CO CREATION LAB

How can autonomous transport systems bring value in cities?

FOREWORD

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This booklet is a summary of a project within the strategic innovation programme Drive Sweden - a joint effort by Vinnova (Sweden's innovation agency), Formas (Swedish research council for sustainable development) and Energimyndigheten (Swedish energy agency).

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The idea of this project was to explore city values of automated, connected transport systems by using a co-creation method.

In common language, we often say Autonomous Drive, or just AD, to express how the city will be populated by self-driving vehicles. In fact, the new possibilities with connected, automated transport systems we are facing or shaping, is much larger. It is about a new system for mobility.

We invited people – all in all close to 100 - to four co-creation workshops. Each workshop had a key question that was both distinct and visionary. The participants were all highly knowledgeable in their area of expertise but often quite unfamiliar with other aspects of the city or the technologies of automated vehicles.

The effect was amazing, inspiring, creative and exhausting. The outcome was beyond our expectations and we are grateful to the participants who gave so much of their energy and shared so much knowledge.

We think these kinds of workshops have a high potential to create necessary and challenging dialogues. The result may lead to new projects, new insights for the Drive Sweden program office such as knowledge gaps to address, as well as an increased understanding of the importance of user and value creation aspects. The issue of what value is actually created from an automated transport system, is even more complex than we thought we knew.

We hope you will enjoy reading about our work and the findings and be inspired to take initiatives for supporting the vision of Drive Sweden.

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ABOUT DRIVE SWEDEN
AND THIS PROJECT

This book is created as a result of one of the strategic projects within the Drive Sweden program, which is one of seventeen innovation programs in Sweden. It started in 2015 and has a 12-year outlook. Its partner base is broad and fast-growing, presently consisting of more than fifty actors from industry, academia, institutes and society.

The long-term goal of Drive Sweden is to contribute to a competitive Swedish industry as well as to the National Transportation Goals and Agenda 2030 as articulated from the Swedish national government. In the short-term perspective, we need to identify competence gaps in many dimensions and raise the awareness level of what an automated, connected transport system could be and how it may affect different stakeholders and users. Furthermore, we need to improve the ability for actions - how to influence or pro-actively shape solutions, and create values for the society.

The intention of the program is to pave the way for an automated, connected transport system which leads to a new approach to mobility. We have a radical shift ahead of us; in just a few years' time there will be entirely new mobility business models enabling sustainable cities and sustainable transportation of people and goods.

Automated transport systems include, essentially all forms of transportation – private journeys, public and freight transport. Various modes of transport are more and more mixed to provide an optimal journey. New, smart solutions also enable flexible goods deliveries in cities. Large areas that are currently used for parking will become available for other activities.

Although Sweden has a tradition of systems thinking and excellent collaboration between industry, academia and government, the transformation to a new transportation system implies new collaborative challenges. Urban planning in a wide perspective will be heavily affected, new areas of

technology will be integrated with the traditional disciplines and digitalization will be a game changer. Laws, policies and standards will be affected and need to be renewed. No actors in the system can handle or grasp the whole issue by themselves. This calls for new tools for analysis and communication, smart demonstrators and pilots of not only technology but also methods, policies and values.

Amidst the challenges, we find the users – individuals, companies, organisations, cities and regions that need or desire mobility. Solutions which create value for the users will be the ones "surviving" in the transition to the new era of autonomous driving.

To address these issues, this project within Drive Sweden was initiated and co-creation lab was used as a method where we:

1. Start from a user/city planner perspective to explore how the automated transport system can be an answer to the needs of the urban citizens. How could an automated transport system, designed in collaboration with city planners and other stakeholders, create value for the city?

2. Explore a method to facilitate the collaborative innovation between individuals with very different backgrounds.

3. Raise awareness of the topic of AD and identify competence gaps that need to be addressed by Drive Sweden.

When Drive Sweden started, it built upon and interconnected earlier projects and initiatives, some of which were completed and others ongoing. These provide important input to the discussions in this particular project. For instance, the Drive Me project in Gothenburg and the Bus-project in Kista City feed practical substance to new ideas. Overall, the intention is to open up for more perspectives and experiences.

CO-CREATION LAB AND
AUTONOMOUS DRIVE

Autonomous vehicles have the potential to create entirely new transport systems and be a part of Mobility As A Service. There is an extreme interest for the new technology, amongst vehicle industry as well as the IT industry. Tests and demonstrations all over the world show promising results. However, now is the time to also include the mobility users as well as the cities as environments for the autonomous transport systems.

Globally, 54% of the world's population lives in urban areas today, and this trend is expected to continue. However, with the speed and scale of urbanization come challenges such as increased traffic, congestion, poor air quality, health issues, climate change and climate adaptation, segregation and inequitable living conditions. Many of the challenges are linked to transport systems and infrastructure.

So far, discussions and projects concerning autonomous vehicles have mainly been related to technology, technical systems, internet services, law and legislation. There is none or very little material about how autonomous vehicles affect the city's structures, traffic, environment, city life and people's everyday lives.

A great deal of understanding and unity is needed to address the urban challenges and explore how autonomous transport systems can help solve these challenges. The complex systems of the city have many possible solutions to its challenges, autonomous vehicles can both solve and exacerbate the problems depending on the involved players' ability to dialogue and analyse.

The Co-creation Lab method has been selected as the tool in this project in order to:

- Achieve acceptance of the new technologies

- Support the establishment of a common view and an increased understanding for the interaction between vehicles, IT systems and urban planning.

- Identify gaps in knowledge and skills, through usage of SWOT or GAP analyses.

- Facilitate collaboration between different actors and around concrete challenges.

- Ensure continuation of work and initiation of project proposals.

The backbone of the Co-creation Lab method are workshops, which in this case were devoted to four specific city challenges. They were performed in four distinct exercises with around 25-30 participants per session in the first three and around 15 in the fourth workshop. The groups were broad, with people from industry and academia as well as city authorities and other public services. The different workshops were conducted at different occasions and for three urban areas which represent distinct types of urban environments along with one workshop addressing the impact on urban planning caused by the advent of AD in Gothenburg.

IDEAS

In each workshop, the participants co-created ideas on how AD can bring value to the specific urban areas addressed in the workshops, while contributing to solving the current challenges. The ideas created are impressive but it has to be acknowledged that the purpose was not to create ideas for implementation but to explore hidden values and to identify the competence gaps to free them. To actually move towards implementation or even evaluation of the ideas, they have to be handled in another project proposal in due order.

THE CO-CREATION RECIPE

The four different workshops and the specific challenges addressed were the following:

- **A multi modal transportation hub with access to the archipelago.**

  Saltholmen is a transportation node in the outskirts of Gothenburg city which is connected to the southern archipelago. Many people have Saltholmen as a point of departure; people living in Saltholmen and the southern archipelago, ferry passengers, boat owners, etc. Furthermore, the traffic- and parking situation at Saltholmen has been strained for a long time. In the summer, the number of visitors to the archipelago also drastically increases. There are many traffic related issues to solve. Can autonomous vehicles become part of the solution to the traffic problems in Saltholmen?

- **Spatial integration in a diverse campus and science park.**

  Kista City is one of Stockholm's most rapidly expansive districts. Transformation is taking place; from business district to a mixed city district integrating residents, students, researchers, entrepreneurs, employees, shoppers, visitors etc. At the same time, accessibility should increase but without further strain on the region's transport and traffic system. Can autonomous vehicles become part of the solution to the accessibility challenge in Kista City? And how can such a possible development be utilized in the best way?

- **Transport of goods and people in a new compact city district.**

  Frihamnen is within the former harbour district in Gothenburg city. It is still quite undeveloped and a part of the River City - one of the largest urban development projects in Scandinavia. The plan comprises 15 000 new dwellings and an equal number of workplaces, including schools, preschools, hospitals, parks, public transport etc. It will be a compact city district with the proximity to public transport, service and trade being a prerequisite for a daily life without a car. Smart sustainable transport for both goods and people is also a prerequisite for success. How can autonomous vehicles play a role in future mobility in Frihamnen?

- **Implications on urban planning with the advent of AD.**

  The City planning office in Gothenburg is currently developing an in depth comprehensive plan of the central parts of the city, and with a focus, amongst others, on transportation systems. A special study will also be carried out with focus on AD, to emphasise the opportunities of these new technologies for urban development but also to identify what is needed for achieving the benefits for the city and the community. In a future with autonomous vehicles, do we have to plan the cities in a different way? Will there be new conflicts of interest? New opportunities for land use? A new, totally different urban landscape? Fewer parking spaces? How can we plan for a future of autonomous vehicles when we do not really know what this means?

By now, you may ask yourself what does co-creation actually mean and why is it so useful for workshops? The co-creation methodology is based on the fact that new knowledge and insights are generated when bringing together people from various relevant disciplines, and through creative and collaborative methods inspire them to discuss and come up with new ideas or concepts. In recent years, co-creation methods have been increasingly recognised as efficient and relevant tools for generating new ideas and solutions. Further, it has been acknowledged that co-creation processes lead to more relevant products and services being generated faster, and the main reason for that is by bringing together stakeholders from various backgrounds and knowledges [1]. The transdisciplinary approach is not only about connecting various disciplines but it can also be seen as a way to bring together society, business and academia with the aim of generating ideas which are more likely to meet the market needs in an appropriate way. This has been the motivation for using a co-creation methodology in the Drive Sweden project; involving stakeholders from various backgrounds with connections to the specific geographical areas.

Preparing a co-creation workshop is a co-creative activity in itself, as inputs from others outside the organizers' discipline and competence is often necessary. In this case the workshop facilitators have been employees from Chalmers University with experience in running co-creation workshops where their own knowledge in sustainability and autonomous transport has evidentially been valuable for the creation of the workshops. Furthermore, input from other experts within urban development and autonomous transport has been essential, as well as the collaboration with the project team from Drive Sweden who has their desired outcomes of the series of workshops. Each workshop had its own preconditions and required its own co-creative process where all the involved parts could contribute with their knowledge and experiences to each workshop.

Part of the co-creation methodology is to enable the participants to think freely and be as creative as possible. This can be challenging when bringing together people from very different backgrounds who have never met before. It is important to try to prevent dominating personalities to take over the discussions as well as enable persons who are less likely to speak in groups, to get their ideas across. This can be done by starting the workshop session with exercises which do not allow for a lot of speaking and letting each person get their ideas presented to the rest of the group. In this series of workshops, we have used a method called Brain Writing which has been proven to be extremely useful and important both in idea generation and in setting and fostering group dynamics and communication (read more about the method in the next chapter).

The group work which usually follows a Brain Writing session encourages the participants to be creative and co-create new concepts or ideas together. The most basic material of a co-creation workshop is sketching tools such as paper, pens, clay, wood, cardboard, glue and computer programs. Having a wide diversity of material allows participants to choose the medium they are most comfortable with or excited about using. It also enables participants to explore the topic at hand from different points of view through mixed media.

[1] Hughes, T., 2014, Co-creation: moving towards a framework for creating innovation in the Triple Helix, Prometheus: Critical Studies in Innovation, 1-13

CO-CREATION USING THE BACKCASTING STEPS

In order to give our workshops a structure that could foster creativity to emerge, we framed them with the Backcasting steps. The steps stem from the Backcasting methodology that was used as the backbone of the workshops in order to be easily followed and understood by all the involved parts.

A LITTLE BIT ABOUT THEORY

Backcasting is a tool for strategic planning. In this context Backcasting means to start planning from a description of the requirements that should be met when the society has successfully become sustainable; then the planning process continues by linking today with tomorrow in a strategic way. The definition of Backcasting methodology is: 'Backcasting is a method in which the future desired conditions are envisioned and steps are then defined to attain those conditions, rather than to take steps that are merely a continuum of present methods extrapolated into the future'[2].

The methodology consists of four simple steps as it is shown in the figure[3]

Step 1 - Define criteria for sustainability:
A future vision is devised accompanied by sustainability criteria.

Step 2 - Describe the present state:
A full understanding of the current situation is achieved by describing the present state of the system or challenge at hand, in relation to the vision and criteria set in the previous step.

Step 3 - Design future sustainable solutions:
Solutions are designed to close the gaps that the tension between the present situation and the envisioned state has created.

Step 4 - Find strategies for sustainability:
The strategic key steps which can accommodate for the implementation of the designed solutions, are planned to ultimately pave the way towards achieving the desired future state.

In the Drive Sweden workshops, we followed the Backcasting steps. In each workshop session, a vision and criteria were given to the participants (Step 1) and then an urban challenge would be presented to them along with the description of the current state (Step 2). Subsequently, the participants were called to co-create solutions that could contribute to solving the given challenges (Step 3) and devise key strategic steps forward that could facilitate the implementation of their solutions (Step 4).

The following pages elaborate on the facilitation techniques and methods as well as the content provided to the participants to spark their creativity.

The backcasting methodology combined with co-creation was to a great extent inspired by the Challenge Lab process[4] that Spyros Ntemiris experienced through his Master thesis.

[2] Holmberg, J. and Robèrt, K.-H. 2000. Backcasting from Non-overlapping Sustainability Principles - A Framework for Strategic Planning. International Journal of Sustainable Development and World Ecology 7

[3] Holmberg, J. (1998). Backcasting: A Natural Step in Operationalising Sustainable Development. Greener Management International, 23, 30–51

[4] Holmberg, J. (2014). Transformative learning and leadership for a sustainable future: Challenge Lab at Chalmers University of Technology. In P. B. Corcoran, B. P. Hollingshead, H. Lotz-Sisitka, A. E. J. Wals, & J. P. Weakland (Eds.), Intergenerational learning and transformative leadership for sustainable futures (pp. 91–102). The Netherlands: Wageningen Academic Publishers. See also website: challengelab.org

1 Define criteria for sustainability

2017 2020 2030 2040 2050

VISION

PRESENT STATE

2 Describe the present state

4 Find strategies for sustainability

3 Design future sustainable solutions
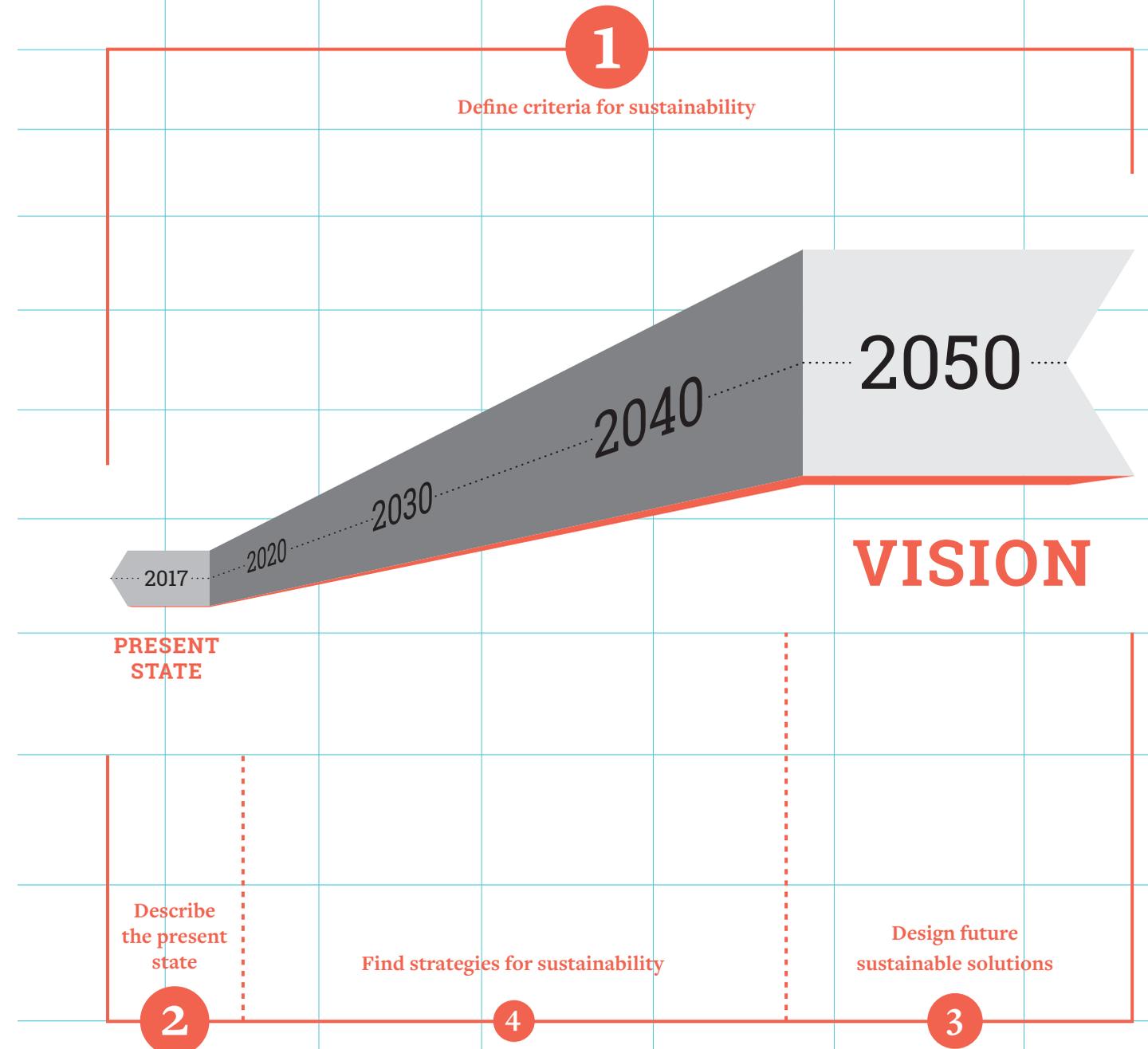
STEP 1 - DEFINE A VISION AND CRITERIA FOR SUSTAINABILITY

The vision for the future of the transport system is expressed in Drive Sweden as follows: Drive Sweden drives the evolution towards a transportation system based on automation, digitization and servitization; which creates a sustainable society and strengthens Swedish industry'. At the same time, the Drive Sweden Program aims at aligning with the National Transportation Goals and Agenda 2030 from Swedish national Government. Therefore, the common umbrella vision that was used for the facilitation of the workshops was taken from the National Transportation Goals and Agenda 2030. The criteria were formed by parallelizing the Functional and Consideration goals from the Swedish National Transport Strategy.

As a result, the vision and criteria for the first three workshops were given by the facilitation team as shown in the figure.

"The goal for transport is to ensure the economic efficiency and long-term sustainability of transport provision for citizens and enterprise throughout Sweden."

Reference: Objectives for transport and infrastructure
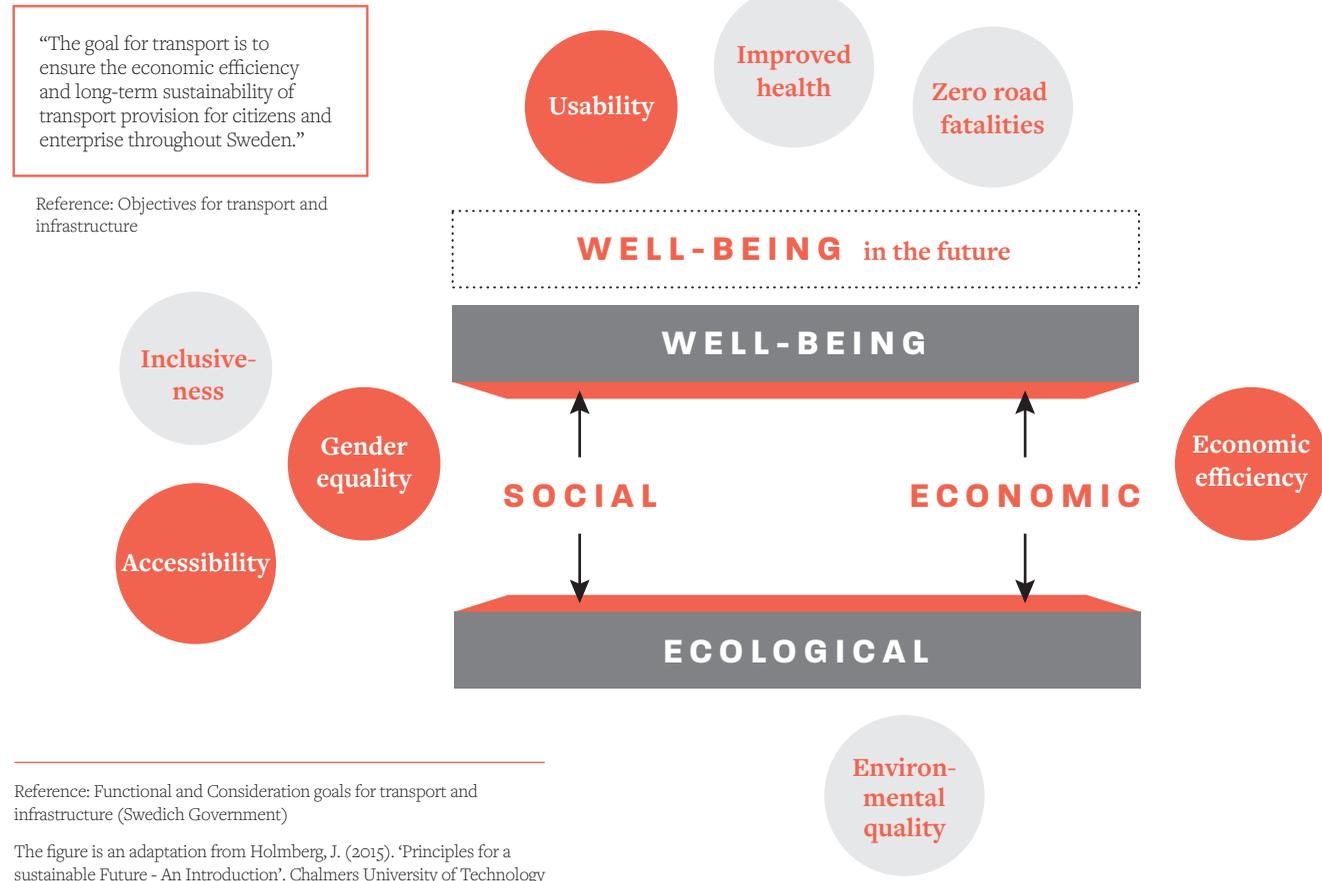
Reference: Functional and Consideration goals for transport and infrastructure (Swedish Government)

The figure is an adaptation from Holmberg, J. (2015). 'Principles for a sustainable Future - An Introduction'. Chalmers University of Technology

STEP 2 – DESCRIBE THE PRESENT STATE

The main topic for the series of the workshops was `How do Autonomous transport solutions bring value to the cities'. To keep it on a practical level, each of the co-creation workshops were dedicated on one specific and concrete challenge that the city is facing and aimed at exploring how autonomous transport can provide solutions to these. Already from the preparation phase, the project leaders and the facilitators had come up with a wide range of urban challenges that Gothenburg and Stockholm face. Topics of challenges would include:

- Land and sea connections
- Freight transport to and from the port
- Equality in mobility and need for integration
- Requirements and desires by the City
- Availability of transport
- Accessibility to all areas
- Public transport to suburban and outlying areas
- Implications on urban planning
- Creating just and liveable cities

In each of the workshops the participants were given explicit presentations about the challenges by relevant experts from academia, private and public sector. Effort was made for the information to be concise, but elaborate enough for them to be able to grasp the problem at hand in very short time.

STEP 3 - DESIGN FUTURE SUSTAINABLE SOLUTIONS

In this step focus would shift, from the facilitators and presenters, to the participants. After being aware of the desired future state (Step 1) but also of the current problematic at hand (Step 2), they were called to create concepts consisting of either a project idea, policies, business model or collaboration model etc.

To incentivize creativity and involve as many participants as possible, ideation techniques were employed, such as Brain Writing. In addition, to enhance communication and co-creation, interactive dialogues and presentations would take place as well as specific exercises such as the World Café method.

Brain Writing:

Brain Writing is an idea-generating technique that involves everyone in a group activity. The participants silently write down their ideas first and then proceed to engage in a group discussion. It differentiates from brainstorming since it is more inclusive, allowing all participants to get their views read by everyone in the group, hence the group work is not dominated by the loud and extrovert participants. The exercise is designed to be an intensive and rapid generation of views about the topic, where deep reflections are not the focus.
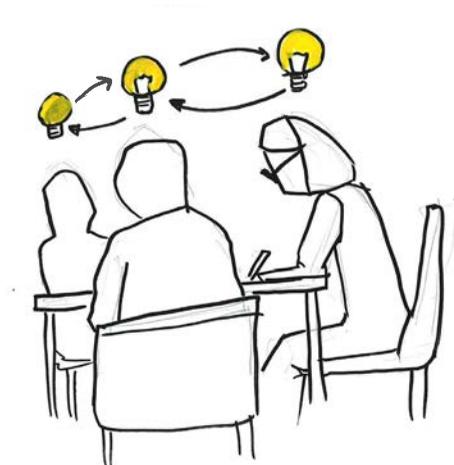
The method is simple and easy to communicate. Once the participants are divided into groups, each group member receives one Brain Writing sheet with a question guide and some inspiration topics which are followed by empty spaces for their input. They are called to fill in their own ideas, questions or comments related to the topic and then hand it out to the person next to them. Subsequently, the next person adds ideas, question or comments building up on the initial ideas generated on the sheet. This whole process is timed in successive rounds of increasing duration. Eventually all group members have had the chance to read and interact with their fellow group members thoughts on the issue at hand and they are now ready to co-create in a following group discussions.


World Café

The World Café method provides an effective and flexible format for hosting large group dialogues and to ensure co-creation, where the participants can contribute to all topics of the workshop as much as possible.

The participants are divided into small groups. Each group is seated around a table and have an internal discussion on a specific topic. They are given a limited amount of time for their discussions and when the time is up, each group decides on leaving one person as the table host for the next round and the rest of the group moves to a new table. The host welcomes the new group and briefly tells them what was discussed in the previous round. This process continues until all the groups have rotated and visited all tables and thereby discussed each topic. After the rotation, the groups return to their initial table where the table host summarizes the discussions which have passed. After the small group dialogues, individuals, but most importantly the table hosts, share insights and other results from the conversations to the rest of the participants and facilitators in an open group discussion.

⏰ **5 minutes per round**

🔄 **groups rotating**

👤 **one person stays to pitch the idea**
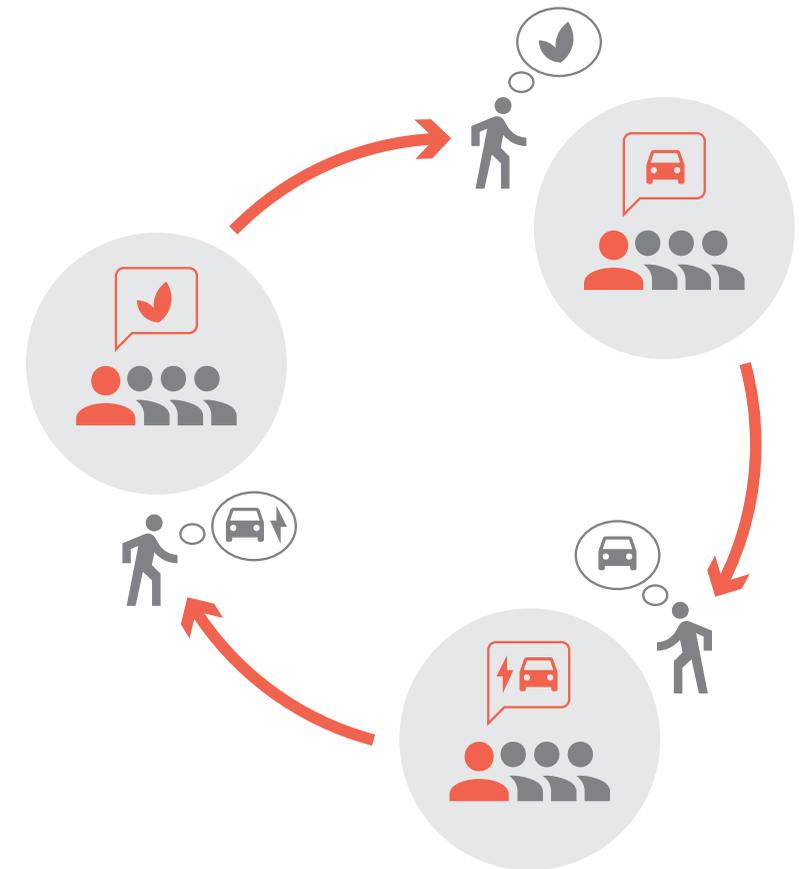
Design Thinking

Design thinking is an approach to generate ideas and solutions for given challenges and is applicable on different levels, depending on how and where in the system the challenge is encountered. The levels of intervention for design modelling are the societal, socio-technical, product-service and product-technology system as their mutual relationship is brilliantly visualised with the Multilevel Design Model, illustrated in this figure[5].

> **"Remember that design thinking is a personal journey and will be different for each person and project"**
>
> Örjan Söderberg[6]

	Reflection	Analysis	Synthesis	Experience
Societal System	S1 – Societal Problem	S2 Preferences Regarding Social Order	S3 Vision Development	S4 New Societal Situation
Socio-Technical System	R1 – System Deficiency	R2 Dominant Interpretive Framework	R3 System Design Process	R4 New Socio-Technical System
Product-Service System	Q1 – Functional Problem	Q2 Functional Requirements	Q3 Product-Service Design	Q4 New Product-Service System
Product-Technology System	P1 – Operational Problem	P2 Program of Demands	P3 Product Design	P4 New Product

[5]Joore, P. and H. Brezet, 2014. A Multilevel Design Model – The Mutual Relationship between Product-Service System Development and Societal Change Processes. Journal of Cleaner Production.

[6]Söderberg, Ö. (2014). 'Design Thinking'. Challenge Lab Compendium. Chalmers University of Technology.

These are the three steps in Design thinking according to the model:

1. **Reflection:** The starting position for a design process or a problem-solving process is the result of a reflection on the current existing situation which can be a description of a problem or even the identification of an opportunity for a potential future situation.

2. **Analysis:** The problem is interpreted and a new desired situation is envisioned in an abstract manner, providing the requirements without concrete solutions or concepts.

3. **Synthesis:** Concrete idea generation and development takes place resulting in a described new possible solution.

The design thinking approach was applied in the workshops as a theoretical background in order to get the desired outcomes from Step 3. The first two exercises in step 3 (Brain Writing and World Café) were merely used as tools to prepare the participants for the design thinking exercise where the actual result of Step 3 is created. In practice, it was used to guide the participants when they were called to design solutions. This was facilitated through the material given to the participants (in this case paper sheets with guidelines and questions), which followed the logic of design thinking even though such a methodology was never presented to them.

Finally, the participants designed autonomous transport solutions that can solve the given challenge and achieve the vision by abiding to the criteria. After the synthesis of their concept, they were called to test and evaluate it in a SWOT analysis format.

STEP 4 - FIND STRATEGIES FOR SUSTAINABILITY

In the last step, after generating their chosen concept of an autonomous transport system, the participants were called to strategize its implementation in the future. Hence, they were called to place the rough time of the concept implementation on the timeline of the Backcasting arrow. Moreover, in order to incentivize a strategic thinking to support the implementation, they were asked the three following questions.

- What are your long-term actions to realise the concept?

- What are your short-term actions to realise the concept?

- What synergies or collaborations do you need to have in place, to realise the concept?

THE WORKSHOPS

On the following pages you can find out about the different workshops; their specific challenges and contexts along with some glimpses of their visionary ideas on how to address the issues in each area. A few of the ideas have been picked out and placed on a Backcasting timeline, in order to give you an idea of how the road map towards a sustainable future with AD could potentially look like. The drawings are interpretations of the groups concept ideas and discussions, made by the graphic facilitator (Afra Noubarzadeh) who were present in two of the workshops with city district focus.

A multi modal transportation hub with access to the archipelago

CONTEXT: Saltholmen is an area in Gothenburg which connects the southern archipelago with the rest of the city. Many means of transport meet there; including ferries, private boats, bikes, goods transports etc. In the summertime, it is especially intense as the number of commuters through Saltholmen increases drastically.

CHALLENGE: Saltholmen faces a diverse challenge of accessibility in accommodating various transport modes as well as parking and storage services. The main problems identified in this area are parking constraints, limited access especially in the summer time, congestion and noise. Key question: How can Autonomous transport solutions bring value and alleviate these challenges?

"Could we have goods delivery at night?"
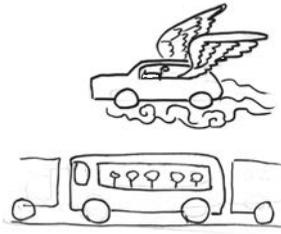
"I am impressed by the power that exists when we assemble different people, we might actually get to do things that make a difference!"

"If driving an AV becomes cool, then traffic jams will increase."
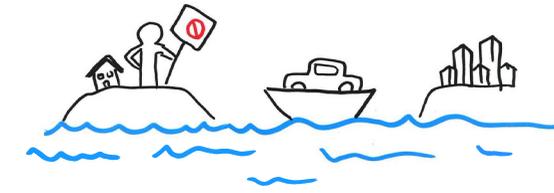
"How do we achieve continuous connectivity between people, vehicles and goods?"

"I am curious, about the AD sector – want to learn more, see what opportunities AD and public transport can provide."

"How much private data am I, as a person, willing to share?"

Public-transport
Cheap-freight-transport
Space
Convenient
Sustainable
Opportunities
Challenge
Hype
Future
Possibilities
Hackers
Data
Safety
No-parking
Hard-work
Drones
Flexibility
Small-vehicles
Humans
Threat
Car-ownership
Changing-the-world
Society-development
Innovation
Entertainment
Satisfy-needs
User-needs
Integrity
Freedom
Hollywood
Intuition
Pods
Pace

"Can you use two lanes in the same direction at peak times?"
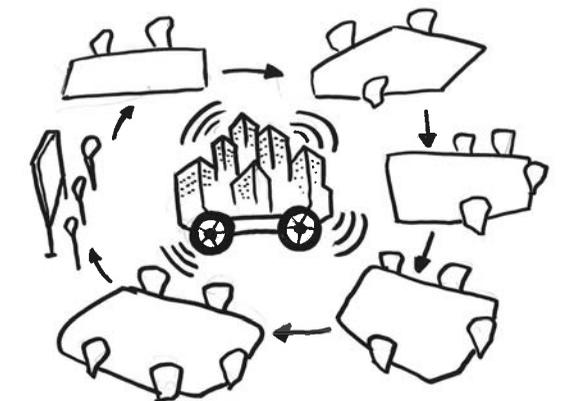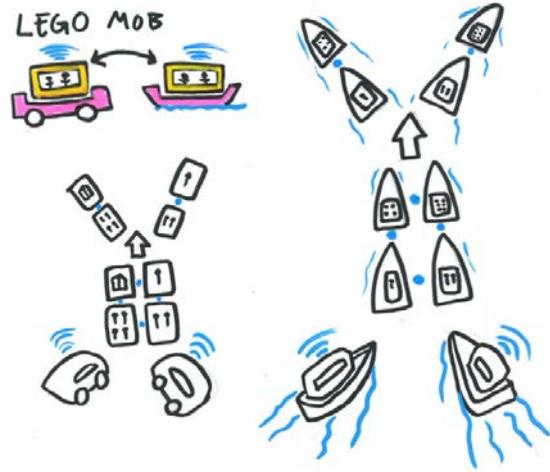
LEGO MOB

LEGO MOB

Concept description: Shared autonomous hybrid (land and water) vehicles for goods and people transport, with vehicle hub and parking in Kungssten:

- Modular vehicles
- Incentivised ride sharing
- On-demand service
- Vehicles for both land and water
- Platooning possibility
- Valet parking further away

Value creation:

- Space efficiency
- Mobility for ones who are not able/willing to drive
- More options of transport modes
- Seamless transportation

Realising time: 2030

LÅNGEDRAGSLOOPEN

Concept description: An innovative traffic design with integrated multimodal mobility adjusted to the advent of AVs, a traffic passing through Saltholmen without stopping:

- Loop design
- No idle vehicles: Continuous pick-up and drop-off of passengers and/or goods.
- Parking relocated to less attractive land

Value creation:

- Resource efficient
- Increased safety
- Continuous availability

Realising time: 2019

LÅNGEDRAGSLOOPEN
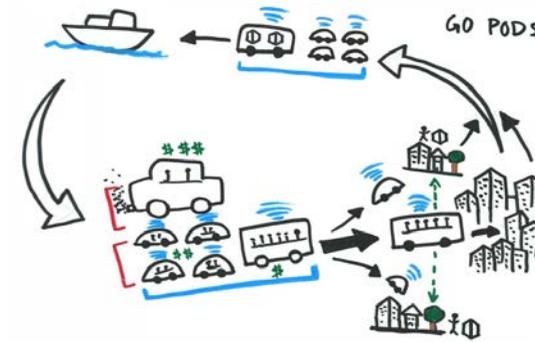
GO PODS

Concept description: Shared autonomous electric pods for goods and people transport to requested specific destinations.

- No idleness of vehicles
- Dimensions: 1.8x4.5 m
- Capacity of driving on the width dimension (space efficient)
- Platooning possibility
- Customization possibilities to meet special needs
- Minimal need for parking space (0.1 parking norm)

Value creation:

- More dedicated space for people
- Safer transport
- Less vehicles
- High asset efficiency through sharing

Realising time: 2030

FLEX ALLA

Concept description: A new transport hub system at Kungsten or Haga with autonomous shuttles and ferries, banning private cars from entering Saltholmen area:

- Parking in Kungssten.
- Autonomous ferries connected with AVs to Saltholmen
- Autonomous shuttles for the last mile from the hub.
- Phase out of trams from Saltholmen - Final stop at Kungssten

Value creation:

Increased options for transport modes and destinations

- Less noise
- Accessible for everyone
- Reallocation of parking space

Realising time: 2026

GO PODS

ELEVATOR ANYBODY

Concept description: Integrated autonomous transport system addressing current issues of parking and noise; the final tram stop and parking is moved to Långedrag:

- Shuttles, pods and moving walkways
- Different options depending on needs and wants
- Transport within the area as well as connecting to the islands and the city centre
- Multi-storey automated parking facilities
- A coupled mobile-app and weather-protected bike lane

Value creation:

- Comfort for users
- Public owned land increases in value
- Reduced noise
- Accessible for everyone

Realising time: 2023

FLEX ALLA

ELEVATOR ANYBODY

WORKSHOP #2 - KISTA CITY

Spatial integration in a diverse campus and science park

CONTEXT: Kista City is a suburban area of Stockholm, it is an urban development hub for "a smart and connected world". It is an innovation hub and a meeting place for students, employees, researchers, entrepreneurs, shoppers, visitors and residents.

CHALLENGE: Kista is growing fast in residencies, people, business development and urban space, on an annual basis. Therefore, Kista faces the challenges of accessibility and spatial integration of diversity. Key question: How can autonomous transport solutions contribute in alleviating accessibility and spatial integration?

"Punctuality in the system is more important than speed."

"I can use some of this to work on. I feel very optimistic. I take all these ideas with me to study further."

"Next step can it be brain connectivity?"
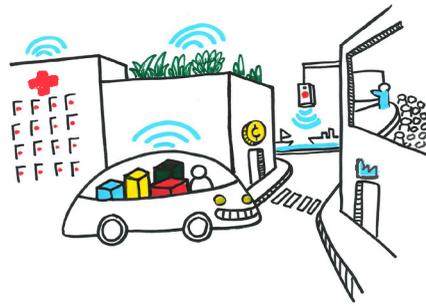
"I feel inspired."
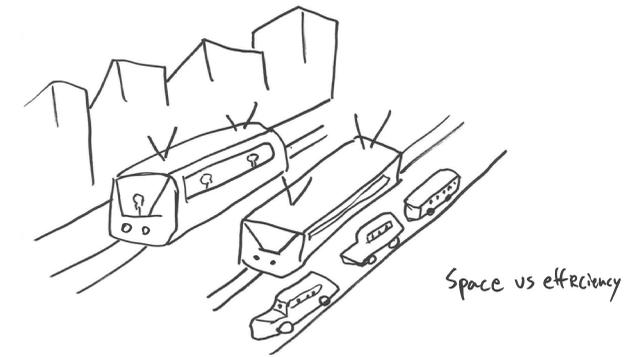
"We can achieve more freedom with autonomous drive but it also requires more responsibility"
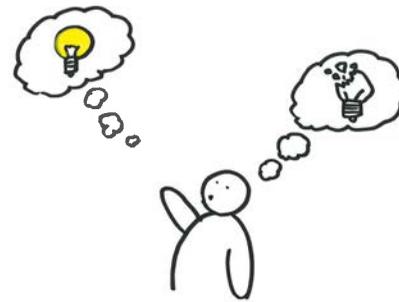
"It has been cool to spend the whole day here with so many inspiring people – a happy feeling!"
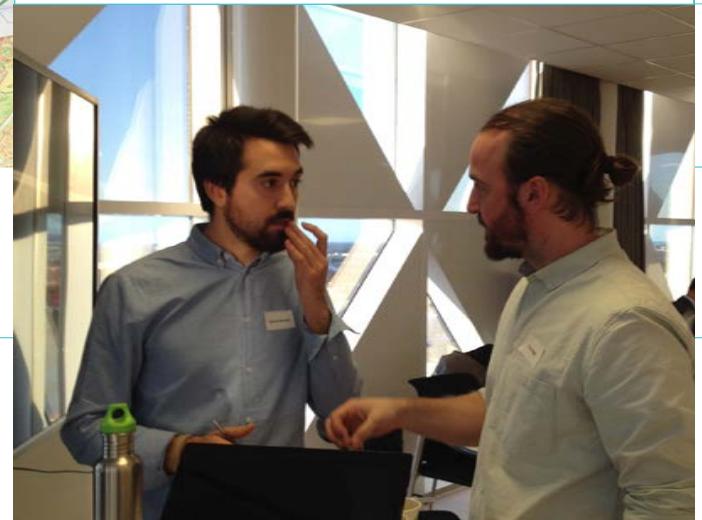
"No stopping, no parking"

Space vs efficiency
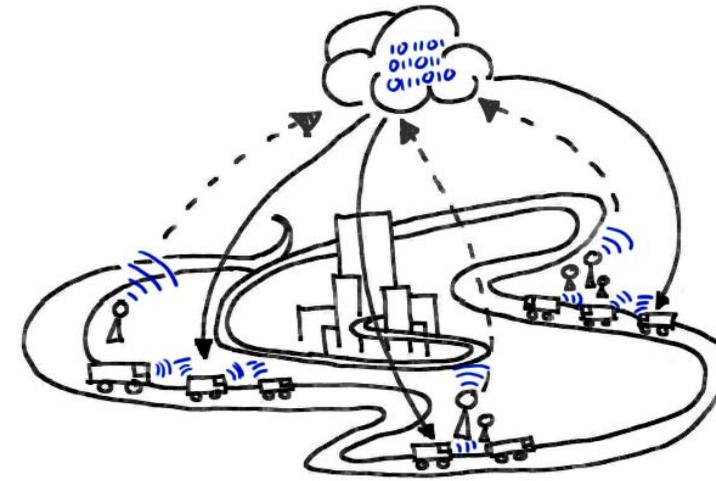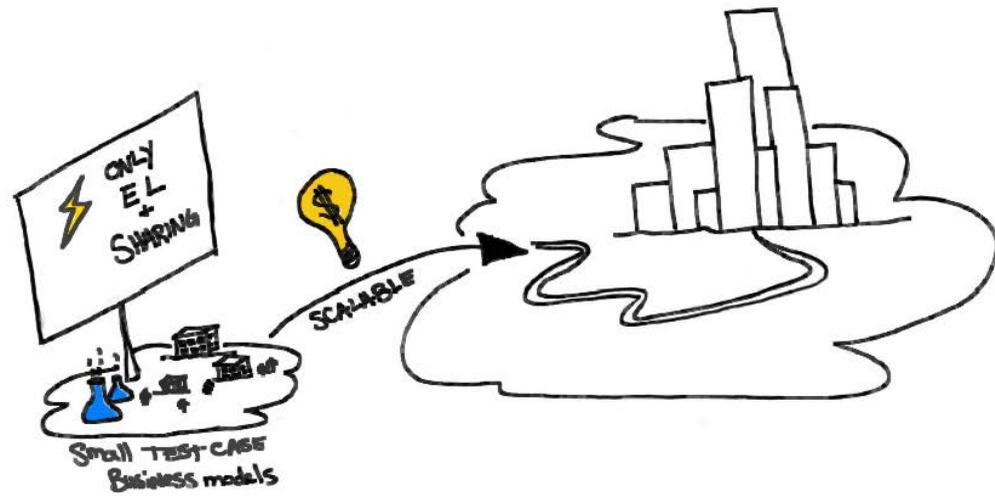
KISTA ACCESS

Concept description: On-demand transport platform with combinations of collective transport and on-demand individual AD solutions:

- High speed pods connecting commuter hubs surrounding Kista
- Different service levels available
- Integrated goods transportation

Value creation:

- Reduced congestion
- Improved travel comfort
- Short travel times

Realising time: 2035

SMART CITY INTEGRATED PLATFORM

Concept description: Digital platform for Mobility As A Service (MAAS) including a scalable business model with focus on sustainable transport:

- Involving local actors from industry, academia and public sector
- Transport solutions within, from and to Kista City
- Incentives for ride sharing, bicycling and walking

Value creation:

- Potential meeting place for social groups
- Interconnectivity for the user
- Strengthened collaboration between local actors
- Shifting mind-sets towards servitization[7] of products

Realising time: 2019

KISTA CONNECT COMMUTE

Concept description: Political and financial incentives for implementation of electric autonomous vehicles:

- Free parking and charging
- Shared electric cars
- Housing companies and real estate actors are engaged
- Autonomous pod system connecting to surrounding areas

Value creation:

- Collaboration between actors of different sectors
- Increased accessibility within and to the area
- Increased land value

Realising time: 2019

NON-STOP

Concept description: Policy package and incentives for safe, sustainable and attractive automated transport solutions:

- Dynamic prizing based on geographic zoning and peak times
- No parking possibilities
- Seamless solutions
- Incentives for ride sharing

Value creation:

- Green liveable cities
- Accessible for all
- Efficient use of infrastructure
- Travel time and cost is predictable

Realising time: 2025

[7]Servitization: The servitization of products describes the strategy of creating value for manufacturing firms by adding services to products or even replacing a product with a service.

WORKSHOP #3 - FRIHAMNEN

Transport of goods and people in a new compact city district

CONTEXT: Frihamnen is an area on the banks of Göta river in Gothenburg which used to be part of Gothenburg port. Now the intention is to reclaim the area and transform it into a modern and sustainable city district with the goals of decreasing the parking areas and car circulation drastically, increase walking, cycling and use of public transport as well as the number of residencies and workplaces. It also includes ambitions of creating optimized systems for waste collection, recycling and goods delivery.

CHALLENGE: A special focus was given to goods management and waste collection. Drastic transformations in land use and activities in this area implies many challenges in themselves. Key question: How can Autonomous transport solutions contribute in reaching the goals set for Frihamnen?

"This workshop has shown that often it is better if we gather from different disciplines, backgrounds and industries. It has been very good discussions giving me insights I would not have received otherwise."

"We should not create more congestion e.g. too many small pods in the streets!"
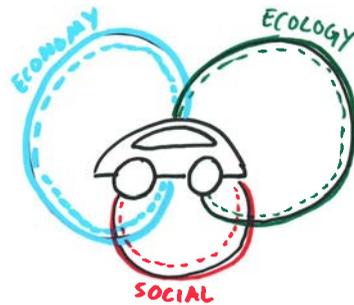
"There are many differences in the concepts here: Some on the macro-level others on the micro-level."

"I feel enthusiastic! Also drained and tired!"

"Waterways are highly important for transportation."

"Could we automate a shopping cart?"
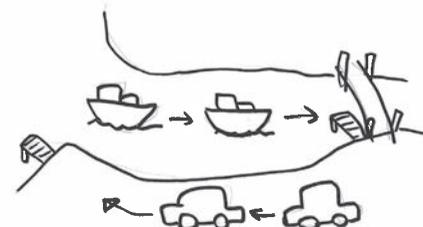
"AD is interesting but there will also be some problems and obstacles; we have to solve them!"

ONE-TWO-ONE

Concept description: Digital platform for a holistic integrated mobility system adapting to transport and delivery needs:

- Services for sharing vehicles
- Automated goods deliveries directly to home
- Transition to only autonomous and electric vehicles
- On-demand travel to requested locations
- Multiple uses for all vehicles

Value creation:

- Increased efficiency in use of vehicles and infrastructure
- Creation of new service jobs
- Increased travel comfort

Realising time: 2035
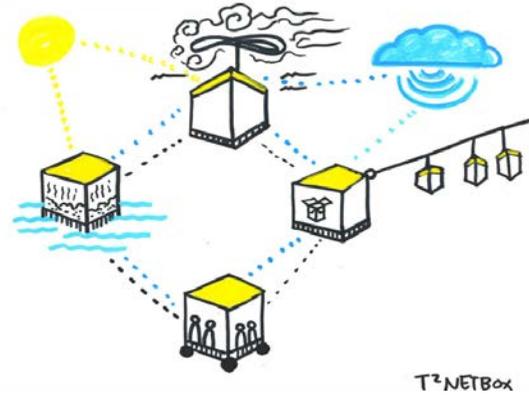
T²NETBOX

T2NETBOX

Concept description: A solar powered infrastructure of autonomous pods for circular transport of goods and people:

- The pods operate on water, land and air
- Standardized for waste and goods
- Autonomous loading of boxes
- Optimized traffic flow through app
- Compatible with post-system

Value creation:

- Covers a large area
- Innovative transformation of the post-system
- Accessible for everyone

Realising time: 2021

FLEXIBLE AMPHIBIOUS AUTONOMOUS VEHICLES

Concept description: Energy independent autonomous land and water based transport system which can connect or disconnect different parts to the vehicles, depending on the need and usage.

- For transport of people, waste and goods
- Docking station distributes goods to service points within the area
- Autonomous home delivery services
- Adaptable to type of load

Value creation:

- Revolutionizing the waste collection sector
- Self-autonomous local neighbourhoods
- More efficient and convenient goods delivery

Realising time: 2030
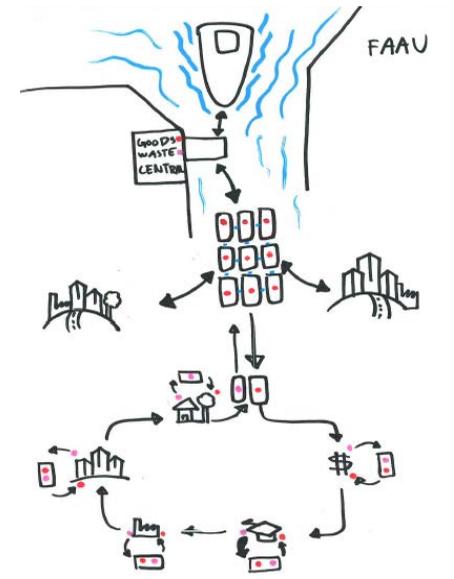
FAAU
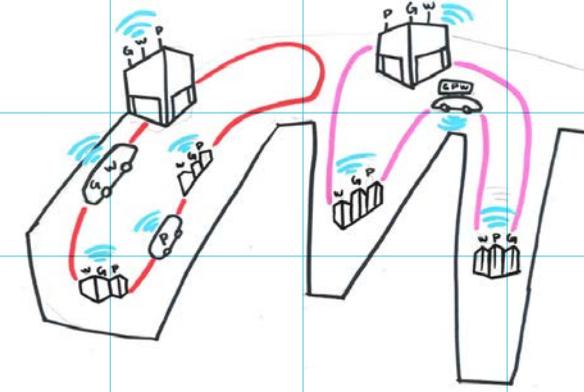
G+W+P AUTO

Concept description: A coordinated system of autonomous modular boxes designed for short distance transport of goods and waste from and to hubs:

- Connects to trams, buses or trucks
- The boxes travel on a loop within the area
- Picks up waste and drops off goods
- Delivery and waste services included in housing rents

Value creation:

- Saves people's time
- Cleaner cities
- Efficient use of vehicles and infrastructure

Realising time: 2020
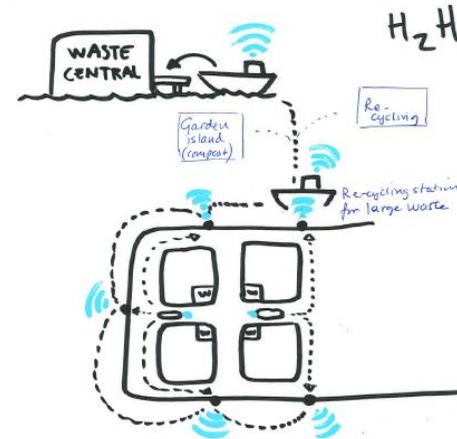
H2H

Concept description: Electric intelligent low-speed autonomous pods for on-demand waste collection, making use of waterways surrounding the area:

- Transport of people, waste and goods
- Small waste/charging hubs on land connecting to larger hub on water
- On-demand collection of waste

Value Creation:

- Decentralisation of waste collection
- Reduced noise
- Efficient land use

Realising time: 2023

BACKCASTING TIMELINE
Projects from the three workshops

● SALTHOLMEN   ● KISTA   ● FRIHAMNEN

H2H
Electric intelligent low-speed autonomous pods for on-demand waste collection, making use of waterways surrounding the area
2023

KISTA ACCESS
On-demand transport platform, combinations of collective transport and on-demand individual AD solutions.
2035

T2NETBOX
A solar powered infrastructure of autonomous pods for circular transport of goods and people.
2021

LEGO MOB
Shared autonomous hybrid mobs for goods and people transport.
2030

VISION

2050

2040

2030

PRESENT STATE

2020

2017

NON-STOP
Policy package and incentives for safe, sustainable and attractive automated transport solutions.
2025

FLEX ALLA
A new Transport Hub system at Kungsten/Haga with autonomous shuttles and ferries.
2026

Roadmap of ideas:

This timeline aims to give you an indication of how we could reach a possible sustainable future with implemented AD solutions in our cities. A few selected concept ideas generated in the three workshops in Frihamnen, Saltholmen and Kista City are placed on this Backcasting arrow, creating a conceptual roadmap which guides the way towards a sustainable city with integrated AD systems.

URBAN PLANNING WORKSHOP

Implications on urban planning with the advent of AD

CONTEXT: Point of departure in this workshop was that autonomous transport systems will be used in Gothenburg City in a not too distant future. The City planning office in Gothenburg is currently developing an in depth comprehensive plan for the central parts of the city, and with a focus, amongst others, on transportation systems. A special study will also be carried out with focus on AD, to emphasise the opportunities of these new technologies for urban development but also to identify what is needed for achieving the benefits for the city and the community. This workshop was one of the initiating activities in the special study for AD in Gothenburg.

CHALLENGE: In contrary to the previous three workshops, generation of concept ideas was not a tool for exploration in this workshop. Dialogues were in focus, in order to increase the understanding for what the advent of AD in Gothenburg could mean to the physical environment of the city but also to the community as a whole. The main challenge was to identify knowledge gaps and possible conflicts of interests within the scope of urban planning, which the advent of AD in Gothenburg could imply. One of the results from this workshop was an initiated dialogue within the working group of the in depth comprehensive plan, where an increased understanding of the challenges ahead was created. The more tangible results from this workshop are integrated in the following chapter as knowledge gaps. Key question: How can Gothenburg city's urban planners include the prospect of having AD in the future cities?a

> "The technical development and AD is coming, we just need to be prepared in the best way."

> "Can AD possibly cause larger gaps between societal groups? How can we make sure AD is available for all?"

Transformation On-demand parking Ignorance Potential Exciting Sharing transport safety city Futuristic opportunities taxis movies innovation New economy Goods Self-driving Efficient cars Freedom Complexity Scary planning
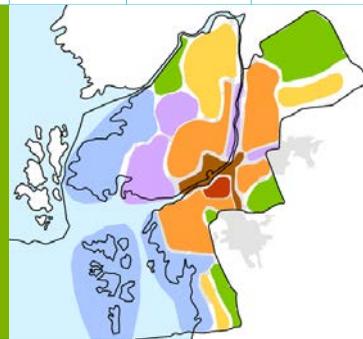
> "If AD will lead to reduced commerce in the city centre, what do we need the inner city for? "

LESSONS LEARNED

To give an idea of what it could actually imply for the society, the urban environment and city values if autonomous driving solutions were implemented in our cities, we have picked out the overall lessons learned from all the workshops. The first section treats identified knowledge gaps, i.e. what do we need to know and what abilities do we need in order to implement our ideas? The second part includes an overall SWOT-analysis of all the project ideas from the workshops. This is to help giving an overview of potential positive and negative effects of autonomous transport solutions, but also of the rebound effect that might occur if AD innovations are not managed properly.

KNOWLEDGE GAPS

Which knowledges, skills and abilities do we lack in order to handle the advent of autonomous transport systems in our cities? The four workshops have given us insights on existing as well as expected knowledge gaps that are necessary to overcome. The knowledge gaps are presented on the following page as they emerged from each confronted urban challenge, i.e. the four different workshops that represent four distinct urban challenges. The results are based on discussions at the workshops as well as analysis of the participants' produced material during the workshops. The ideas gathered manage to cover a great range of identified gaps currently encountered in relevant limited literature on autonomous transport.

When ideating new solutions in the workshops, it commonly emerged questions regarding the need for new business models when it comes to shared mobility. Autonomous transport is often considered highly connected with shared and multi-modal mobility models, which was very evident even here. Furthermore, heated discussions often started around concerns about cyber security and sharing private data from users in the future. Another recurring issue is the need to investigate further how interdisciplinary collaboration can be facilitated in order to accelerate the advent and the diffusion of autonomous transport solutions. In addition, an interesting question, especially with climate adaptation measures in the urban environments, is how cities like Gothenburg can take advantage of the waterways and integrate them in the current transport network by using autonomous technologies. Finally, questions were raised such as whether autonomous transport will contribute to amplifying the social inequalities or narrowing the gaps in the society in the future.

CHALLENGES

SALTHOLMEN

A multi modal transportation hub with access to the archipelago

- There is a great need for business models for shared mobility - Does it work with private ownership?

- Politicians need more information to understand where AD development stands - How do we maintain a continuous information flow?

- How do we achieve all-inclusive connectivity among people, cars and goods?

- How do we shield highly digitalised systems against terrorism? - Cyber security issues etc.

- How much data do people and users want to share in the future?

- How do we achieve scalability for the autonomous transport innovation projects?

KISTA CITY

Spatial integration in a diverse campus and science park

- How do we achieve continuous collaboration between public and private sector in mobility solutions?

- Standardization is important. How do we work towards standardization already in the early stages?

- An important trade-off: How do we achieve punctuality over speed in the transportation system?

- How do we achieve the last mile service on the very local level?

- We need to know more about payment schemes and business models in intermodal mobility platforms.

- There is a need for larger share and exchange of information flows among users and involved actors. E.g. for making sharing models of transport successful.

FRIHAMNEN

Transport of goods and people in a new compact city district

- We need investigation of automation of the waste management centres or in the housing infrastructure instead of adding equipment on pods/collectors. E.g. unmanned delivery of goods or waste at night.

- How do we use waterways more effectively? – We need investigation on how to transfer waste collection to the sea and take the noise away from neighbourhoods.

- We lack the knowledge to standardize freight containers that can handle both goods and waste to enable automation at all stages.

- How do we avoid creating more congestion? We need to investigate mono-rail system solutions e.g. only for goods, or only for waste.

- There is a need for investigation of airborne delivery of goods and waste.

- Today we need to sort waste. Will it be the same in the future as well? How do the trends develop?

- Can the waste stay and be used within the area? Can we have local circular exchange of waste? E.g.: symbiosis with farms and urban agriculture.

- Need for legislation reform around combined transfer of waste, people and goods.

- Do we run the risk of eliminating our physical exercise down to health-hazardous levels, by making transport more comfortable and accessible?

GOTHENBURG CITY

Implications on urban planning with the advent of AD

- How do cities become proactive in their development criteria and requirements so that all the involved actors know in advance and act accordingly? - How do we engage the city politicians and the city planners in the early stages?

- Need for investigating potential need for additional infrastructure.

- What is the best way to benefit from the freed space in the future cities?

- What will AD mean to our community? What about equality? Can AD cause larger gaps between groups in society? How can AD be available for all?

- What is the goal? Personal mobility freedom or the best for the community/environment?

- What are the risks with having more AD?

- How do we plan and design decentralized parking lots for autonomous vehicles?

- Are people willing to lend out their personal car during idle time?

- What about meeting points in the city? Today commerce is an important role in the urban life (e.g. Shopping malls in the city centre). If commerce is reducing, what do we need the inner city for? Will we continue using the inner city for work (offices etc.)?

SWOT ANALYSIS

The participants were asked to evaluate their own project ideas using SWOT-analyses during the three workshops focused on specific urban districts. Here we have gathered the most notable strengths, weaknesses, threats and opportunities which the concept ideas would contain if they were developed further. This gives insight to what the advent of autonomous transport could imply in terms of possible positive and negative effects on the society and the urban environments. They are presented based on the three respective challenges. This content is a result from the participants' produced material as well as observations by the facilitators and the project leaders at the workshops.

STRENGTHS (advantages, unique characteristics)

SALTHOLMEN
- Space efficiency
- Energy and noise reduction – if electric
- Phase out noisy trams
- Reduce traffic
- User friendly solutions
- Higher accessibility

KISTA
- Reduced congestion
- Improved traffic safety
- Improved accessibility
- Better use of existing infrastructure
- Less vehicles and less emissions

FRIHAMNEN
- Taking advantage of waterways
- Reduced congestion on land
- Higher accessibility
- Automation of waste management centres instead of adding equipment on pods/ collectors.

WEAKNESSES (disadvantages, potential improvements, avoidances)

SALTHOLMEN
- Too many swaps and intermissions with multimodal mobility - may cause frustration
- Fear that autonomous vehicles might increase the social division and inequalities
- Conflicting parking policies
- Potential risk for higher congestion with single or zero-occupancy autonomous vehicles
- High costs for autonomous shuttles

KISTA
- Attractive business models are needed for users, operators and investors
- Critical mass of users is not there (proof of concepts needed)
- Dependence on strong collaboration between private and public actors

FRIHAMNEN
- Empty or single occupancy for vehicles/pods/shuttles
- High noise levels for waste collection

OPPORTUNITIES (trends to benefit from, potential advantages)

SALTHOLMEN
- IT and cloud integration technologies
- Possibility of combination with decentralized parking – Better use of urban space
- Puts city authorities on the map of future innovation
- Solutions with Mobility As A Service mean business opportunities for operators

KISTA
- People's mind-set on shared economy is transforming the car industry to be service/mobility providers.
- Sweden could deliver pioneering solutions on the subject
- Use the public spaces differently

FRIHAMNEN
- New service-oriented jobs
- Multiple purposes for vehicles
- Increased versatility. - Pods that can circulate both on land and sea.

THREATS (obstacles, other competitors)

SALTHOLMEN
- High costs - low investments
- Legislation hinders for inclusion of autonomous transport
- Increased or unchanged number of vehicles if peoples traveling patterns remains unchanged.

KISTA
- The desire to have privacy in your own car is still too strong for sharing models to be diffused - Private ownership is also seen as most convenient
- Several stakeholders have to be involved in early stages

FRIHAMNEN
- Increased convenience might increase the amount of transport
- When implementing autonomous waste collectors, residents must strictly sort their waste.

REFLECTIONS AND RECOMMENDATIONS

Anna Nilsson-Ehle
Anna Svensson

REFLECTIONS AND IDEAS FOR THE FUTURE

The method used in this project – co-creation workshops, has proven to be useful for the challenges we set out to explore. The question if and how autonomous transport systems create value for cities require the open-minded engagement of many perspectives. The ideas created in the workshops are impressive but of course merely sketches. The actual purpose was not to create ideas for implementation but to create ideas to explore hidden values and to identify the competence gaps to free them.

The objectives for the project were

- Get a general understanding of both city challenges and possibilities of AD

- Communicate, raise awareness and build competence and consensus around autonomous vehicles/systems and urban planning

- Increase collaboration between actors from industry (automotive, IT, etc.) and the city and traffic planning

- Create input for continuation of work and initiation of project proposals

The objectives are quite generic but the innovative approach has been a different starting point than usual for the technology driven development. The workshops are centered around the cities' needs of growth, renewal and sustainable development. The key question is whether new technologies for automation will enable, support or hinder these aspirations. The approach is meant to open up for new perspectives and attract a broader group of professionals, beyond the already active engineers from the automotive community.

A successful choice was to use graphic facilitation in the workshops. It helped participants with different professional languages to communicate and thus it was a good way to strengthen the collaboration within the groups. It was also important in order to communicate the ideas which emerged from the discussions. The nature of the sketches portrays the level of elaboration of the ideas and communicate in themselves areas to explore or knowledge gaps to bridge.

The outcome of a workshop is solely the result of the people who are present. The project ideas are what they are do due to the fact that people from various backgrounds meet and co-create by contributing with their own knowledge and experiences. It is important to underline that the participants were not invited to comment on an existing idea or proposal, their results emerged through collective ownership of the ideas and challenges.

As expected, it became visible that there is a strong interplay between urban planning and autonomous drive. The interdependency means that a continuous dialogue and collaboration is necessary to realize potentials that the technology implies as well as to meet different needs from society. However, the influence of different perspectives is proportional to the engagement and involvement from the people with knowledge of the respective perspectives. The level of involvement is a result of different stakeholders' insights, resources and active invitations. The actors not aware of the ongoing development or with less ability or ambition to contribute will have less influence on the actual implementation. The workshops are tools for illustrating this fact and increase awareness among stakeholders that it is important to take part in the shaping, rather than wait and hope to be able to respond when a new technology is introduced.

It is not possible to say how many ideas emerged during the workshops, but 14 of them were presented in response to our main challenges.

Some common conclusions are that

- All solutions involve connectivity and digitization – not only for the vehicles but for the transport system and infrastructure as well as users.

- All solutions encompass pods, shuttles or the like as elements in the transport system in combination with traditional mobility

- The borders we know today within the transport system are largely challenged if not partly erased. The line between public/private transport, people/goods transport, taxi/car sharing is changing or even disappearing

- Mobility As A Service is the big game changer and probably a must

- Several ideas concerned physical transport hubs where all modes would dock in - autonomous vehicles, public transport, bikes, goods deliveries etc.

- Business models are key and it is a shared understanding that the complex relations on the systemic level is a difficult challenge. The business models have to involve all relevant stakeholders and ensure sustainable economic conditions for those who take responsibility for the system.

- The majority of the concepts call for a behavioural shift on the user level. Therefore, trialability programmes and test-platforms are important for the diffusion of autonomous transport systems.

The exploration of benefits and value from autonomous driving focused much on freed space due to less parking spaces and fewer vehicles. The city might also benefit from better traffic control which would lead to less congestion, higher punctuality, better planning of public transport.

Many participants thought private car ownership will decrease heavily leading to personal benefits such as better economy, less responsibility, less trouble with maintenance, reliability, planning etc. With autonomous vehicles as part of the public transportation it was argued that individuals would experience more useable public transport with higher degree of safety and security, reliability and flexibility.

Concerns were raised based on two common conclusions – technology exists and the challenge is to use it to reach the societal targets, and there will be a strong need of policies, regulations and standards. There are several different scenarios for the introduction of this technology – some might lead to more traffic, congestion and emissions while some might lead to less, or a mix. It is still very unclear if the introduction of autonomous vehicles will be beneficial to the cities – a lot more research is needed to understand the effects of automation

These workshops mostly involved Drive Sweden partners and with limited scope. Participants raised questions such as whether politicians see both possibilities and threats. They also highlighted the need for themselves and Drive Sweden to increase collaboration and cooperation in order to understand each other's perspectives better.

RECOMMENDATIONS

- Continue working in this manner where various stakeholders are invited to co-create new solutions. The capacity to collaborate and come up with meaningful answers and ideas is great; in spite of the complexity of the issues, different organisations, differences in time perspective (an IT-solution lasts for days, a vehicle lasts for years, a road lasts for decades and a city for centuries) and much more.

- Continue with open calls that support research to understand effects on national transportation goals and Agenda 2030. Present the results to politicians and discuss how they would like to be involved.

- Continue, increase and strengthen support to arenas for cooperation and collaborations and the methods that enable the stakeholders to create and build stronger trust and understanding. There is research supporting the fact that trust is a key issue for solving complex system challenges. It is also known that trust is built in steps where no step can be skipped. Every level of collaboration has to be consolidated before a new and tighter relation can be established.

- Make a research call within Drive Sweden where a couple of the sketched ideas can get the chance to make a feasibility study with a more thought-through cross-boundary team. It is also important here to present the result to a group of politicians to discuss how they would like to be involved.

- Design and execute a new round of co-creation labs built on the experience of what´s done in this project. An important learning from the workshops is the understanding of how important it is to talk about details when solving large system problems.

  If the discussion stays on the high level, there are so many unknown parameters and assumptions that only a superficial agreement is reached, if any. Thus, the participants have to narrow down to very detailed questions and talk about the real life.

In our project, we chose real geographical areas with real travellers. We could also have chosen real mobility use cases of individuals or companies. The important thing is that the workshop participants will use their knowledge, apply it on sharp situations and explore how this will change in the future, based on given input, expected technologies, visions and other system prerequisites for the workshop.

The set-up of workshops with good detailed questions within the broad system challenge is a challenge in itself. In that sense, we have to develop how we feedback the results to the system level and the bodies that need to take action. In any case, we ought to continue finding ways to pose questions that are sharp and relevant and engage the many actors and organisations that need to be involved. The design of the co creation workshop is in itself an important part of the process to create understanding among the stakeholders.

STRONG RELATIONSHIP
frequent collaboration projects, mutual dependency

COLLABORATION
common resources and goals

COOPERATION
exchange of knowledge, common activities

PARTICIPATE
conferences, meetings, workshops

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GOTHENBURG CITY WORKSHOP 2017-05-05

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How can autonomous transport systems bring value in cities?

This question has been applied in a project that explored four specific urban challenges through co-creation methods in workshops. This booklet summarizes the results of the project which is incorporated in Drive Sweden, a national innovation program with the objective to pave the way for an automated, connected transport system suggesting a new approach to mobility. Stakeholders from various professions and backgrounds gathered in these co-creation workshops, where they through creative exercises developed new ideas and concepts related to autonomous transport systems in specific urban contexts. The purpose was not to create ideas for implementation but to explore hidden values and identify the competence gaps to free them. The effects and outcomes of the workshops were beyond our expectations and demonstrate that the question of what value an automated transport system actually creates, is even more complex than we anticipated.