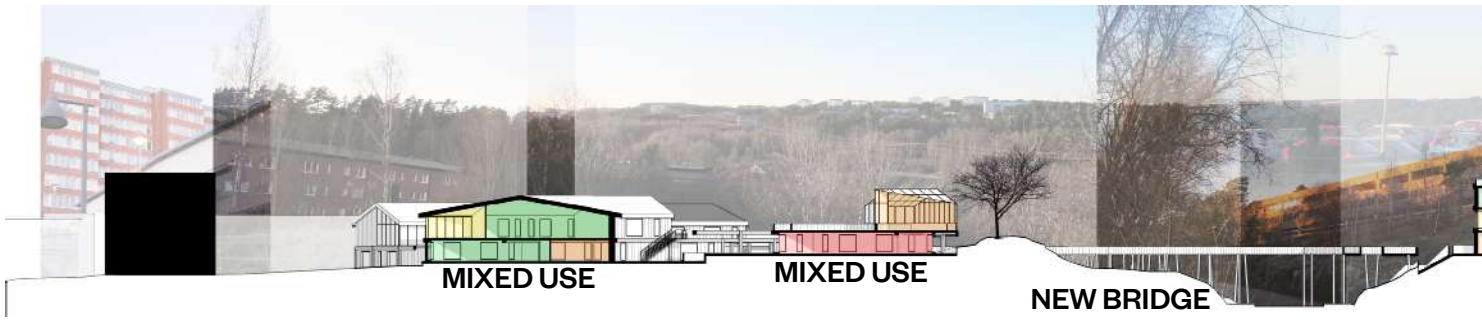
RENEWABLE ENERGY.

In order to recive a sustainable future to make investments in renewable energy is extremly important. Since the vehicles within a city in the future will most likely be electric the demand will not decrese.



PUBLIC SPACES

To create quality public spaces in connection to the new mixed use centre is absolutely necessary if the project is to be a success. To have outour spaces that can be used for both formal and informal activities is a key in order for keeping the project active. Weekend markets, outdoor restaurnat areas, musicevents etc is activities that would work well in a context as such.



TRANSPORTATION STOPS

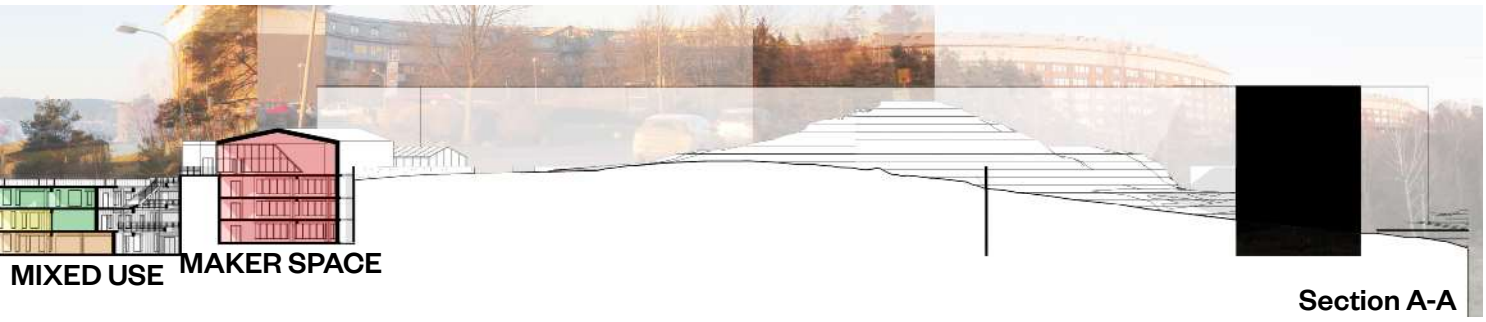
BUS / RIDE SHARING / TAXI SERVICES

RIDE SHARING / TAXI SERVICES

TAXI SERVICES

URBAN FARMING

Urban farming is a good way for repurposing unused space. As automation will reduce the need for work in general, to have sustainable and purposefull activities for people. Uban is one of many examples of this.



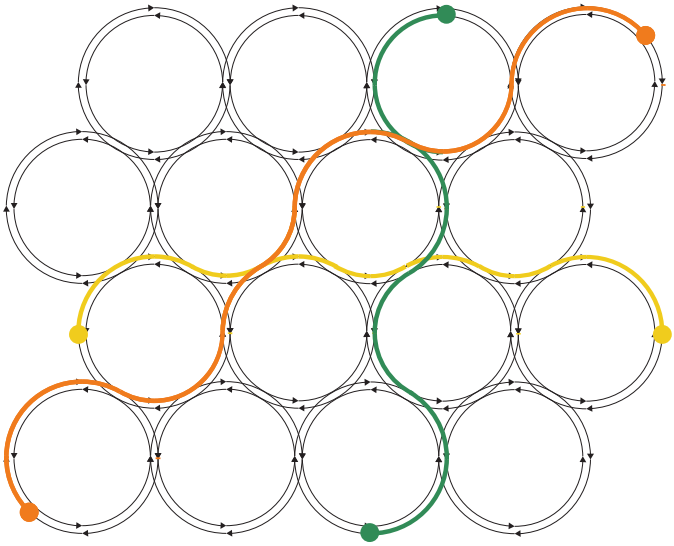
Section A-A

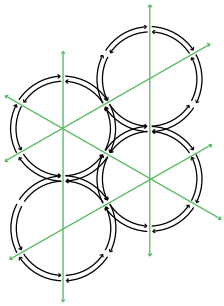
CONCLU-SION / RE-FLECTION

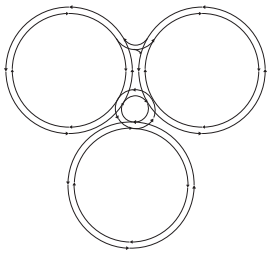
WORK PROCESS.

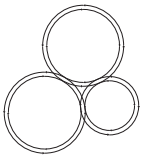
To understand how to relate to the potentials of Automated mobility systems was not as simple as on might think. In the early process i was focusing on different ideas on how to design a city for autonomous vehicles. This is of course something to consider in the quite distant future, but since i believe AVs will be here soon it is the wrong way to go. The beauty of AVs is the fact that doesn't require any active design but can be used on the existing infrastructure.

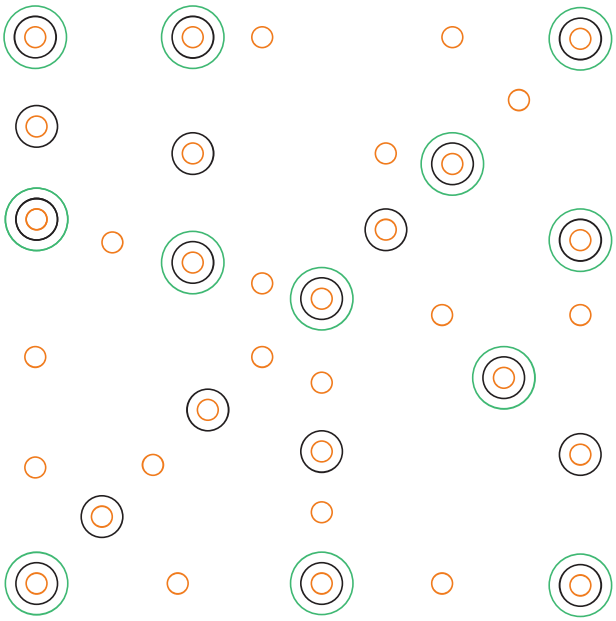
Another aspect of designing a system for AVs and a ride-sharing system in particular is the fact that it doesn't create any hierarchies. As a planner one often wants to decide where the center should be, often based on the public transport network. But with a ride-sharing system you create no hierarchies. To accept and find ways to relate to this rather abstract new way of mobility was the greatest challenge of this project and many different turns needed to be made in order to realize just that.

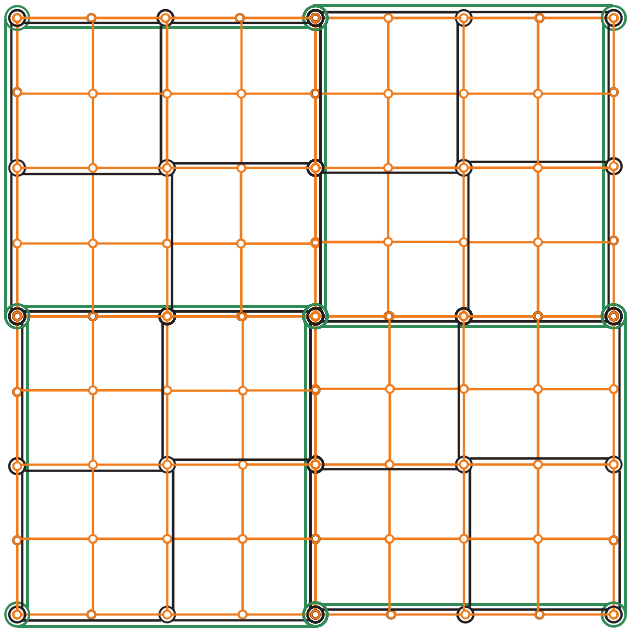


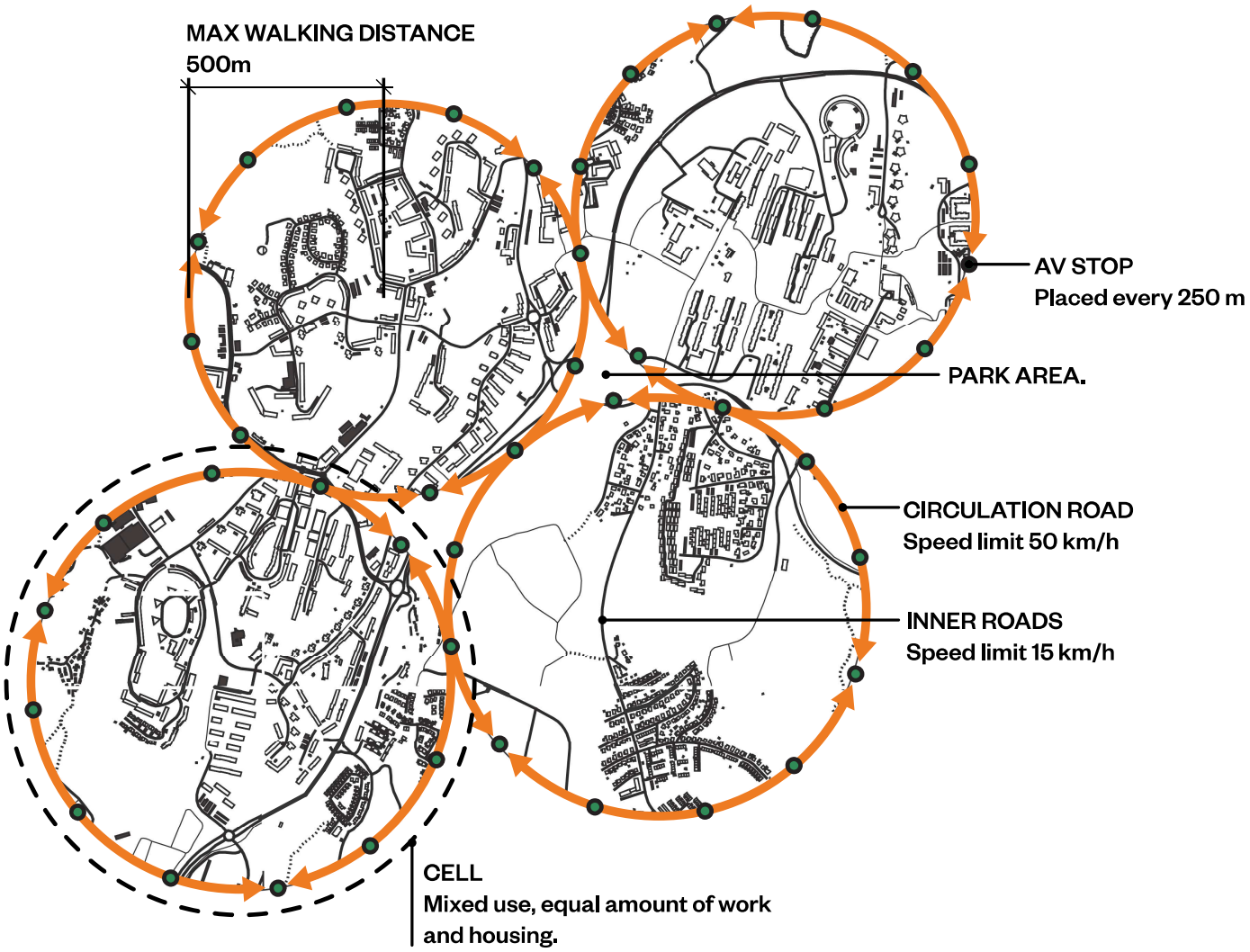


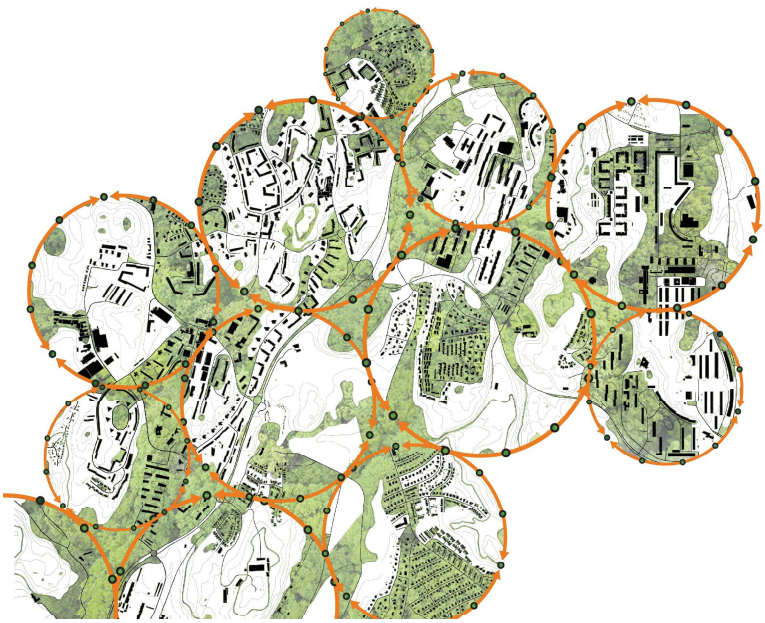


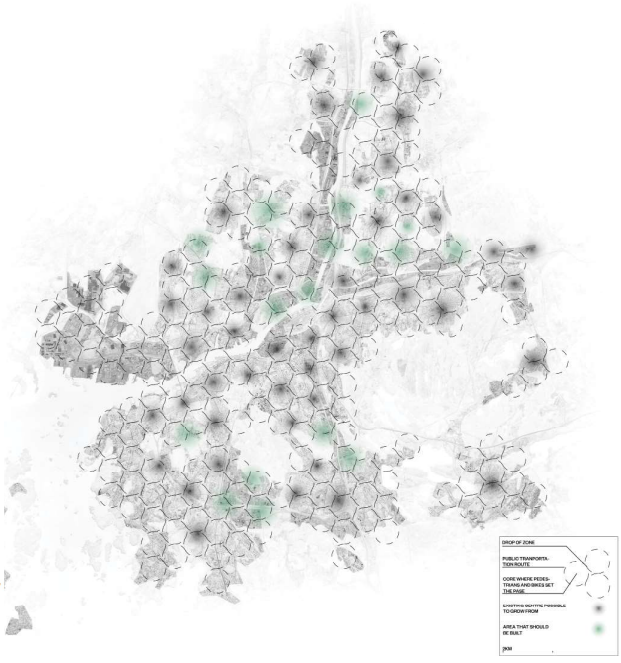







MAX WALKING DISTANCE
500m
AV STOP
Placed every 250 m
PARK AREA.
CIRCULATION ROAD
Speed limit 50 km/h
INNER ROADS
Speed limit 15 km/h
CELL
Mixed use, equal amount of work
and housing.





DESIGN RESULT

What this process has brought me to reflect on is the importance of mobility. The way we move is very closely connected to how the city functions and if you change the logic of either the city or the mobility system it will have huge impacts on the other. Yet a mobility system will not solve the problems of today. To blindly believe that technology will solve social problems is wrong, yet it can open windows of opportunity for change if used right.

This project is by definition a speculative one. Yet i believe that the result is of importance in the future to come. The connection with mobility and social issues is to me clear, and even if autonomy does´nt come improvements in the mobility, especially in the suburbs is important. To connect the different suburbs with each other and start to look at them as more than just problem areas but areas filled with opportunity possible to be more than just housing but a vital part of the city.

NEXT STEPS

This is a topic which is just emerging and to keep thinking of, and explore how this can be used in positive way is needed. This project is more of a thought experiment and to make it more real other fields of expertise would be necessary to include in the process.

To have simulations made on Gothenburg, exploring what and how new mobility systems could effect the city, would make it possible to produce more detailed ideas of what this could mean and be utilized to improve the city.

In my proposal i zoom in on the suburbs as i believe they can benefit from this new technology the most. If the you would change the urban fabric the way i propose this would then mean that changes in more central locations would come as well. To look into what a distributed city would mean in the center is another aspect that would be interesting to look into.

When thinking of automated mobility i think that it is important to realize that this technology has the potential to disrupt the current modes of mobility completely. This means that more or less every aspect of urban life will be effected. To keep speculating on what this could mean in all scales and on all levels is necessary if we are to be able to utilize it to the fullest

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IMAGES

If not mentioned the image is produced by myself.

Figure 1: ***1950s vision of future.*** https://muscleheaded.wordpress.com/tag/self-driving-car/

Figure 2: ***Autonomous prototypes.*** https://www.pinterest.se/pin/269230883953752206/. https://wordlesstech.com/olli-self-driving-bus/. http://www.newsweek.com/why-did-googles-self-driving-car-crash-bus-431992

Figure 3: ***Olli.*** https://wordlesstech.com/olli-self-driving-bus/

Figure 4: ***River delta.*** https://www.google.se/maps/@64.6566198,40.2915996,26724m/data=!3m1!1e3?hl=sv

Figure 5: ***Domino house.*** https://www.pinterest.se/pin/438538082442376260/

Figure 6, 7, 8: ***Street views.*** https://www.google.se/maps/