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Project Report

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Policy Lab for Autonomous Transport Services

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Challenges, possible solutions, and open questions
related to policies for trials with self-driving transport
services

POLICY LAB FOR AUTONOMOUS TRANSPORT SERVICES

BACKGROUND

This report is a final summary of learnings established in the project PLATT - Policy Lab for Autonomous Transport Services - that aimed at investigating possibilities and challenges related to trials of self-driving transports in Sweden. The project was performed by Combitech AB, RISE, Volvo GTT samt Einride AB within the strategic innovation program Drive Sweden, a joint effort by the Swedish Innovation Agency Vinnova, the Swedish Research Council Formas, and The Swedish Energy Agency.

Specific report were also released. Combitech's report considering the perspective of the public authority is published [here](#). Volvo's case is described in more detail [here](#). Einride's learnings are described [here](#).

The project makes use of the initial learnings from a preceding project called KRABAT where the permit processes of the very first public trials with autonomous vehicles, in Kista and Gothenburg, were studied.

Policy development for innovation is one of five thematic areas of Drive Sweden. More information is found [here](#).



INTRODUCTION

In Sweden today, extensive technical development is under way in order for the vehicles and transports of tomorrow to be self-driving. The Swedish state supports these activities through a number of initiatives, including the strategic innovation programme Drive Sweden. In association with the rapid technical development, work is also needed on the regulatory frameworks of today and tomorrow so that the introduction of new technology takes place safely. We call this kind of regulatory work "policy development".

The Ordinance on Autonomous Vehicle Tests was passed in 2017. It clarifies the circumstances under which it is reasonable to conduct tests of self-driving vehicles by supplementing the Vehicle and Traffic Ordinance. It also establishes that it is the Swedish Transport Agency that determines the suitability of each test. In connection with the first tests, Drive Sweden conducted policy development in the KRABAT project. The ordinance was new, there were new actors entering the market and it quickly became apparent that there was a lot to do to simplify the application process and clarify how the regulations should be applied. As a continuation of KRABAT, the Policy Lab for Autonomous Transport Services (PLATT) was therefore initiated.

Within the scope of PLATT, AB Volvo, Einride, Combitech and RISE conducted policy development together with a number of different players in the transportation industry. We thereby identified a number of challenges that the applicants are facing. It is a matter of both being able to budget for the application in the form of cost and lead time, as well as the

scope of the application. At the same time, we have seen a number of different strategies to handle the uncertainty. Both well-tried strategies that have been used both specifically within vehicle development and generally in the Swedish exercise of authority, and new strategies that put their finger on how to handle safety in the introduction of new technology without slowing the rate of innovation.

By widely inviting participation in the project's activities, we have also gathered many practical tips on how an applicant both can influence how long it takes to have an application approved, but also the amount of work needed for a successful application. The tips also shed light on aspects that have a beneficial effect on how the testing activities are perceived by the surroundings, such as the rescue services and the public.

In this report, we highlight the overall results of the project while specific aspects are described in their own reports. First up are therefore the challenges, which are followed by the strategies that have been tried or proposed to address the challenges. This is followed by practical suggestions that simplify the application work before we highlight what we believe are the opportunities and challenges moving ahead. Last in the report is a description of the PLATT project, where the objectives and the approaches are highlighted.

Lastly, many people have contributed to the insights in this report. However, the responsibility for the contents and the conclusions in the report rests entirely with the project parties.



CHALLENGES

Within the Policy Lab for Autonomous Transport Services (PLATT), brief internal project meetings were supplemented with longer, broader outwards meetings. From these meetings, we gathered examples of challenges from both the project parties and other actors that play or are planning on playing a role in relation to the Test Ordinance (1). Within the project group, we analysed these challenges and aggregated them to five overall themes that we present below.

LEAD TIME

How much time does it take to get the go-ahead to begin the trial? The uncertainty on the time for when the application is granted makes it difficult to plan for the testing

activities. In the course of the project, the various steps in the application process have been clarified by the Swedish Transport Agency and presented to the participants at the PLATT meetings before they were posted on the agency's website. The work on how the process is communicated is continuously under way – there is a large difference in the information, comparing the website as it looked in 2017 and today.

Despite this, the agency cannot provide exact lead times for the various steps in the application process since the time needed depends largely on the applicant. An application that requires many supplemental submissions or is difficult to decide on will require more time to review. The same

(1) Försöksförordningen (2017:309) Stockholm: Justitiedepartementet

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applies to the vehicle. If it is an unknown prototype vehicle, more work will be required to go through the safety analysis and the exemptions from the Vehicle Ordinance than if the application builds on a vehicle that has already been used in pilot activities or has already been type approved.

In summary, it could be said that the more that is new (vehicle, area, self-driving technology, necessary expertise, etc.) in the application, the more likely it is that getting it through will take more time.

COST

How much does a pilot permit cost? The cost depends on how long it takes to process the application as the Swedish Transport Agency uses an hourly tariff (currently SEK 1,400/hour). The time spent in turn depends on the application's scope, the quality of the various parts of the application, the number of iterations that have to be gone through before the application is complete, etc. The uncertainty on the final cost makes it difficult for stakeholders to budget for the application and thereby the pilot activities.

LEGAL DEPENDENCIES

What other laws and ordinances need to be taken into consideration? The Test Ordinance (2) refers to the Vehicle Ordinance (3) and the Traffic Ordinance that both in turn refer to both international and national regulations. The Traffic Ordinance regulates how vehicles are to behave in various situations, such as the obligation to yield in pedestrian speed areas or that it is not permitted to reverse on a motorway. For the route where the vehicle is intended to drive, one therefore needs an analysis of every turn, cross walk and possible

deviation from the ideal case. How does the trial handle something unclear (such as a plastic bag or a child) that comes moving over the street or a police officer that gives a stop signal?

The Vehicle Ordinance with associated authority regulations specifies in detail what requirements are placed on a vehicle in order for it to be considered safe to use and thereby be able to obtain a type approval (meaning that they meet the technical specifications that apply for that type of vehicle, for example the requirements on a light truck differ from those on a heavy truck). Many of the vehicles included in the trials with autonomous vehicles are not already type approved. They might lack a steering wheel or windscreen or have a design that is symmetrical so there is not a clear front or rear wheel axle. All such exemptions from the Vehicle Ordinance must be specified by the applicant and approved by the Swedish Transport Agency before the trials can begin. The same detailed approach also applies to the various sensors, actuators and algorithms in the systems that enable autonomous functionality when the vehicle is not driven by a person with the help of a steering wheel and pedals.

Depending on the nature of the trial, one may also, for example need permits under the Commercial Traffic Act (4) if the vehicle is to be included in public transport services or used as a truck between two temporary storage areas. Consideration may also need to be taken to the Work Environment Act (5) if the work's organisation is affected or because new technology requires new safety procedures, which may in turn make union

(2) Fordonsförordningen (2009:211) Stockholm: Justitiedepartementet

(3) Trafikförordningen (1998:1276) Stockholm: Justitiedepartementet

(4) Yrkestrafiklagen (2012:210) Stockholm: Justitiedepartementet

(5) Arbetsmiljölagen (1977:1160) Stockholm: Justitiedepartementet

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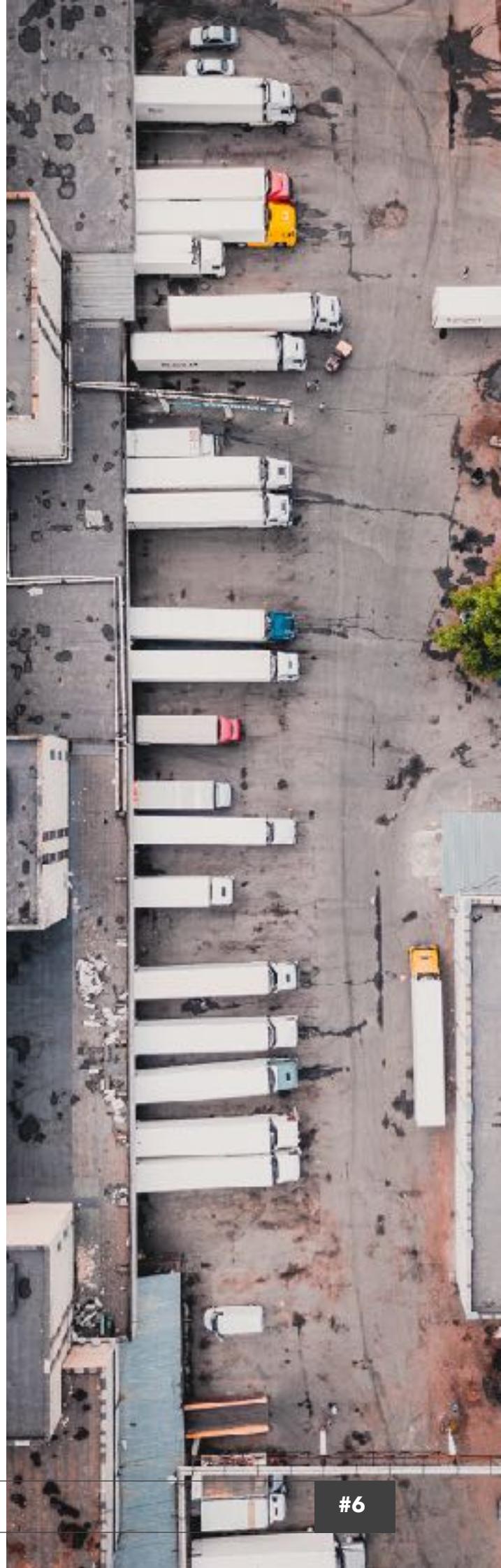
negotiations relevant. In other words, it is a complex legal reality that meets the applicant where many decisions need to be made. It is worth pointing out that union negotiations do not need to be included in the actual application, but rather the new safety procedures that gave rise to the negotiations.

The challenge for a new player in the market then lies in knowing what exceptions from the Vehicle Ordinance should be requested for a bus-like vehicle without a steering wheel and what driving licences and training are required to be a safety operator for such a vehicle, and where it may be operated and under what circumstances, as well as if union negotiations are needed for the new routines and work tasks. Taken in total, there are often very many details to take into account in a trial and it is not always clear how or if they belong in the application.

SCOPE OF THE APPLICATION

What is included in the application? What do the authorities want to know about our sensors? At what level of detail should we describe our algorithm? What can we assume the authorities already generally know about our technology? The Swedish Transport Agency now has a template on its website where it is clear what an application should include that provides guidance for the applicant, but the first time an application is made, it is difficult to assess what should be included in the respective point and what level of detail is required. There is also a dependency between the scope of the application and how the trial relates to other regulations (see Legal Dependencies).

Should we update our application if we make changes to the software? Can we replace a sensor without having to apply again? Since it involves pilot activities, where the technology is under development, it is hard to plan in detail from the beginning how the pilot activities will develop over time. Many applicants also work agilely



CHALLENGES

and test their way forward along the way. There is an uncertainty about how much room there is to make changes in on-going trials, which have already received permits.

Another uncertainty is around the question whether my vehicle is covered by testing activities, meaning does my vehicle count as autonomous or is it a vehicle with driver assistance technology? We know that a vehicle that can make a right turn on its own is autonomous while a vehicle that parks itself offers a driver assistance service. But a vehicle that can take over control from the driver and pull into a station or make centimetre adjustments to a loading dock, is that autonomous or is it a driver assistance service? It may sound like splitting hairs, but if it counts as autonomous, a permit is necessary according to the Testing Ordinance, but not otherwise.

NEW ACTORS WITH NEW PERSPECTIVES

What is the authorities' role? Historically, there have been a small number of vehicle manufacturers in Sweden that have had established contacts with authorities, such as the Swedish Transport Agency. With autonomous vehicles, the Swedish Transport Agency comes into contact with entirely new actors, many of which have no prior experience of interacting with Swedish authorities or have experience of interacting with other operations. This means that they do not know why or when they should talk with the authorities or how they should understand what is communicated.

The opposite is also true, new actors come from different contexts and have different expectations of the agency. Knowing how to interpret what is said by the applicant and how to formulate communication so that the applicant understands what is expected becomes a challenge for the officials. One complicating factor is that the Swedish Transport Agency charges per hour, which means that actors with small margins refrain from having contact with the





POSSIBLE STRATEGIES

During the work with PLATT, we refined old strategies that were highlighted in, for example, KRABAT (6), but also identified some new ones. It is worth noting that although they differ in content and nature, there are often possibilities of combining them, as is the case with third parties and risk analysis.

THIRD PARTIES

From the first trials with autonomous vehicles, the challenges concerning communication between the applicants and the authorities

were identified. From the evaluation of the trials, a strategy was proposed where a third party could serve as a mediator (or representative) between the applicant and the authorities to remove misunderstandings and explain the respective contexts. During the work on PLATT, the role was developed and today, a third party could also serve as a consultant in implementing (parts of) the application, such as a safety analysis of the trials. A third role could be as an expert by providing its opinion on the application. Here, a third party could guarantee the

(6) KRABAT på Drive Sweden hemsida, <https://www.drivesweden.net/projekt-3/krabat>

POSSIBLE STRATEGIES

reasonability of a safety analysis to thereby make it easier for the Swedish Transport Agency to accept the application. Of course, this builds on the third party in some way being able to verify the legitimacy of the guarantee, such as through an ISO certification or accreditation by a competent body.

Motor vehicle inspections are an example where a third party carries out vehicle inspections on behalf of the Swedish Transport Agency. In general, the principle is legally rooted in Swedish administration as we have free production of evidence. There is thereby always an opportunity to append an opinion from an external expert or to cite the sources that support your proposal.

INDUSTRY PRACTICE

The transportation industry could itself work to spread knowledge about and from trials with autonomous vehicles. The benefits of a more systematic effort by the private players would be that collective knowledge makes the actors more skilled at carrying out safe trials and finding the most relevant tests so that technical development is accelerated. A collective industry practice could also be something that authorities and local road maintainers refer to and could serve as support for new applicants.

Clear recommendations would also make the Swedish market more attractive to pilot activities since they make it easier to assess the effort required for a successful application and give a professional impression when the industry itself works to secure trials. The final report that is to be sent in to the Swedish Transport Agency after a trial has been conducted could have served

as a tool to harmonise and gather experiences, lessons learned and incident reports where the compilation is subsequently anonymised and made public on an annual basis.

AUTHORITY CODE OF CONDUCT

Just like the industry sees possibilities in its own best practices, the public actors need to continuously review their own working methods and guidelines concerning how to take into account regulatory compliance, political visions and the needs of the industry. Principles such as being equal in the eyes of the law must be respected at the same time that these actors have an examining role and exercise of authority. In parallel, both national and local policy-makers have expressed that Sweden is to be a leading country in automation and that administrations and authorities are to actively promote the pilot activities. But must also ensure traffic safety and consider how Sweden will implement the zero vision.

For an authority, it may be an opportunity to participate in policy development to have a chance to express its own perspectives while accessing those of others in a neutral place. However, from an authority perspective, the risk may be that the actors that participate in the workshops gain advantages over the actors that do not, which can put at risk everyone being equal in the eyes of the law.

GENERAL EXEMPTION FROM THE VEHICLE ORDINANCE

Sweden has a long history of vehicle testing. The Test Ordinance therefore needs to be seen in a historic context. For vehicles driven by a driver, there has long been a possibility

POSSIBLE STRATEGIES

of a general exemption from the Vehicle Ordinance. If a vehicle manufacturer receives a general exemption, the possibility opens up to register manually operated trial vehicles as test vehicles in the road traffic register without having to request exemption from the Vehicle Ordinance and approval by the Swedish Transport Agency in each individual case. But the general exemption does not cover autonomous systems; that kind of test is regulated by the Test Ordinance and exemptions are not given there.

General exemption was introduced in the 1960s when a need was recognised to accelerate pilot activities for the two Swedish automakers that existed at the time at the same time that it entails a substantial work savings for the authorities. The basis for the decision was the trust that the manufacturers would not risk traffic safety through unserious testing activities and thereby risk losing their favourable general exemption.

Since then, Volvo Cars and NEVS have received their own exemption in connection with their being separated from companies that already had exemptions. Several actors, including universities, have wanted to obtain a general exemption in order to conduct their tests (with drivers) in a smoother way, but were denied with the motivation that they are not vehicle manufacturers.

However, a general exemption means that an advantage arises in the testing activities with autonomous vehicles for those who already have such an exemption. A vehicle manufacturer that has a general exemption can work based on a test vehicle and then add the autonomous technology and only apply for the latter, which means that the application procedure for the test activities

with autonomous vehicles becomes significantly easier. It is also easier to make changes to the test vehicle during on-going tests. If the change can go in under the general exemption, it does not affect the test activities. Vehicle manufacturers without a general exemption do not have this opportunity.

STANDARDISATION

In this context, standardisation should not be confused with functional requirements or certification of new technologies. The need for standards instead comes from the possibilities of sharing resources and having interacting vehicles from different suppliers. It will require different vehicle developers to have a common way of sharing data between vehicles and back-office/control towers and between vehicles, but also that they have the same interface for charging batteries and remaining capacity.

An example of the need for standardisation in passenger transports is IT for Public Transport (7) - ITxPT - is a growing standard for how services in vehicles and between vehicles and the surroundings are growing forth. The objective is to thereby avoid technology-specific solutions where the actors become locked to a supplier or need parallel systems because it is not possible to integrate information from the vehicles in a common view. When the number of actors grows, the solutions will diverge and impede synergies if there are no common interfaces for date sharing and operations.

Another aspect of standardisation is that extensive efforts are required today for each test to create digital maps over the area in which the test is to be conducted.

(7) Open IT architecture for Public Transport, <https://itxpt.org/>

If it were possible in the future to have large-scale activities in larger areas, there will be extensive value in maps that can be downloaded for an area instead of creating them on one's own. However, this requires reliability over time so that the information does not become dated, but also a clarity regarding who is responsible for keeping them updated.

FUNCTIONAL REQUIREMENTS

To meet the challenge around the new technology and how to present a safe testing procedure, it would make it easier if the level of detail could be reduced from handling a specific lidar or left turn to focusing more on function in relation to safety. This is now done to some extent in relation to the Traffic Ordinance, partly by approving tests within an area instead of for a specific route, and partly by the applicant being able to describe how left turns are done in general and not in each specific traffic solution. But when it comes to the Vehicle Ordinance, the regulations still require a material technical review, meaning that the applicant must present a detailed account of all exceptions from the Vehicle Ordinance and how the autonomous technology has been realised.

International work is under way to define functional requirements for autonomous vehicles; see for example the UN work in the report Framework document on automated/autonomous vehicles (8). But such work takes time and other strategies will be needed to meet the immediate challenges.

(8) <https://www.unece.org/fileadmin/DAM/trans/doc/2019/>



AGILE PROCESSES

For new applicants, the work to apply for test permits is an opportunity to learn how the application process works and how the various regulations interact. However, even those who have done one or more trials are faced with new challenges when they take care of the next application. Of course, this also applies to the officials at the reviewing authorities. Many therefore see the application as an iterative and incremental learning process where work is done gradually to an approved application.

However, the Administrative Procedure Act (2017:900) is based on a decision only being issued once the application is complete and that an authority cannot give a binding advance decision along the way. At the same time, both public and private actors are convinced that there is a need for a dialogue in the application process. A more agile process therefore sets new demands on the authorities' code of conduct (what can be said to whom), but also on the applicants so that they have reasonable expectations of the authorities' possibilities to be agile. Here, the industry's own dissemination of good examples can play a role.

RISK ANALYSIS

The Test Ordinance is deliberately written so that it is technology neutral. This means that it differs from the Vehicle Ordinance, which clearly specifies vehicle types based on technical dimensions. To present an account of the safety of a test without referring to technology that has been listed as approved in the regulations, new methods are therefore needed.

Risk analysis and risk mitigation strategies are a possibility to meet the challenge that are frequently used in relation to the Test Ordinance. This requires methods and competencies that do not necessarily exist at the applicant, as well as new competence at the reviewing authorities since there is a multitude of risk analysis methods and various ways of conducting systematic safety work. It opens up for a third party that assesses the reasonability of the method used and/or the analysis, and reviews and trains the applicants. A consequence of working with risk analysis is also that the perspective changes from safe tests being risk-free to safe tests knowing what the risks are and having strategies to handle them.

CHRISTIANIA

Another possibility would be to grant a geographic area as a free zone for tests. A real environment is created with mixed traffic, but where those who are present in the area are aware that tests are under way with test vehicles and technology. This is originally an idea to permit tests in certain areas without an application being made. The need has come forth primarily among research actors that work with test vehicles where they want to be able to test new functionality with small or large changes – but limited to a certain area, such as Kista Science City in Stockholm or Lindholmen in Gothenburg.

We do not yet have examples of this kind of free zone, but in that practice concerning the applications and tests has developed in Sweden in the past year, we currently have a similar idea where applicants can receive an area approval, meaning an approval to conduct the test within a certain area instead of on specific streets.

POSSIBLE STRATEGIES

In the very first test permits that were granted by the Swedish Transport Agency, the test was approved based on the vehicle being operated along the route A to B. Recently, the Swedish Transport Agency has also granted permits for a geographic area within which the vehicle may be operated, which has facilitated the test procedure.

This also means that the risk analysis need not be written at the same level of detail. Instead of presenting how a right turn will be done in an intersection to then describe how a right turn is done at the next intersection, area approval opens up for a general description of how a right turn is done in general.

A third angle on Christania is test tracks, such as Astazero (9) that permit tests with autonomous vehicles within a delimited area. In order for tests on test tracks to provide reliable results, the test tracks need to be able to recreate representative traffic situations. Internationally, this is a track that has gained attention. In the UK, there is for example the Autonomous Village (10), which has a test track where developers can test their autonomous vehicles in an area that is to correspond to a typical small town. Singapore has opened the western part of the city as a test arena to enable tests in more traffic environments (11). Exactly what the conditions will look like to carry out tests there is under development.

(9) <http://www.astazero.com/>

(10) <https://www.millbrook.co.uk/press-office/news/leading-self-driving-vehicle-test-facilities-open-for-business/>

(11) <https://www.lta.gov.sg/apps/news/page.aspx?c=2&id=9db90550-148c-4da3-85e5-143eeb3eb0df>





PRACTICAL TIPS

Tips come from interviews and meetings with those who have applied for permits for tests, various officials and stakeholders who participated in PLATT's activities.

ACCREDITATION

If the applicant has an ISO9001 certification, it indicates an internal competence and functioning processes to conduct systematic safety work. This is an aspect that the Swedish Transport Agency can take into account when the agency decides on how large changes to the test can take place within the scope of the permit before they want to see a new application. If there is safety competence internally, it may be enough to continuously

inform the Swedish Transport Agency about the adjustments made instead of submitting a new application.

Exactly what accreditation the Swedish Transport Agency relies on is not established, so take up the internal competence in connection with the test being presented to the agency so you can utilise it in how the application is written and how the tests can change over time within the current application. At the first application, regardless of accreditation of internal competence, the applicant will need to demonstrate it in practice by presenting an account of the risks and how they will be handled in the test.

RE-USE OF KNOWLEDGE

It may be of significance who applies for a test permit. Test permits may, for example, be applied for directly by the vehicle developer, but the test permit may also be applied for by an operator (service provider). This in turn means that an operator can use an autonomous vehicle that has already undergone the process of obtaining exemptions from the Vehicle Ordinance in an earlier application, where another operator or vehicle developer was the applicant. The problem is that the knowledge about the vehicle does not readily lend itself to being re-used between different applications, but rather the applicants must begin from the beginning. Why knowledge cannot easily be transferred between different applications is related to them largely being confidential since they contain trade secrets. Nor can it be expected that the applicants are interested in sharing knowledge with competitors.

However, somebody that could be interested in the knowledge being spread is the vehicle developer, who also knows which vehicles were involved in which tests. It can therefore be worth asking the supplier if they have access to approved exemptions from the Vehicle Ordinance. Because if they can share the information, this is something that makes more tests with their particular vehicle easier.

CONDUCT CHECKS

It pays to make various checks before the application is submitted to the Swedish Transport Agency. For example, check with the Swedish Transport Agency before you begin the application if the risk analysis method you intend to use is known by the authority. Risk analyses that you have already done surrounding technology choices can be re-used even if they might need to be

reformulated to be comprehensible to the Swedish Transport Agency.

The Swedish Transport Agency can also provide information about whether or not the autonomous system is so advanced that it falls within the Test Ordinance or if it is counted as a driver assistance service. In the latter case, no permit is needed based on the Test Ordinance. Another reason to maintain contact with the Swedish Transport Agency is that they have all of the previous applications. They are official documents and can be requested. Even if much of the information is in appendices that are not public, one can obtain a perception of the scope and content by looking at the applications of others.

Also check with the road maintainers of the roads you will operate on that they do not have their own plans for the section of road in question that conflict with yours. The Test Ordinance recommends that the applicant obtain the road maintainer's position on the test, but practice is that you will not have the application approved without all road maintainers providing their approval.

If a road maintainer believes that the inconvenience is too large, the Swedish Transport Agency will probably deny the application. In addition, it can often be worth talking with the road maintainer before contacting the Swedish Transport Agency to establish where it is reasonable to conduct tests. If you have the road maintainer's consent, it is both easier to apply to be permitted to operate in a certain area than on a specific route between A to B and the test will be less sensitive if the route needs to be changed at short notice.

PRACTICAL TIPS

Another stakeholder worth talking to are the emergency services. They face a growing plethora of vehicles for each year. If they get a heads up on your vehicle's fuel, how it is vacated and who to contact in case of emergency their work becomes so much easier. It might also make it easier for you to identify the risks and mitigation strategies concerning your trial if the emergency services have given their view. A similar reasoning goes for the Police as well.

A more in-depth account of relevant stakeholders and their take on the trialling process can be found in Combitech's interview study (12), which was conducted within the project.

LEGAL DEPENDENCIES

The Swedish Transport Agency will do their best to inform applicants about other laws and regulations that are applicable for your trial. If the trial involves commercial activities your contact person at the Swedish Transport Agency can point to relevant contact persons for logistics or public transport at other units at the Agency in order to obtain the necessary permits. The Agency can also answer questions regarding which driver's licenses are needed or if there are other qualifications to be met in terms of training and education. They also help in detailing complementing vehicle tests that need to be conducted before the trials, such as EMC-testing to ensure the vehicle's electromagnetic integrity - i.e. that it will not affect other systems such as pacemakers or cellphones and reversely not be affected by them.

(12) Therese Dahlfors, "Tillståndsprocessen för autonoma fordon i Sverige från ett myndighetsperspektiv", Combitech, 2019.



COMMUNICATION IS FREE OF CHARGE

There are no costs associated to talking with the Swedish Transport Agency. It is the time spent reviewing the application they charge for. Until an application is submitted you can therefore ask questions and get their view for free. So go through the application template with your contact person to reach an agreement about what goes where and the choice of risk and mitigation strategy. However, they will not give you any guarantees regarding the trial as such since they need to see the full application before making formal decisions.

THINK BIG - START SMALL

Baby steps have many advantages:

- You get to establish your relations with other actors and thus get to know their view on what you do, how you do it and why
- A limited trial is easier to constrain in terms of risks, making the risk analysis easier to perform and review
- The easier it is to understand that you have done a reasonable risk analysis and have adequate mitigation strategies in place, the easier it will be for the Swedish Transport Agency to accept the application
- As you demonstrate your capability to perform trials with adequate safety procedures other actors will start to trust you and take your role in the ecosystem more seriously. And that will make it easier to strike new partnerships and get more complex trials accepted.

It is also possible to negotiate with the Agency how the trials can expand in terms of complexity over time; which adjustments can be performed within the current application, which adjustments require a new application? We know of cases when the applicant has been given access to not only a specific route but a certain area or when software upgrades can be done within an accepted application. In all these cases the applicant started out with a limited trial in the first application and thus demonstrated the capability to perform trials with adequate safety before taking on more complex trials.

It is important to remember that by applying for a trial the applicant builds internal competence. So stay by your vision but be prepared to get there stepwise.

TYPE-APPROVED VEHICLE

When applying for a trial the risks you need to account for regarding the vehicle are only the ones that are not covered by the type-approval. So if your vehicle is type-approved it is the technology enabling the self-driving functionality that is within scope. On the other hand, if the vehicle is not type-approved, you need to list all the exceptions you have in regard to a specific type and then analyse each exception's impact on the safety of your trial. That means that it is easier to apply for a trial with a vehicle that is type-approved (or registered as a test vehicle under the general exemption).



GOING FORWARD - OPEN QUESTIONS

As is apparent from the described challenges and strategies, there are many questions that still have no answers. Here, we list the ones that seem most urgent to continue working on. Something that is common to all cases is that good solutions will require collaboration between public and private actors.

STANDARDISATION

One open question is what can and needs to be standardised? Some standards also already exist, such as communication between traffic signals and vehicles. For example, the SPaT traffic light's current signal and time until it changes and MAP describe what an intersection looks like with the number of lanes and what direction each lane

represents (13). However, there is no standard to describe the intersection as a 3D model so that autonomous vehicles can navigate to the right lane.

One question is then to what extent such a model needs to represent reality and who is responsible for the contents. For example, if the speed limit on the digital map does not match the one on the road sign, what applies if the autonomous vehicle drives faster than the road sign allows? How should the costs for the development and maintenance of common resources be covered? Is it infrastructure that is to be paid with tax funding or are these services that one pays

(13) <https://www.iso.org/standard/69897.html>

GOING FORWARD - OPEN QUESTIONS

for according to need? Or are there other business models?

FROM DRIVER TO OPERATOR

What happens when today's drivers become operators instead? Today's solutions regarding the regulation of working hours with the help of data recorders become out-of-date, but might not be able to be replaced by regular working hours since the work's load varies over time, by what happens during the shift and according to how many vehicles the operator is to handle at the same time.

The industry's own estimate is that 50,000 new drivers will be needed in five to ten years (14). The autonomous vehicle might be able to reduce the number of drivers that actually sit in vehicles, but will hardly exclude humans from the loop entirely. This means that in a few years we may need to train thousands of operators who can handle several vehicles in traffic at the same time that they have the right qualification to drive the vehicles and competence to do so remotely. This will set new demands on what skills and competencies an operator will be expected to possess. Exactly which ones remains to be seen, as well as who will and can offer this training?

In parallel with the driver shifting to becoming an operator, new tools will be needed to manage the vehicle fleet. Depending on the number of vehicles each operator is to handle and the complexity of the tasks to be carried out, everything from a wireless control panel to full-scale control towers will be needed. And this will in turn build on wireless communication, which in

turn needs to be guaranteed to not introduce its own risks with the trials. Of course, 5G can play an important role here.

INDUSTRY PRACTICE AND INTELLECTUAL PROPERTY

An updated compilation of the industry's well-tried working methods could help new actors see what is needed to get an application approved. This would deter unreliable actors and simplify matters for the Swedish Transport Agency when it raises the quality of the applications, but could also facilitate the likelihood that the applicant has its application approved quickly and easily.

But who will compile and make the industry's own experiences available in the future? Is this, for example, a task for the trade association BIL Sweden (15)? Can the private actors cooperate with the Swedish Transport Agency, which has the task of being a scrutinising authority, but also holds all of the applications and experience reports?

At the same time that the need for a practice is something that could open up the Swedish market, many applicants classify details in their application as confidential since they do not want to share the vehicle's technical specifications or how they handle risks in the traffic area they intended to operate within. This is fully understandable. Getting a type-approved vehicle approved for tests represents an investment in both time and money so it is of course not something one wants to share free of charge. The route, the operator's service schedule and training can also reveal details about the applicant, which together with other information gives away

(14) <https://www.di.se/nyheter/stor-brist-pa-lastbilschaufforer/>

(15) <http://www.bilsweden.se/>

important intellectual property and allows competitors to get a free ride on the applicant's own investment. Balancing the need for information sharing with securing the own organisation's IP will accordingly be a challenge in the future.

GENERAL EXEMPTION

It does not appear likely or desirable that the general exemption will be removed since it would entail large administrative costs for the Swedish Transport Agency and would be negative for the auto industry's possibilities of vehicle testing. At the same time, manufacturers with a general exemption have a large competitive advantage compared with a start-up company. This bodes poorly with the principles of everyone being equal in the eyes of the law and that the exercise of public authority shall be transparent and foreseeable. At the same time, it is not possible to build a legal system based on trust – we trust you, but not you – as it opens up for arbitrariness.

Perhaps the solution is a clearer regulatory framework – a new authority regulation – concerning general exemption? Such a regulation could specify the conditions for receiving a general exemption, such as the number of vehicles in testing and/or production, certain turnover, the number of employees, etc. At the same time, the exemption could become temporary and

regularly reviewed to counter unreliable testing. Finding a suitable combination of criteria will require extensive work. NEVS for example currently manufactures no cars, but nonetheless has a general exemption and sees itself as a start-up. The same is true of Einride, but they have, as yet, no exemption.

At the same time that there is reason to review the general exemption so that it applies to more manufacturers, there is reason to not be too open. The activities concerning adaptation of vehicles to those with disabilities should still be regulated since it is exactly adaptation of already type-approved vehicles.

ABOUT THE PROJECT PLATT - POLICY LAB FOR AUTONOMOUS TRANSPORT SERVICES

The project was carried out in November 2018 to November 2019 within Drive Sweden's project portfolio. The project was led by Combitech with Einride and AB Volvo as industry partners and RISE as the academic party.

OBJECTIVES

The objective of PLATT was to...

- ...map, develop and describe how applicants can handle several different regulatory frameworks to successfully apply for complex transport services,
- ...empower the application process for both authorities and established companies that today do not view themselves as providers or practitioners

of autonomous transport services (as traditional vehicle manufacturers),

- ...synthesize and compile the experiences to promote future general and technology-independent application processes, and disseminate the Swedish work on testing activities concerning autonomous transport services in international contexts.

The nature of the objectives meant that it was very suitable to implement the project as a policy lab.

POLICY LAB

As regulatory frameworks cannot be changed at a speed that matches the rapid development of technology and markets,



ABOUT THE PROJECT

new methods are needed for policy and regulatory innovation. In Sweden and in other countries, so-called policy labs (16) have begun to be used, which seem to be able to use interactive and iterative methods to accelerate the adaptation of regulatory frameworks to the technology.

Policy labs are characterised by methods where new solutions are tested out from a user perspective together with relevant actors. Policy labs are done in active cooperation between concerned authorities, businesses and other stakeholders. Key characteristics of policy labs are co-creation, iteration and agility with a view to integrate as many perspectives as possible in the process. Instead of developing a perfect, static solution for a problem, the methods are characterised by experimenting to develop prototypes and pilots where ideas are tested in so-called "sprints" in real settings. Other important characteristics of policy labs are:

- Interdisciplinary approaches: Working groups consist of experts from various disciplines for a better holistic view. This contributes to overcoming the prevailing silo structures that are characteristic for public institutions.
- Co-design: Also called co-creation, refers to the idea that public services or policy should not be formulated for the citizen, but with them. This contributes to greater acceptance and insight into the decision making.
- Agility: This entails a higher degree of adaptive ability and flexibility, but should not be confused with a lack of planning. Agility is best suited to problems with extensive inherent uncertainty and non-linearity.

(16) <https://www.vinnova.se/m/smart-policyutveckling/policyutveckling-och-innovation/>

These characteristics make it possible for policy labs to bridge two different worlds: on one hand, the slow and risk-averse politics that develop regulations for citizens over the long term and, on the other, the innovative and risk-inclined businesses that create solutions for individual needs typical of growing markets based on new technology and possibilities.

ORGANISATION AND PROCESS

To achieve the objectives, the project work was conducted in two different groups. The daily work was done in a small group consisting of the project's parties where Combitech had the responsibility for project management, Einride and AB Volvo each conducted their own tests (from application to evaluation) and RISE contributed its expertise in policy development. In parallel, a larger group met once a quarter over the project period. At these meetings, local administrations, national authorities and different private actors had the opportunity to contribute their experiences and perspectives.

By Volvo and Einride bringing their experiences and thoughts to the quarterly meetings, the policy development was stimulated by concrete questions concerning implementation of the permit process and tests, at the same time that the discussions were able to be broadened and generalised by more actors being able to provide their views and thoughts.

In spring 2019, Volvo Group Truck Technology carried out an application process with the aim of obtaining a permit from the Swedish Transport Agency to conduct road tests with

ABOUT THE PROJECT

automated city buses. The permit process was conducted with the clear objective of showing that planned road tests shall be done in an acceptably safe manner and thereby meet the requirements set by legislators on testing activities with autonomous vehicles.

The work on the application was also done with a high degree of transparency with regard to principles and models to develop safety argumentation, although not with regard to technical data, so that the policy lab would work based on reality-based questions.

A description of the progress of the work together with the prepared safety argumentation is in the report "The Permit Process - Volvo Bus case study" (17).

Corresponding experiences from Einride's case are in the report "Einride findings" (18). It mentions the challenges regarding budgeting and planning, the importance of a focus on systematic safety work and the human in the system, as well as how it really is a process, both within and between tests. At the same time, it is pointed out how willing to cooperate Swedish authorities are in this process.

generalising them, and by producing this report, which summarises the conclusions from these meetings.

Further results are the more detailed reports that Einride and Volvo produced within the scope of PLATT. In that they are public, they contribute to spreading good examples of what an application can look like and how a systematic analysis of the risks concerning tests with autonomous vehicles can be presented and handled.

The work to disseminate the results has already begun with presentations at Drive Sweden Forum 2019 and Transformative Innovation Policy Consortium 2019. In the future, the project and its conclusions will be presented at Transport Research Arena 2020.

RESULTS

The project achieved the set objectives by holding the four large meetings where both public and private actors in the testing activities shared experiences and conclusions, but were also involved in problemising and

(17) Björn Enqvist, "Tillståndsprocessen - Volvo buss praktikfall", AB Volvo, 2019.

(18) Pär Degerman, "Einride findings", Einride, 2019.

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Policy Lab for Autonomous Transport Services

The report is written by Håkan Burden och Kristina Andersson. The project was done as part of the strategic innovation program *Drive Sweden* - a joint effort by the Swedish Innovation Agency Vinnova, the Swedish Research Council Formas, and The Swedish Energy Agency.



RISE

RISE RESEARCH INSTITUTES OF SWEDEN

RISE is Sweden's research institute and innovation partner. Through our international collaboration programmes with industry, academia and the public sector, we ensure the competitiveness of the Swedish business community on an international level and contribute to a sustainable society. Our 2,800 employees engage in and support all types of innovation processes. RISE is an independent, State-owned research institute, which offers unique expertise and over 100 testbeds and demonstration environments for future-proof technologies, products and services.