Ref. Ares(2023)7794270 - 21/12/2023

Rail to Digital automated up to autonomous train operation

D40.3 – Lessons learnt report on approval processes for automated tramways.

Due date of deliverable: 30/09/2023

Actual submission date: 17/11/2023

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Reviewed: Y/N

Document status		
Revision	Date	Description
01	13/11/2023	First draft
02	17/11/2023	First issue

Project funded from the European Union's Horizon Europe research and innovation programme		
Dissemination Level		
PU	Public	X
SEN	Sensitiv – limited under the conditions of the Grant Agreement	

Start date: 01/12/2022 Duration: 10 months

ACKNOWLEDGEMENTS

This project has received funding from the Europe's Rail Joint Undertaking (ERJU) under the Grant Agreement no. 101102001. The JU receives support from the European Union's Horizon Europe research and innovation programme and the Europe's Rail JU members other than the Union.

REPORT CONTRIBUTORS

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EXECUTIVE SUMMARY

- Context and objectives:

  The report is based on realities for Oslo and Norway and small or bigger deviations must be expected when going trough the process in other countries. This is due to the different level and structure of laws and regulations not only for autonomous vehicles, but also for operations of tramways in different countries and even in different cities in the same country.

  Report gives overview over the process itself, potential stakeholders, documentation requirements, timeline and level of approval needed for the demonstrator. The report outlines expected process for final approval of autonomous vehicles for urban context in controlled areas.

  Approval process for autonomous vehicle in urban context and commercial use might be only outlined with some assumptions and expectations. We need to remember that there is still lack of national laws and regulations for autonomous tramways in Norway. There is, however, legislation for testing of autonomous road vehicles in place, which we have used as a referance and done a comparison with in the process for approval of demonstrator in Oslo.

- Methodology:

  Step by step description of the process with some outlines of documentation necessary during the approval process has been used to cover objectives of thes deliverable. As mentioned in the name of this deliverable, this report is a lesson learnt for approval process for permission of testing / demonstrating remote controlled vehicles up to autonomous movements in the controlled areas with no access for the public.

  We knew before we started, that it will be a learning process not only for STR as a body seeking approval for the demonstrator, but also for the legal authorities issuing approvals and permissions. This is by many means a new issue not addressed before.

  It is also important to be aware of the fact that the guidelines depicted in the report are applicable only for urban context in non-commercial areas and are hardly transferable to mainlines or trains.

- Conclusions from the deliverable:

  The approval process has given us a unique possibility to identify and learn about what is and is not in place in both legislature and knowledge capacity at authorithies approving testing and demonstrating autonomous technology.

  Although many limitations to the process, lesson learnt is extreamely valuable source of information for both preparation of applications for testing and operating remotely controlled or autonomous vehicles, but also for shaping a future legislation for operation of autonomous vehicles, in this case light rail / tramways in urban context.

  No applicable legislation exist for for testing and demonstrator in closed areas, hence, no need to update any of legislation in order to get approval for testing and demonstrator in closed areas, but we have identified the possible need for such legislation when testing of autonomous functions in commercial traffic and non-restricted areas is applicable. Relevant legislation exist, but is not applicable to light rail / tramways, only for road vehicles.

ABBREVIATIONS AND ACRONYMS

ATO	Automatic Train Operation
R2DATO	Rail to Digital automated up to autonomous train operation
RAMS	Reliability, Availability, Maintainability and Safety
SJT	Norwegian Railway Authority (NRA)
SL18	Tramway type used in Oslo and in demonstator
STR	Sporveien Trikken AS
SVV	Norwegian road authorities

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1 INTRODUCTION

Deliverable D40.3 **Lessons learnt report on approval processes for automated tramways** is outcome for WP40 **Autonomous Tram Demonstrator** and task 3 **Approvals, derogations, and special permits.** Deliverable covers the required bureaucratic activities in order to get derogations or any other permission and approvals to enable the demonstration in WP41 and WP42. It includes activities such as meetings with railway authorities and the city of Oslo, or paper works and documentation preparation, among other. A valuable outcome of this task is a guideline and recommendations based on lessons learnt to facilitate such processes in other cities in Europe.

The present document constitutes the Deliverable 40.3 "**Lessons learnt report on approval processes for automated tramways**" in the framework of the WP 40, of FP2 R2DATO. It contributes as well to WP 41 **Remote Driving and Telecommand Demonstrator**, and WP42 **Tramway autonomous movements in depot demonstrator**.

These two work packages under the cluster "Demonstator" in the R2DATO are relevant in practical testing and validation of the solution for remotely controlled vehicle up to autonomous movements in closed depot areas. Demonstrator shall be executed at Sporveien Trikken's premises in Oslo.

Even though the demonstrator is binded to close depot areas, certain notifications, approvals and permissions are necesseary to obtain from regulation authorities in Norway and demonstrate compliance with Norwegian legislation and requirements.

Clear limitation to this report is

- Approvals, derogations, and special permits are restricted to closed depot areas and closed secured test tracks.
- Approvals, derogations, and special permits are temporary and applies to scope of WP41 and WP42 demonstrator.

Timeline with major milestones is presented in the report and reflects real situation and legislative requirements specific for Norway and Oslo. Certain modification might occur in other countries and cities. Having a national authority, no variations in legislation and requirements from a city to a city in Norway, and the same process will be applied in Bergen or Trondheim.

2 STAKEHOLDERS AND LEGISLATION STATUS IN NORWAY

2.1 NORWEGIAN LEGISLATION – SPECIFIC STATUS

Operation of tramways in Norway is regulated by the Norwegian Railway Act. Ref.[1]. Act on the construction and operation of railways, including tramways, tunnels, and suburban railways.

Subway and tramway are regulated by the same regulations, “kravforskriften”, Ref.[2]. At the same time, operating of the tramway system in Oslo is mostly carried out in the mixed traffic with other vehicle, pedestrians, and other traffic participants and as such must comply also with general road traffic regulations and traffic laws.

This situation has a substantial influence on the process for approval of test activities and vehicle modification related to the demonstrator, as well as developing the needed legislation.

No applicable legislation and / or regulation of operation with autonomous vehicles is yet introduced in Norway but an Act on testing self-driving [road] vehicles, Ref.[3], and Regulations on testing self -driving motor vehicles, Ref.[4], are applicable for testing of self-driving motor vehicles.

2.2 STAKEHOLDERS IN THE APPROVAL PROCES

2.2.1 SJT (Statens Jernbanetilsyn) – Norwegain Railway Authority

The Norwegian Railway Authority is the control and supervisory authority for rail traffic, which also includes tramways and underground in Norway.

The Authority is responsible for ensuring that rail operators meet the conditions and requirements set out in rail legislation that governs the traffic. The authority is also responsible for adopting regulations, issuing licences and authorisations for rail activity and approving rolling stock and infrastructure.

SJT is the authority that gives permissions and approval for modification of rolling stock used on rail network for railway operations. It is anticipated that an approval from SJT of the testing activities of remote and autonomous movement related to the demonstrator, not will be needed, since this activity will be sited in non-commercial and controlled areas with no access for the public.

The county or council are not involved in approving changes to trams and tramways in Norway.

2.2.2 SVV (Statens Vegvesen) – Norwegain Road Authority

The Norwegian Public Roads Administration leads the way in the development of an efficient, safe, and comprehensive transport system adapted to tomorrow's needs and technology in Norway.

The responsibility for national and European roads and for road users and vehicles makes the National Roads Administration the largest player in road transport in Norway.

The Norwegian Public Roads Administration is responsible for planning and building, operating, and maintaining this part of the road network.

SVV gives input and helps with guidelines in the approval process of the demonstrator and has no legal authority to grant or not grant permissions for modifications on trams with todays legislation. The main contribution is through experience with developing test laws for other autonomous vehicles (busses and cars) on public roads in Norway.

Guidance has been sought from SVV due to their experience on the subject matter.

2.2.3 Samferdselsdepartementet - Ministry of transport in Norway

STR is seeking guidance from the Ministry of transport in relation to which legislation will apply to self-driving vehicles/ autonomous functions for trams, which also run on public roads. This is because the existing legislation does not appear to be adapted for the use of autonomous/self-driving functionality in tram operation.

The Ministry of transport acknowledges that Norwegian legislation is not adapted to tram /light rail and has asked SVV to propose improvements to the legislation. STR is in contact with Ministry of transport, with intention to participate in the process of creation of legal frame for testing of autonomous vehicles.

3 DESCRIPTION, TIMELINE AND MILESTONES IN THE PROCESS

3.1 PROCESS DESCRIPTION

As the process of approval of testing remotely controlled tramway to autonomous movements with test vehicle is a completely new process not only for executors, but also for approval authorities, early communication between all stakeholders was necessary.

Orientation meeting with SJT and SVV – A guidance meeting with Norwegian Railway Authority, The Norwegian Public Roads Administration regarding SL18 Autonomous Tram Research Project was held in July 2022.

This meeting was a kick-off meeting to the whole process with aim to onboard Norwegian authorities and major stakeholders to the R&D project and outline scope and plans.

Main milestones for the approval process were discussed together with information about STR intention to send Notice of change to SJT for two SL18-vehicles.

Since the tram is operated in both separate tracks and shared traffic with road vehicles and pedestrians, this project wants to inform both rail- and road authorities. Regulations in the area of autonomous driving are scarce or lacking, and therefore this needs to be a joint effort going forward.

It was agreed to continue in communication and irregular meetings whenever necessary to exchange relevant information about project and status.

Follow up meeting with SJT and SVV – A second guidance meeting with Norwegian Railway Authority and The Norwegian Public Roads Administration regarding SL18 Autonomous Tram Research Project was held in June 2023. At this point, the project was progressed much longer and had a defined progress plan.

The road authority's recommendations and takeaways from this meeting were:

- A recommendation of sending the "Notice of change" to Norwegian Rail Authorities, also to be sent to the Norwegian Ministry of Transport (Samferdselsdepartementet) and the Norwegian Public Road Authorities (SVV) for information.
- Elaborated information from SVV about the test laws and regulations regarding autonomous functions and driving for road vehicles was given. An Act on testing self-driving [road] vehicles, Ref.[3] and Regulations on testing self -driving motor vehicles, Ref.[4], have been drawn up for the testing of self-driving motor vehicles. SVV provided some background on how these laws and regulations were developed.

Notice of change is used when vehicles with exiting operation permission are modified to extent, which does not require a new approval process for a new operation permission.

Notice of change to Norwegian rail authorities – In July 2023 STR sent notice to SJT in accordance with the Regulations on requirements for tramways, subways, and suburban railways (the requirements regulations, Ref.[2]) § 12-8 and § 12-9, a notification is submitted regarding changes to trams 455 and 456 of the tram type SL18.

The expected outcome was that an application for the modification of the two trams is needed, but no application for the testing activities within closed areas with non-commercial operations is needed. The application must show that the modification has no influence on the original configuration in passenger service. The expectation is that the authorities will not need an application of the autonomous functions at this stage since the demonstrator and tests will happen on non-commercial and restricted areas.

The letter also informs the Norwegian Public Roads Administration about testing of self-driving trams and outlines a need for guidance from the Ministry of Transport (SD) regarding legislation for the development of autonomous functions for trams in traffic and in controlled areas outside the tram network.

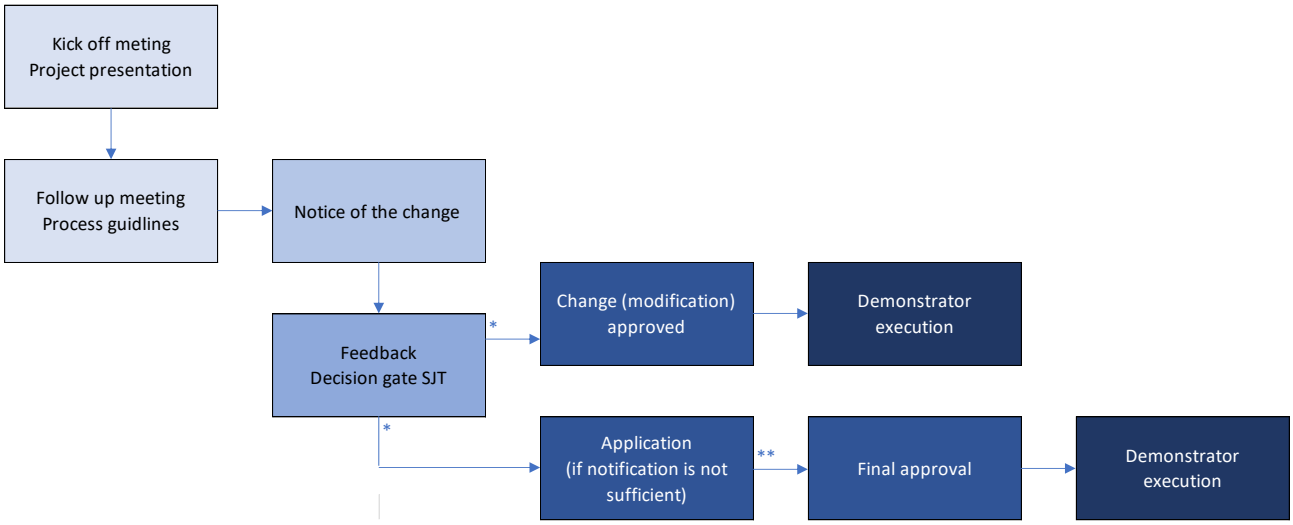
Due to lacking legislation in this area STR points to the Act on testing self-driving [road] vehicles, Ref.[3], and Regulations on testing self -driving motor vehicles, Ref.[4][4] , STR has reviewed this law and regulations, in the absence of corresponding legislation for trams, and aims to fulfil all relevant requirements given there to support the project on the legislation that exists in the area.

Application for modification of trams – following the SJT response, this step is not necessary for controlled areas outside the tram network, but this can vary in other countries as a notice could not be enough in some cases. It is quite possible that in some countries, the notification and application step can be merged to one depending on the practise in each individual country.

Internal approval of an activity – this is the internal approval requirement in STR, where all activities not included in common operation description need to be evaluated, risk assessed and mitigated actions agreed prior to execution of such activity. This approval is based on an approved technical solution, a test / activity execution plan, risk analysis, safe job analysis and mitigation action plan. The approval is issued by Safety and Technical department in Trikken.

3.2 TIMELINE AND DECISION GATES IN THE APPROVAL PROCESS

Illustration of the possible approval process flow



"" and "**" – legally grounded three months processing time for answer and / or approval for SJT*

Figure 1: Illustration of the process flow for approval in Norway

3.3 NOTIFICATION TO NORWEGIAN AUTHORITIES

Notice of changes to trams for testing of autonomous functions, notification of significant importance, information on testing, and request for guidance in relation to legislation in the area.

The purpose of this letter was to

- submit notice to the Norwegian Rail Authorities (SJT) about the change of two trams.
- submit a notification to the Norwegian Rail Authorities significant functional or actual changes with significance for operations.
- inform the Norwegian Public Roads Administration about testing of self-driving trams, and
- seek guidance from the Ministry of Transport (SD) regarding legislation for the development of autonomous functions for trams in traffic and in controlled areas outside the tram network.

STR is still waiting for a response regarding guidance from the Ministry of Transport. A response has been received from SJT confirming that an application is required for operations on the tram network with active autonomous functions enabled. The project is progressing with the assumptions made in chapter 3.1.

Attachments to the notification:

- System description
- Activity plan and schedule for progress for approval process
- Safety plan
- Risk assessment
- List of applied standards

4 CONCLUSIONS

The positive outcome from SJT, that just the application for modification of the trams are required for operations on the tram network with active autonomous functions enabled confirmed our assumption. No application of the testing activities within closed areas with non-commercial operations is needed.

The deliverable describes a process regardless of outcome of the first stage (notification of change to the Norwegian rail Authority) and covers all process flows to obtain the final approval.

An issue if not obstacle in the process is missing or incomplete legislature for operation of driverless vehicles.

However, during this project, with testing and demonstrating remote and autonomous driving only in restricted areas, our assumption is that lacking legislation will not hinder the approval of the demonstrator; the changes made on the trams will not be active in public transport, only during testing in restricted areas not included in the scope of the legislation (kravforskriften, Ref.[2]).

Our expectation is therefore that the need for updated legislation is more needed in the next stage of testing, following R2DATO, when autonomous functions need to be tested in public areas. As a preparation for this, the project seeks to fulfil the test-laws developed for autonomous road vehicles in Norway. Uniqueness of Norwegian legislation for operation of tramways covered by the same laws and regulations as subway, must be also taken into the consideration when applying principles of this guidelines in different countries.

It is important to onboard all stakeholders in the process soon enough and prepare documentation for smooth evaluation and so simplified approval process.

- All objectives of this deliverable are achieved, and comprehensive description of the demonstrator approval process gives good starting point for all operator potentially seeking approval for similar testing;
- Although approval process for STR in not completed yet, all possible outcomes, subsequent actions and mitigations are described in the deliverable;
- Process setup is proved to be resistant to potential deviations due to the fact that it was designed together with relevant Norwegian authorities;
- The main executor of the process was Safety and technical department in STR.

The deliverable covers all aspects of this task – to guideline approval process for demonstration of remotely control vehicles to autonomous movements in non-commercial areas as it is scoped in R2DATO WP41 and WP42.

REFERENCES

[1] The Railway Act (Jernbaneloven) – (LOV 1993-06-11 NR 100, 01.07.1993)

[2] The Requirements regulations (kravforskriften) – (FOR-2014-12-10-1572, 01.01.2015)

[3] Act on testing self-driving vehicles (LOV-2017-12-15-112, 01.01.2018)

[4] Regulations on testing self -driving motor vehicles (FOR-2017-12-19-2240, 01.01.2018)