



AI Driven Mobility
Vanja Carlén, Anna Kristiansson
Januari, 2022

With support from

VINNOVA

Swedish Energy Agency

FORMAS

Strategic innovation programmes

Table of Content

1. SUMMARY	2
2. SWEDISH SUMMARY	2
3. BACKGROUND.....	3
4. PROJECT SET UP	4
4.1 PURPOSE	4
4.2 OBJECTIVES	4
4.3 PROJECT PERIOD.....	4
4.4 PARTNERS	4
5. METHOD AND ACTIVITIES	5
6. RESULTS AND DELIVERABLES	5
7. CONCLUSIONS, LESSONS LEARNT AND NEXT STEPS.....	8
8. DISSEMINATION AND PUBLICATIONS.....	9

1. Summary

The emerging development of Artificial Intelligence (AI) as the key technology for innovation, growth of new jobs and societal development will substantially transform society, and the mobility and transport systems during the next 10-20 years. Sweden has a long tradition and a strong ecosystem driving growth in the mobility area. However, when it comes to applying AI, Sweden is not in the forefront. Few organisations and companies will manage this transformation on their own, and collaboration will be a prerequisite for successful use of AI. To succeed, AI experts and mobility experts need to create new collaborations, increase domain knowledge, and increase the understanding of AI and its possibilities together. The vision is that Sweden takes a leading role in creating future mobility systems for people and goods that are sustainable, safe, and accessible for all.

AI Driven Mobility is a first step to further understand the potential of AI in the mobility system, and to build a platform for generating new initiatives and utilize the cross competence of AI experts and mobility experts involved in the project. The project partners demonstrated great interest in collaborating and finding new solutions together leading to a creative environment for idea generation, knowledge sharing and new collaborations.

A one-year project is a short amount of time for this kind of transformation. One can view the activities performed as a kick-start of something much bigger. Thus, it is strongly recommended to continue exploring the topics touched upon in this project. The participants have shown substantial interest in the initiative, and it is clear the organizations believe AI is, or will be, an important factor for their organisations' future viability. However, for some it has been difficult to understand how to apply AI to their own operations. They signed up to be part of the project to start learning and exploring opportunities.

For the continuation of the AI Driven Mobility initiative it is recommended to assign an advisory board, consisting of a diverse group of people from various organizations representing industry, public sector, and academia and incorporate more AI support in the actual idea creation work to support organizations in translating their needs into actual project ideas and AI applications. There is great potential to keep developing this platform; extend the network, include more partners, and include more mobility areas. Also, to continuously explore new ways of building knowledge and sharing experiences with the goal of bridging knowledge gaps and enabling new collaboration initiatives.

2. Swedish Summary

I det strategiska projektet AI Driven Mobility synliggörs den stora potential Artificiell Intelligens (AI) möjliggör inom hållbar mobilitet. AI är en drivande teknologi för innovation, tillväxt, och samhällsförändring och under de kommande 10-20 åren kommer AI förändra såväl mobilitet- och transportsystemet som samhället i stort. Sverige har en lång tradition av ett starkt ekosystem som driver tillväxt och innovation inom mobilitetssektorn. När det kommer till tillämpning av AI ligger Sverige däremot inte i framkant och få organisationer kommer leda den förändring som krävs på egen hand. För att lyckas krävs det helt nya samarbeten mellan AI-experter och mobilitetsexperter för att öka domänkunskap och se

möjligheterna och potentialen med AI inom området. Visionen är att Sverige tar en ledande roll i skapandet av ett framtida mobilitetssystem för människor och gods som är hållbart, säkert och tillgängligt för alla.

AI Driven Mobility var ett första steg i att förstå den stora potential AI möjliggör i mobilitetssektorn och börja bygga en plattform för generering av konkreta initiativ inom området genom att kombinera den kunskap som finns i projektet av både mobilitet och AI. Projektets deltagare visade stort intresse av att samarbeta för att hitta nya gemensamma lösningar, vilket ledde till en kreativ miljö för idégenerering, kunskapsdelning och nya projektsamarbeten.

Ett ettårigt projekt är en kort tidsperiod för den här typen av transformation och aktiviteterna i projektet var ett sätt att komma igång och påbörja något större. Deltagarna har visat stort intresse för initiativet och det är tydligt att många organisationer tror att AI är, eller kommer att bli, en viktig faktor för fortsatt konkurrenskraft. För vissa av de medverkande organisationerna har det dock varit svårt att förstå hur AI ska tillämpas och de gick med i projektet med ansatsen att vara en del av nätverket, utforska möjligheter inom området och lära sig mer om hur AI kan tillämpas.

För att ta ytterligare ett steg i att utveckla plattformen rekommenderas att i projektets nästa steg tillsätta en Advisory Board, bestående av offentlig sektor, industri och akademi med kunskap inom både mobilitet och AI, samt involvera mer AI-stöttning i idégenereringsarbetet för att stötta organisationer i att översätta behov till konkreta projekt och AI-tillämpningar. Det finns stor potential att utveckla plattformen genom att utvidga nätverket, inkludera fler partners och fokusera på fler mobilitetsområden. Det är också viktigt att fortsätta utforska nya sätt att bygga kunskap och dela erfarenheter med målet att brygga det kunskapsgap som finns och möjliggöra för nya samarbeten och initiativ.

3. Background

The emerging development of AI as the key technology for innovation, growth of new jobs and societal development will substantially transform society, and the mobility system during the next 10-20 years. The transformation has already started, and AI brings the opportunity of developing completely new products and services and making operations and processes more efficient. Sweden has a long tradition of strong ecosystems driving growth in the mobility area. However, when it comes to applying AI, Sweden is not at the forefront. Few organisations and companies will manage to carry through this transformation on their own. Collaboration will be fundamental for a successful implementation of AI.

The above is in line with Drive Sweden's AI Strategy. It is important to increase the general AI knowledge among different stakeholders, while having a holistic perspective when incorporating AI into the mobility system. Collaboration initiatives between AI experts and mobility experts are essential to accelerate this transformation.

The AI Strategy identifies several potential areas of new research and innovation projects. AI can be an enabler in the quest for social equity or environmental protection solutions and provide business advantages for industry actors. AI clearly has the potential to accelerate a sustainable mobility system. Sweden has a chance to take a leading role in creating future

mobility systems for people and goods that are sustainable, safe and accessible for all with the Sustainable Development Goals (SDGs) in Agenda 2030 as the base of this transformation.

4. Project set up

4.1 Purpose

AI Driven Mobility is one dedicated component to bring new solutions to the Swedish mobility ecosystem with the overall purpose to make Sweden accelerate the application of AI into the mobility system. The initiative is targeting the three pillars of sustainability: social equity, environmental protection, and economic viability. By bringing organizations representing societal challenges and needs, private companies within the mobility sector and AI experts and evangelists together. The question of how AI, digitalisation and automated transport systems can create value for societies has been at the core of the project from the start and the project will directly contribute to the mission of Drive Sweden.

The fundamental purposes of the project:

- Identify long-term opportunities to solve societal challenges and strengthen Sweden's competitiveness on a global market.
- Identify and implement short-term opportunities, and use-cases to implementation of innovative solutions
- Strengthen the AI competence in the mobility sector and the knowledge sharing between partners, projects and activities.
- Monitor and communicate international best practice and leading examples, as well as establishing relationship with leading international environments and attract relevant talent to support the Swedish ecosystem

4.2 Objectives

The objectives of the project were to:

1. Establish a network of organizations and individuals able to drive concrete change with focus on AI as enabler for more sustainable mobility
2. Substantially increase the knowledge and awareness of AI and its potential for the mobility sector
3. Based on joint challenges, identify minimum five concrete cases and possible solutions that would benefit society and citizens, possible to realize within 3 years
4. Initiate and start minimum three projects aiming at developing concrete solutions
5. Identify, and if possible, quantify, minimum five long-term opportunities that if realized would bring substantial value to society and citizens, as well as driving Swedish industry's competitive advantage
6. Long-term plan for continuation including financing, actors etc

4.3 Project period

The work took place from October 2019 to December 2021.

4.4 Partners

Lindhomen Science Park AB, Volvo Group, Zenseact, Polestar, Ericsson, NSR, Malmö University, Högskolan i Borås, Chalmers University of Technology (SAFER), Uniquesec, Univrses, Viscando, AFRY, Kista Science City, Region Västra Götaland, Örebro kommun, VTI, Trafikverket, Sjöfartsverket, Region Örebro Län and Region Jönköping Län.

5. Method and activities

The aim of the project was to increase the knowledge and understanding of the potential of AI and identify concrete and relevant opportunities for both companies, cities, regions, and citizens. This was done by facilitating meetings with actors from academia, private, and public sector where needs, challenges, and opportunities were discussed.

The project group was large and multidisciplinary. One goal of the first phase was to bring partners together to agree upon a shared vision of why the project is important for future development of the mobility system, and how to get started with identifying problems where advanced data analytics or AI can be an enabling solution.

In the second phase of the project, the focus areas were defined. With a starting point in the focus areas proposed in Drive Sweden's AI Strategy new focus areas based on the interest from participating partners were defined. Meetings and workshops with partners were arranged to identify possible thematic areas of interest in combination with use case presentations and inspirational activities and presentations for knowledge sharing.

During the last phase all project work was performed in the separate focus areas. Pre-studies in each focus group were also identified and prioritized to make sure that concrete projects and project ideas were initiated.

Throughout the whole project time, the project coordinator has invited project group members to join project meetings, half year conferences and breakfast/lunch seminars to keep the project group aligned and facilitate networking and knowledge sharing. Partners and guests have been invited to share their work in the field and international examples and best practices have been shared for inspirational purposes.

6. Results and Deliverables

AI Driven Mobility was a first step to further understand the potential of AI in the mobility system, and to start to build a platform for generating new initiatives and utilize the cross competence of AI experts and mobility experts involved in the project. The project partners demonstrated great interest in collaborating and finding new solutions.

AI Driven Mobility has created a network of mobility and AI experts representing different parts of society. There is a great potential to keep building this network for dissemination of upcoming results, to find new partners and collaboration initiatives, and to understand the underlying needs of the mobility system. These new partnerships are crucial when aiming to accelerate the application of AI in the mobility system.

The project has also strengthened the AI competence in the mobility sector by exploring the potential of AI, presentations, and examples of international initiatives, facilitating knowledge sharing between partners, understanding how AI solutions can be implemented, and what kind of problems are suitable for AI applications. It has also been essential for the AI experts to get somewhat an insight into how the mobility system works and what are the most important aspects when identifying solutions.

AI driven mobility has developed a methodology for idea creation and project generation for exploring and applying new technologies in the mobility system. Given the complex area of mobility, including both private and public passenger traffic, and transport of goods, the project partners together identified focus areas where dedicated partners met in smaller groups. The focus areas identified was: Efficient resource utilization for freight and passenger transport; Traffic Safety; Logistics; and Long-term solutions from a public sector perspective.

One success factor was to focus on collaboration initiatives around concrete and, for the participating organizations, relevant opportunities to improve their own operations. One significant driving factor was the needs of the participating organizations themselves. These kinds of system transforming activities are built upon the will of the actors involved. That is the engine and without the fuel of willingness to change, no change will happen.

Six pre-studies were initiated with a general objective to identify activities where AI would have the biggest potential in terms of achieving sustainable solutions for the future of mobility systems in the short- and long-term perspective. The goal of the pre-studies has been to propose project structures and contents that could be developed into larger projects. Hence, the expected outcomes of the pre-studies are drafts of bigger applications. However, this work is explorative and will change as more knowledge is retrieved. The main takeaways from the pre-studies are described below:

AI at road works

Road works are important to improve existing infrastructure by reparations, at infrastructural changes and for some types of road maintenance. It is important for the road administrator to reach an as high traffic efficiency as possible at the site of the road work, at the same time as there are high requirements on safety for drivers and road workers. Since 30% of the accidents at road works are rear-end crashes at the end of queues, the Swedish Transport Administration (Trafikverket 2020) decided to use Intelligent Transportation System (ITS) at all larger road works with the goal to achieve a safer traffic environment at road works and additionally increase the traffic efficiency.

The purpose of the project is to build knowledge and increase the understanding on how the traffic conditions can be measured in real time using different data sources and how this real time information can be used as input to a control strategy to optimize the traffic control at road work sites. In addition, the purpose is to evaluate one or more control strategies that are believed to have high potential to improve the traffic efficiency at road work sites.

AI reducing risks of near incidents

Merging at on- and off-ramps on urban motorways is a large source of incidents. The large traffic flows in and out from the city centre during peak-hours is creating congestion and at on-and off-ramps. Large variations in speed, merging, lane-changing actions, accelerations/decelerations at such traffic flows are the cause of many incidents. Promising control measures to improve the traffic safety (and traffic efficiency) at on-and off-ramps have previously been introduced and exist on many urban motorways today.

The purpose of the project is to build knowledge and increase the understanding on how near-incidents and risk indicators can be calculated in real time at on-and off-ramp locations using different data sources and how these near-incident/risk indicators can be used to find

problematic areas at on-and off-ramp locations and as input to a control strategy at the on- and off-ramp locations with the goal to improve traffic safety.

AI driven roadside object identification “Multilayer road data model”

The main objective of the project is to create precise and up-to-date information of the road surface and surrounding areas. The resulting information is in the format of a multilayer 3D model that describes the static roadside infrastructure for use cases such as route planning and navigation of AD vehicles, predictive maintenance for road authorities, digitalization of the road networks for urban planning, etc.

AI support for community and infrastructure

The combination of new technologies gives us new opportunities to plan and manage our society and the challenges we face. There are new methods for analysing large amounts of data (big data) and often from new data sources (e.g. sensor data). Traditional long- and mid-term planning is based either on data from surveys, forming a microscopic sample of historical data or on in worst cases “rules of thumb”. The surveys and other input also have deteriorated in quality over the years. The theories, methods and models and associated economic and management frameworks are additionally designed primarily for decision solely for large scale problems in a long-term planning process and lack features for managing more agile strategies that planners and managers are currently facing.

Key drivers that enable the creation of a new type of models will increasingly influence the future. The most important of these include:

- The emerging new digital infrastructure
- The new value networks that are emerging as technology development
- Creative business models enabled by digitalization.

It can be stated that the research community and the stakeholders are relatively far apart, where the research community needs to learn more about the challenges facing the stakeholders and the stakeholders need to learn more about AI and machine learning to understand each other. Based on this there is a need for an external analysis and a State-of-the-art overview to create a common understanding and platform that we can build on. It will most likely take longer than we wish and hope to realise the potential of AI in community and infrastructure planning.

AI applications in society’s transports - long term solutions

This pre-study has aimed at identifying project ideas for how AI can be used for longer term transport solutions. Stakeholder interviews and a workshop with participants from the project “AI-driven mobility” have been undertaken. Participants represented authorities, regions, cities, industry, research, and AI Sweden. A general conclusion is that while participating “owners of long-term needs” (administrations, regions, and cities) express many long-term goals and targets, there are less proposals for what a potential AI-project should contain in terms of work-packages or use-cases in order to help contribute to the goals. Instead, a demand for “finding an application that can help us see the benefits and use of AI” has been expressed.

System analysis of the potential of applying AI in the Logistics sector

A system analysis based on interviews with participating partners related to freight transport was performed by AFRY. Many challenges and exciting opportunities where AI can be applied were identified. It was difficult to find an overarching issue that represents the need of each project partner; however, some potential synergies are identified. A common denominator has, for example, been based on booking and planning systems. It is difficult for many organisations to meet the opportunities that arise with new and more developed data sources with the current booking and planning system. A solution could be to combine different data sources to create a better understanding and overview. The systems commonly used today can share data in a very limited form. A joint project that many partners could benefit from would be to find a common platform for how this data can be handled and shared in an efficient way. In several cases, competitors can also benefit from sharing data with each other, but the conditions for being able to do this effectively are lacking.

7. Conclusions, Lessons Learnt and Next Steps

First, a one-year project is a very short amount of time for this kind of transformation. One can view the activities performed as a kick-start of something much bigger. Thus, it is strongly recommended to continue exploring the topics touched upon in this project. The participants have shown substantial interest in the initiative, and they believe AI is or will be an important factor for their organisations' future viability. However, for some it has been difficult to understand how to apply AI to their own operations. They signed up to be part of the project to start learning and exploring opportunities.

There is a barrier between AI experts and mobility experts. To be successful, this should be addressed and ideally eliminated. AI driven initiatives with focus on mobility often require completely new collaborations and partnerships. The knowledge gap between AI and mobility experts sometimes stands in the way for such initiatives to happen. Mobility system actors need to retrieve basic AI knowledge, to understand what can be done with the help of AI, and to identify advantages. They should also recognize what kind of data is needed and in what form. The AI experts should gain understanding of the basic functional characteristics of the mobility system, and its core challenges. It is recommended to have a dedicated AI expert actively taking part in the idea generation work of the focus groups, to support the public organizations and other stakeholders. The mobility system actors with limited AI experience, need support in finding relevant long-term goals and targets, and turning these into concrete proposals, and feasible use cases.

Another essential activity going forward is to map the network of partners that must be part of this transformational journey. The mobility system is a huge web of different actors and dependencies. Changes in how things are done at one point, can have effects far away. Nevertheless, the AI Driven Mobility initiative has played a significant role in kick-starting such closing the knowledge gap movement. The platform is fostering cross competence collaboration, building a network for knowledge sharing, and facilitating idea creation and initiation of new projects.

Another important aspect of the idea generation process is also speed. The ideas created should quickly be tried out, to focus on the fruitful initiatives in a long-term perspective. An explorative platform assessing new technologies for a future mobility system needs to be

administratively easy to manage. The project's financial structure that allowed pre-studies, trying out ideas and new collaborations to quickly move forward has really been a crucial process for the success of the project. It is highly recommended to continue this way of working for these kinds of complex areas.

For the continuation of the AI Driven Mobility initiative it is recommended to assign an advisory board, consisting of a diverse group of people from various organizations representing industry, public sector, and academia. To be relevant, it is crucial to include an even balance between AI and mobility expertise in this group. The advisory board can function as a north star to provide guidance and direction of the work ahead. The AI Driven Mobility initiative is still in an exploring phase, and thus specific activities and focus will develop and change along the process.

There is great potential to keep developing this platform; extend the network, include more partners, and mobility areas. Also, to continuously explore new ways of building knowledge and sharing experiences with the goal of bridging knowledge gaps and enabling new collaboration initiatives.

8. Dissemination and Publications

The results of the project have been presented and disseminated in different forums, workshops, and meetings. One year is a short amount of time for transformation to happen, and the focus of the project relating to dissemination of results has been to form a next step and continuation of the initiative, bringing more participants and areas of mobility together and keep building the network of AI Driven Mobility.

The pre-studies developed in the project will be shared on the project site at CLOSER.se and will also lead to separate project applications published in the Swedish innovation system.