MERIDIAN

Report

T1.04 Knowledge Building:
Digital Corridor Management

Sub-task T1.04.03
Digital Corridor Management

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Preface

The T1.04 Knowledge Building workshops on Digital Corridor Managements were organized as part of the horizontal task T1.04 of work package WP1 ‘Project Management and Knowledge Building’ of the Meridian project.

The purpose of task T1.04 is to exchange and build up knowledge on relevant topics, amongst others Digital Infrastructure, C-ITS, Bottleneck and Digital Corridor Management and Multimodal Services, etc.

The workshops summarized in this report are focused on the topic of **Digital Corridor Management**, and selected areas of interest thereof.

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1 Abbreviations

AADT	Annual Average Daily Traffic
ADR	Accord européen relatif au transport international des marchandises Dangereuses par Route (i.e. dangerous goods)
AI	Artificial Intelligence
ANPR	Automatic Number Plate Recognition
AV	Autonomous Vehicle
CCTV	Closed Circuit TV
CEF	Connecting Europe Facility, an EU funding programme
CEN	Comité Européen de Normalisation, European Committee for Standardization
C-ITS	Cooperative Intelligent Transport Systems
C-V2X	Cellular Vehicle to everything (3GPP standard)
DAS	Distributed Acoustic Sensors
DATEX II	DATa EXchange between traffic and travel information centres
DCM	Digital Corridor Management
DFRS	Data for Road Safety
DR	Delegated Regulation
EIP	European ITS Platform
ERTICO	European Road Transport Telematics Implementation Coordination Organisation
F&LS	Freight & Logistic Services
IM	Incident Management
ISO	International Organization for Standardization
ITS	Intelligent Transport Systems
MaaS	Mobility as a Service
NAP	National Access Point
NAPCORE	National Access Point Coordination Organisation for Europe
OEM	Original Equipment Manufacturer, i.e. car or truck manufacturer
RTTI	Real-Time Traffic Information
SCADA	Supervisory Control And Data Acquisition
SOP	Standard Operating Procedure
SRTI	Safety Related Traffic Information
TCC	Traffic Control Centre

TM	Traffic Management
TMC	Traffic Management Centre
TMP	Traffic Management Plan
TMS	Traffic Management Services
TM2.0	Traffic Management 2.0
TTIS	Traffic & Travel Information Services
VMS	Variable Message Signs
V2I	Vehicle to Infrastructure
V2V	Vehicle to Vehicle
V2X	Vehicle to everything
WIM	Weight In Motion

2 Introduction

This report is a summary of three workshops that were organized by the Meridian corridor project as part of its knowledge exchange and knowledge building task, and more particularly on the topic of **Digital Corridor Management**. The workshops were organized as on-line events in order to attract the necessary experts. The workshops were held on 27 June 2023, on 7 July 2023 and on 25 September 2023.

The workshops were organised around a number of thematic sessions, being:

- ★ Definition of Digital Corridor Management
- ★ Eco-system partners of the Digital Corridor Management
- ★ Financial sustainability
- ★ Bottlenecks that can make mobility management along a corridor more difficult
- ★ The minimum requirements for optimal mobility management along a corridor
- ★ Technological and organizational solutions that benefit mobility management along a corridor.

The main purpose of knowledge exchange and knowledge building task of Meridian is to exchange experiences, issues and solutions between the different partners of the Meridian corridor project.

Besides presentations by the different experts of the respective Bottleneck and Digital Corridor Management implementation projects (grouped in work package WP4), discussions and knowledge exchange, also a prominent speaker outside the Meridian corridor project was invited during workshop 3 to testify on the implementation of digital corridor management within his organisation.

This document is structured in a section per workshop and its conclusions: sections 3, 4 and 5. A 6th section focusses on overall conclusions and section 7 gives some further reading which were collected during the workshops.

3 Workshop 27 June 2023

3.1 Session A1 - Presentations of Meridian Partners

Welcome and introduction

The workshop started with a welcome and some basic information by the host and organisers:

- ★ Welcome and introduction by Ilaria De Biasi, Meridian Corridor (Autostrada del Brennero).

Ilaria introduced the scope and goals of the first workshop:

Purpose is to give a short presentation by the first 9 partners involved in the DCM activity (15' each). Each partner was asked to present its implementing task / project focusing on the 3 main areas of interest we would like to highlight in the deliverable on Digital Corridor Management, being:

- ★ Definition of Digital Corridor Management
- ★ Eco-system partners of the Digital Corridor Management
- ★ Financial sustainability.

The Meridian implementation tasks identified for the first workshop are:

- ★ T4.01 Dynamic Traffic Management and Peak hour lanes
  T4.02 Tunnel Safety Systems (Flemish Agency for Roads and Traffic)
- ★ T4.03 Strategic Corridor Management Germany (Autobahn GmbH)
- ★ T4.04 ArBIS Roll-Out to regional partners on the Alpine Corridor (ZVM Bayern)
- ★ T4.05 Data extension and exchange in the Alpine Corridor (ZVM Bayern)
- ★ T4.06 Deployment of ITS equipment on the M7/N7 on the approach to M50 to facilitate incident detection (Transport Infrastructure Ireland)
- ★ T4.07 Deployment of ITS equipment at approaches to Cork's Jack Lynch Tunnel (N40/M8/N25/N8) (Transport Infrastructure Ireland)

★ T4.15 Detection of critical traffic situations and notice to users “Viaggiare in Trentino” (Autonomous Province of Trento).

3.1.1 T4.01 Dynamic Traffic Management and Peak Hour Lanes & T4.02 Tunnel Safety Systems - Flemish Agency for Roads and Traffic

Speaker(s): Jean Walravens

Jean presented the T4.01 Dynamic Traffic Management and Peak Hour Lanes implementation task, being implemented on stretches of the E40 and E17 motorways in Flanders. The services implemented by this task were mapped on the EU EIP Reference Handbook defined Traffic & Travel Information Services (TTIS), Traffic Management Services (TMS) and Freight & Logistic Services (F&LS). Since the T4.02 Tunnel Safety System implementation task is not directly linked to Digital Corridor Management as such, it was not highlighted.

The presenter also gave a definition of Digital Corridor Management. DCM is traffic management for corridors and networks where the output / what is exchanged (Traffic Management Plans - TMP - the measure which is agreed and activated) is digitalized in a harmonized and standardized way and exchanged with other stakeholders. Such DCM can be at different levels: regional, cross-regional / cross-border. According to the EU EIP, a Traffic Management Plan (TMP) is a pre-defined allocation of a set of measures to a specific situation in order to control and guide traffic flows as well as to inform road-users in real-time and provide a consistent and timely service to the road user. Initial situations can be unforeseeable (incidents, accidents) or predictable (recurrent or non-recurrent events). The measures are always applied on a temporary basis.

The eco-system partners of such a Digital Corridor Management service are classified in road users, the Flemish TCC, the TCCs of cities, conurbations, regions, neighbouring countries, navigation service providers / vehicle manufactures, the National Access Point (NAP) and the Flemish open data portal.

As to the financial sustainability it was considered that traffic management – on a corridor or not – is intrinsically inherent to our operations, hence incorporated in our way of working. It is recognised that additional developments result in additional costs to our operational cost. There is a need and an understanding to cooperate between public & private organisations, as is proven by different initiatives like e.g. the Data for Road Safety (DFRS) initiative in the context of safety related traffic information (SRTI) and recent workshops in Paris and Berlin between NAPCORE and TM2.0 in the context of real-time traffic information (RTTI). Such initiatives are based on goodwill from both the public and private sides and should create a win/win/win for the road users/ road authorities / service providers.

3.1.2 T4.03 Strategic Corridor Management Germany - Autobahn GmbH

Speaker(s): Matti Strohschein

Matti presented the T4.03 Strategic Corridor Management tasks being implemented in Germany. Cooperative Network Management on strategic corridors between metropolitan areas is a new task for the 9 state-operated TMCs. Historically, the state-operated TMCs had no technical interfaces between each other and thus, management strategies involving two or more TMCs were only event-based. With the new Corridor Management, travel time-based strategies will go into operation. At the current state of play, die Autobahn is implementing tools to enable TMC-operators to manage the national corridors, with a plan to embed international corridors into the system. The workflow management system allows for strategic coordination of scenarios between

TMCs to be planned as measures in digital corridor management. The presenter also expanded on the ecosystem partners involved in the Cooperative Network Management on Strategic Corridors, as well as on the financial sustainability in the sense that the costs are born by the government were as the gains are of socio-economic nature.

3.1.3 T4.04 ArBIS Roll-Out to regional partners on the Alpine Corridor - ZVM Bayern

Speaker(s): Axel Burkert

Axel explained in short the ArBIS roll-out to regional partners like for instance districts, municipalities and telecom operators who also plan road works. ArBIS is the Bavarian road works management and coordination system.

3.1.4 T4.05 Data extension and exchange in the Alpine Corridor - ZVM Bayern

Speaker(s): Axel Burkert

Axel also shortly explained the data extension and exchange implementation task which goes beyond planned road works warning information and also includes traffic flow, camera images information, etc. exchange with neighbouring regions and countries on the Alpine Corridor, and on alternative routes to the Alpine Corridor.

Axel expanded on the provided services as defined in the EU EIP Reference Handbook.

3.1.5 T4.06 Deployment of ITS equipment on the M7/N7 on the approach to M50 to facilitate incident detection - Transport Infrastructure Ireland

Speaker(s): Gorkem Yetik

Gorkem introduced the implementation task T4.06 which entails the development and deployment of new systems to provide crucial information to road users and enable Transport Infrastructure Ireland to efficiently operate the key motorway section M7 and national primary road N7. Among others, TII will deploy Distributed Acoustic Sensors (DAS) monitoring vibrating mechanical /acoustic waves along an optical fibre as one of the traffic & incident detection systems.

The EU EIP defined Traffic and Travel Information Services (TTIS) and Traffic Management Services (TMS) that will be enabled by the task were explained.

3.1.6 T4.07 Deployment of ITS equipment at approaches to Cork's Jack Lynch Tunnel (N40/M8/N25/N8) - Transport Infrastructure Ireland

Speaker(s): Munya Mutyora

Munya explained the Cooperative Intelligent Transport System (C-ITS) facilities as part of Digital Corridor Management at approaches to Cork's Dunkettle Interchange and Jack Lynch Tunnel (N40/M8/N25/N8) and how – together with traditional ITS facilities - it enables EU EIP Reference Handbook described Traffic & Travel Information Services (TTIS) and Traffic Management Services (TMS). The involved stakeholders in the ecosystem were explored and categorised in road/transport authorities, local councils, road network operators, end-users, C-ITS and ITS equipment manufacturers, smart mobility partners, international partners, cellular telecommunication companies, vehicle manufacturers, standardisation organisations, academia and some other stakeholders.

3.1.7 T4.15 Detection of critical traffic situations and notice to users "Viaggiare in Trentino" - Autonomous Province of Trento

Speaker(s): David Tamanini

David presented the how the detection of critical traffic situations and the provision of information and warnings to users on the road network of the Autonomous Province of Trento fit in the Digital Corridor Management. Where the province of Trento is crossed by motorways, it also has a lot of arterial roads, hence the ecosystem partners are next to the road manager of the Autonomous Province of Trento itself, the A22 Brenner motorway operator, the public transport operators and the end users (road users including cyclists and pedestrians, public transport users, etc.).

3.2 Session A2 – Discussions on the Definition of Digital Corridor Management

After the first session with the different presentations of the first set of implementation tasks a workshop discussion was moderated by Jean, with the aim of coming to a definition of Digital Corridor Management.

The core of Digital Corridor Management is the standardised exchange of **plans**, Traffic Management Plans (TMP) - what measure such a rerouting to take in case of particular events, and standardised exchange of **data** via NAPs (in DATEX II). Digital Corridor Management has a cross-border dimension.

There have been projects where TMPs and alternative routes were added as DATEX II extensions. TMPs go far beyond alternative routes because there are scenario's involved and there is an organisational aspect. Important to stress is that it is not only about a common data format, but the more complex task of Digital Corridor Management is at the organisational level: the organisational structure, the processes and agreement between different organisations on specific plans per scenario or when reaching particular threshold. As an example, a road authority proposed alternative route is in most cases different from an alternative route calculated by a navigation system provider, since their algorithms are based on shortest route or shortest travel time. On the same page, a proposed alternative route from one national road authority might be in conflict with the approach a neighbouring road authority wants to see implemented because of e.g. road traffic capacity.

TMP covers both planned events (e.g. road works), predictable (recurrent or non-recurrent) events, but also unplanned events such as incidents, accidents or when traffic reaches certain thresholds.

It was suggested to collect past TMP experiences from our partners (and associated partners) and provide some guidelines and collect best practices as input for a future discussion. In part, such guidelines and best practices can be found in the section 7 on Further Reading.

It was highlighted that in the new RTTI DR (EU)2022/670, service providers must process and include in the relevant services they provide, data on any traffic circulation plans and traffic regulations and restrictions developed by the competent authorities.

After the first workshop, in summary the DCM eco-system consists of:

- ★ TMC of the road authority/operator
- ★ TMCs of cities, conurbations, regions, neighbouring countries
- ★ road users

- NAP
- OEMs / service providers / aftermarket service providers
- public transport organisations;

sometimes extended with:

- emergency services (police, ambulances, fire brigades, towing services)
- ITS equipment and services suppliers and integrators
- service and content providers: radio stations, TV broadcasters.

Some of the pre-requirements for a DCM are:

- information sharing among stakeholders at local/regional as well as cross-border level
- corridor not only means motorway, but also urban and peri-urban network
- involvement of private and public stakeholders
- work on interoperability / interconnection of systems and TMCs
- availability of hardware and software to share information among stakeholders – digitalization of process and information sharing
- involvement of OEMs also needed
- harmonisation of road works needed
- need to improve existing TMPs (digitalization and info sharing with regional authorities) – TMPs already in place since Corvette and Ursa Major projects
- 1st step: improve infrastructure / 2nd step: improve info sharing (even multilingual and not restricted only to certain categories of users)
- share info to navigation service providers
- improve real-time information through C-ITS information
- standardized way of exchanging information / data among different stakeholders, TMCs, etc. via NAPs for instance.

4 Workshop 7 July 2023

4.1 Session B1 - Presentations of Meridian partners

On the second workshop, Ilaria introduced again the scope and goals of the workshop.

Purpose is to give a short presentation by the remaining 8 of the 17 partners involved in the DCM activity (15' each). Each partner was asked to present its implementing task / project focusing on the 3 main areas of interest we would like to highlight in the deliverable on Digital Corridor Management, being:

- ★ Definition of Digital Corridor Management
- ★ Eco-system partners of the Digital Corridor Management
- ★ Financial sustainability.

The Meridian implementation tasks identified for the second workshop are:

- ★ T4.08 Tunnel 4.0 (ANAS)
- ★ T4.09 Advanced traffic counting and classification system with multi-technology sensors support and AI (Autostrada Brescia Verona Vicenza Padova)
- ★ T4.10 Creation of a MaaS integration layer including traffic data and extension of the infrastructure to reduce emissions (Autostrada del Brennero)
- ★ T4.12 Urban sensors network (Comune di Trento)
- ★ T4.13 Digitalization and management of the arterial road network of the Autonomous Province of Bolzano (Autonomous Province of Bolzano)
- ★ T4.14 Platform for integrated monitoring of mobility in Trentino along the Brenner axis (Autonomous Province of Trento)
- ★ T4.16 Real-time information on road closures (National Data Warehouse – city Amsterdam)
- ★ T4.17 Digitalize traffic management scripts (Rijkswaterstaat)

4.1.1 T4.08 Tunnel 4.0 - ANAS

Speaker(s): Daniele Boffa Natalino

ANAS operates 32.000 km of roads and highways in Italy, over 2.000 tunnels, of which 280 km of TEN-T tunnels. Remote control is performed via a digital Road Management Tool (RMT) with a Tunnel Telecontrol sub-system (SCADA system). The "Tunnel 4.0" task aims to implement, in some Anas tunnels, sensors capable of detecting parameters such as temperature, vibrations, air opacity, speed, CO_2, NO_X, etc., which influence the management of the road infrastructure, to carry out predictive maintenance. The Tunnel 4.0 task aims at integrating existing sensors/devices of 2 tunnels (7 km long) into AI neural network, to optimise the usage of the collected data.

Daniele also highlighted the EU-EIP Reference Handbook defined services which are provided by the Tunnel 4.0 task: Traffic & Travel Information Services (TTIS) and Traffic Management Services (TMS).

Digital Corridor Management is defined as implementing digital systems and services along the busiest European freight corridors in order to increase traffic safety, reduce congestion and reduce environmental pollution

Ecosystem partners of the DCM are 24 ministries, road authorities, road operators, urban and port authorities, a federal highway research institute and hub operators from several EU countries.

Regarding financial sustainability, the abovementioned capability enabled by Tunnel 4.0 improves the financial sustainability of the ANAS road management system, optimizing the costs by reducing maintenance operations and preventing safety hazards.

4.1.2 T4.09 Advanced traffic counting and classification system with multi-technology sensors support and AI - Autostrada Brescia Verona Vicenza Padova

Speaker(s): Matteo Gironi

Context is the West-East A4 corridor crossing the A22 Brenner motorway.

Counting and classification of traffic by transversal multilane radar sensors (30) and integrating with the existing WIM (Weight in motion) counting and classification system, and AI based CCTV counting system.

Ecosystem partners are municipalities, connected and non-connected vehicles (road users), interconnected motorway operators and insurance companies.

From the point of financial sustainability, we manage a tolling road, hence traffic management is our core business. Better management with less road closures and less accidents leads to lower economic and social costs. In addition, by law we are required to classify the traffic in 8 classes.

With respect to the services defined in the EU EIP Reference Handbook, Matteo highlighted the applicable Traffic & Travel Information Services (TTIS) and Traffic Management Services (TMS).

4.1.3 T4.10 Creation of a MaaS integration layer including traffic data and extension of the infrastructure to reduce emissions - Autostrada del Brennero

Speaker(s): Ilaria De Biasi

Ilaria explained the 2 sub-activities, being at the one hand a MaaS integration layer including traffic data, and on the other hand the extension of infrastructure to reduce emissions. The first sub-activity creates an information layer collecting data from different modes and implementing a real-time multimodal/intermodal management dashboard and trip planning engine. It will use available traffic data along the corridor, exposing route calculation functions to third parties. The project aims at the construction of a digital European motorway corridor, bringing together infrastructures and services from different geographical, national and cross-border areas.

The second sub-project integrates low-cost air quality measurement sensors, traffic detection systems (inductive loops, CCTV cameras) and variable message signs in order to extend the traffic management measures implemented as part of the European BrennerLEC project to increase motorway capacity and reduce emissions, thereby achieving the environmental objectives. Traffic, weather and air quality data is collected to dynamically forecast and suggest speed limits to be activated by the traffic control operators.

Ilaria highlighted which EU EIP Reference Handbook services are implemented by the implementation task.

Ilaria expanded on the definition of Digital Corridor Management:

- ★ Implementation of a **set of measures to efficiently manage corridor traffic in a harmonized way and with the support of technology**, by involving road operators and stakeholders at cross-border, regional and local level and extending the area of interest from the motorway corridor to the urban and suburban road network and possibly including several modes of transport passing along the corridor of interest.
- ★ The **management of construction sites and major and/or emergency events** that may have a cross-border impact should be handled jointly along the entire corridor. In case of specific events having an impact at cross-border level (major weather events, accidents, traffic blocks, major roadworks, etc.), TMPs are applied to manage corridor traffic.
- ★ **Communication among road operators and stakeholders** to handle corridor events must be regulated by agreements: creation of a single coordination committee of the infrastructure operators involved meeting at regular intervals to discuss future construction sites and possible major events and taking joint measures (defining thresholds, scenarios, etc. of events considered to be of interest for the corridor).
- ★ **Coordination** for the management of construction sites (planned or unplanned) and other (partly also unplanned and hardly foreseeable) events must take place on different levels.
- ★ **Real-time information** to users is of paramount importance to prevent queue risks and to manage crisis situations -> need to provide users with real-time information; to provide users with recommendations for their journeys (important: a distinction must be made between private and professional users) to avoid overloading the infrastructure; to collect information from the travelling user to improve real-time data or exploit commercial floating data; to educate users.
- ★ Effective crisis management relies on being able to **exchange accurate information** in real time.
- ★ **Joint management of mobility and crisis situations** along a corridor can significantly reduce or eliminate congestion and stop-and-go phenomena that have a strong impact on air quality.
- ★ A **digitized corridor** should improve traffic management, reduce congestions and pollution.
- ★ Digital Corridor Management should integrate **different modes of transport** (also public and private)

Stakeholders of such DCM are the road users, the road and railway operators, the TCC of motorway operators, provinces and cities along the corridor, navigation service providers, organizers of large events, car manufacturers and the police.

As too the financial sustainability Autostrada del Brennero (the A22 is a tolled highway) has a financial plan until 2050 for investments contributing to the creation of a digital green Brenner corridor, including aspects of digital corridor management.

4.1.4 T4.12 Urban sensors network - Comune di Trento

Speaker(s): Adamo Ferro

The Trento municipality is located in the Alps and crossed by the A22 Brenner motorway and several national, provincial and local roads. The current traffic management of the commune of Trento is based on a large set of sensors/traffic lights but working stand-alone / off-line and not

integrated. The new systems will allow traffic lights, loop detection systems, CCTV camera's, etc. to exchange data. This **enabling project** provides more and real-time data, and could allow to use the data to perform traffic management / digital corridor management.

DCM for a city should allow for harmonic traffic management between different road levels (motorway, provincial roads, secondary roads) and provide quick solutions to occurring problems.

Ecosystem for DCM consists next to the municipality Trento, of the A22 Autostrada del Brennero, the Trento province and neighbouring provinces.

Relevant EU EIP Reference Handbook defined services are TTIS-01 (Traffic & Travel Information Services) Forecast and Real-time Event Information and TTIS-02 (Traffic & Travel Information Services) Traffic Condition, but the municipality of Trento is not going to provide these services directly.

With respect to the financial sustainability the implementations are carried out and maintained with internal funding. EU CEF co-financing facilitates the implementations.

4.1.5 T4.13 Digitalization and management of the arterial road network of the Autonomous Province of Bolzano - Autonomous Province of Bolzano

Speaker(s): Fabian Telch

The province of South Tyrol is crossed by the Scandinavian - Mediterranean corridor consisting of two parallel roads, the A22 highway and the SS12 national road. Interaction occurs between the A22 and the SS12 in case of accidents, road works, etc. On the other side there is interaction with the provincial roads. Traffic data is traditionally captured by inductive loops, but more data is captured now via ANPR cameras and used in the first place for traffic analysis. The data can be used for e.g. better organisation of road construction sites, reducing accidents and queues, optimize public transport, control of exceptional transport, control of dangerous goods (ADR), reduction of air and noise pollution, etc. Statistical data can be exchanged with and from Autostrada del Brennero or the neighbouring provinces.

4.1.6 T4.14 Platform for integrated monitoring of mobility in Trentino along the Brenner axis - Autonomous Province of Trento

Speaker(s): Iuri Apollonio

The project deals with improvements of the infrastructure to collect more data for traffic optimisation purposes.

The autonomous province of Trento (PAT) implementation task aims for the optimisation of the existing road transport network, i.e. the Brenner corridor and the transversal roads feeding the Brenner corridor.
Work areas are the creation of a dense traffic control network to acquire high-precision data in real time; to perform data analysis and software development to alert critical issues, and sharing and information with eco-system partners.

Iuri highlighted the applicable Traffic and Travel Information Services (TTIS) defined in the EU EIP Reference Handbook.

Next to Viaggiare Trentino, the ecosystem consists of the province of Trento road department, the municipality of Trento, consortia of municipalities, A22 Autostrada del Brennero, the Trento area public bus transportation organisation, …

Iuri highlighted the applicable Traffic and Travel Information Services (TTIS) defined in the EU EIP Reference Handbook.

Expected results such as of the project were highlighted. Besides direct results also the data can be used for statistical analysis.

4.1.7 T4.16 Real-time information on road closures - National Data Warehouse & city of Amsterdam

Speaker(s): Vincent Lau (city of Amsterdam)

Vincent gave an overview of the existing data chain / ecosystem between road authorities, the NAP and service providers, etc. However planned road works can be delayed, margin, etc. Hence such data has poor data quality. An RFQ for new Floating Car Data providing 2 million active probes of road segments of 500m (population of 16 million inhabitants), which in the IDEA (Intelligent Data Exchange Alliance) project are merged with planned road works and closures data and real time data allows to validate the road works and creates more quality. A feedback loop with service providers is further investigated, also in the context of NAPCORE (cfr. RTTI). Cost went down 80% because a bulk purchase compared to individual purchases.

4.1.8 T4.17 Digitalize traffic management scripts - Rijkswaterstaat

Speaker(s): Video

The instruction video was shown explaining the Diego tool for road operators. The tool is used for making digital traffic management scripts. Digital traffic management scripts can be designed, approved, managed and consulted within a traffic management organisation and can be communicated to other traffic authorities.

4.2 Session B2 – Discussions on the Definition of Digital Corridor Management

After the different presentations a discussion took place. It was considered that with the information gathered so far, there was no need to organise further information gathering e.g. based on PAPI (Pen-and-Paper Personal Interview) methodology.

No further discussion on the DCM definition was carried out as enough elements were collected during the workshop. Two added values were added:

- advantage to have 24/7 TMCs
- advantage to have pre-defined scenarios to activate management measures (like in the Netherlands and in the Province of Bolzano).

It was suggested to all partners to share best-practices on how they manage specific events having impact at corridor level, showing how the cooperation and communication among different actors can improve traffic management.

As for financial sustainability, it was summarized that both private toll operators and public road authorities consider Digital Corridor Management their core business and want to invest on it and maintain it.
They are also forced to do that considering new directives on ITS and on the fulfilment of Scope 1, 2 and 3 at environmental level.

After the second workshop, in summary the DCM eco-system consists of:

- stakeholders varying from project to project according to their implementation, but always including both private and public actors
- police only at municipality level. Police and emergency services are not really to be included in traffic management measures at corridor level, as they are more part of service handling. Whereas at local level the police is not only involved in emergency situations but also for traffic management at local level
- information sharing at local level among the stakeholders involved, but also at national level with the NAP: stand-alone projects are not efficient; information sharing is always needed
- importance to involve cities if their position is relevant along a corridor.

5 Workshop 25 September 2023

The third workshop was structured in two parts, where Mr. Enrico Ferrante from Autostrade Alto Adriatico (before Autovie Venete) as a guest speaker talked about the approach and the lessons learned of the implementation of cross-border traffic management activities and in particular of the implementation of traffic management plans with Austria and Slovenia. The second part of the workshop consisted of a deeper dive into three additional questions:

- ★ What are the bottlenecks that can make mobility management along a corridor more difficult?
- ★ What do you think are the minimum requirements for optimal mobility management along a corridor?
- ★ What technological and organizational solutions do you think could greatly benefit mobility management along a corridor?

5.1 Guest Presentation by Autostrade Alto Adriatico

Speaker(s): Enrico Ferrante

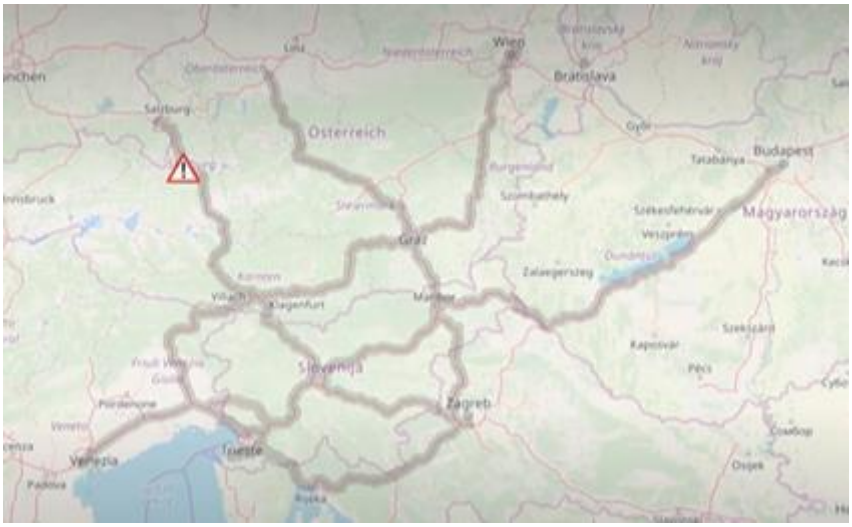
Enrico is the former leader of the Expert Group on Traffic Information Services (TIS), collecting Best Practices and review of the Deployment Guidelines of EU EIP.

Autostrade Alto Adriatico, which recently replaced Autovie Venete is managing the motorway between Venice and Trieste. It's an important Italian motorway, having a strategic position as it connects North-East Italy to Slovenia and to Austria. During the Crocodile project traffic management plans (TMP) for international traffic purpose were developed. In the specific case of Autostrade Alto Adriatico they focus on seasonal peak traffic days (in summer, in winter). The Crocodile project focused on the exchange of event information for road conditions in other countries and cross-border traffic management plans (TMPs). The goal of the project was to create, upgrade and digitalise international TMPs on TEN-T corridors.

The project started with several meetings during the first years between the road operators to define what was needed in order to deploy cross-border TMPs. This explanation is focusing on the approach that was taken and the results obtained. Important was to understand and have the basic knowledge of the managements to determine a common understanding in a LoI (Letter of Intent) or a MoU (Memorandum of Understanding).

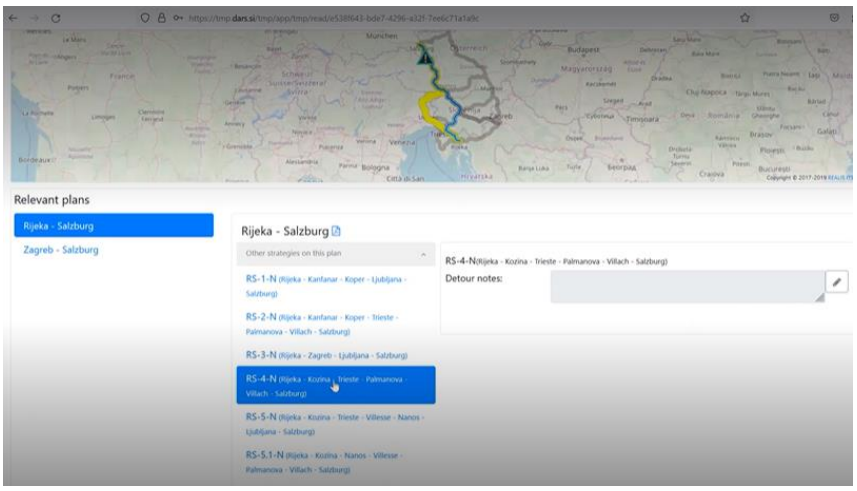
The stage of a signed Memorandum of Understanding (MoU) which is an engagement of all the stakeholders is an important step which is also described in the guidelines handbook. This was followed by a study of the different national management plans trying to link them into one international TMP. Next is a study of the minimum required level of ITS systems (e.g. how to measure the threshold traffic level). Efforts will be in vain if TMC operators do not manage to make drivers act in the way that the TMP intends them to do, so the means of dissemination is another crucial element in the value chain of working with cross-border TMPs: which channels to use to inform the drivers also in Slovenia, Hungary, … (e.g. which VMS messages, app, websites, radio broadcasts, etc). Radio broadcasts are very related to TIS (Travel Information Services) which is also conveyed to the major Service Providers. Other topics were addressed too such as, e.g. parameters to consider when describing a detected event, the process of the detour selection and corresponding organisational matters. Main issue was the same definition and comprehension of events across all stakeholders involved in the process, as well as the understanding of the roles, responsibilities and the power of stakeholders to deploy traffic management measures, which can be different across the different countries. Important is the evaluation after the activation of the traffic management plans in order to adjust and improve the traffic management measures. The importance of analysing already existing TMPs at local and regional level before defining a common cross-border TMP was also stressed.

Enrico demonstrated the web application for sharing TMPs between stakeholders such as AutovieVenete (now Autostrade Alto Adriatico, Italy), ASFINAG (Austria), DARS and DRSI (Slovenia), Közút (Hungary) and HAC (Croatia).



Enrico also showed an example of a linked TMP documentation which gives an overview of relevant information such as the location of control centers involved in the process, the decision

centers, the traffic loads (in AADT), the definition of the different traffic management scenarios, the flow charts for launching a strategy, etc. …



A critical point highlighted is the fact the service providers often divert traffic to the route already set up for a TMP. The effect is that traffic is rerouted before the activation of the TMP by the motorway operators. He also highlighted the difficulty to implement fully automated TMPs. Nevertheless, Artificial Intelligence could help as support to authorities to take decisions.

In conclusion Enrico explained the necessity of a good infrastructure which is digitalized to convey information to road users and between different motorway operators and authorities, etc. Important are a good common definition of events, definition of thresholds, definition of responsibilities of rules and agreements between stakeholders, but most of all a signed high level MoU to settle the engagement of the stakeholders. Optimal would be to include also rail operators to have real intermodal TMPs.

The speech of Enrico triggered a lively Q&A session which was well appreciated by the audience.

5.2 Part 2: Additional Focus Questions

The second part of the workshop went into a presentation by the different workshop partners of the 3 additional focus questions cited above.

5.2.1 Bottlenecks

The first question "*What are the bottlenecks that can make mobility management along a corridor more difficult?*" led to following conclusions grouped together into following categories.

- Organisational hurdles:
  - structure of TMCs with their own responsibilities and different background (responsible for their network an no cooperation with other TMCs on a daily basis
  - corridors crossing territories with different characteristics which are managed by different entities
  - agreement on corridor or mobility management strategies
  - different road operators: lack of communication and data exchange; lack of harmonization
  - poor stakeholder engagement and coordination (operators and emergency services / incident management teams)
- Infrastructure limitations:
  - inadequate network capacity, poorly maintained road side equipment, or outdated transportation systems
- Service uptake limitations:
  - low subscription to ATIS or C-ITS services / lack of awareness of services
- Technological challenges:
  - outdated traffic management systems or a lack of smart transportation solutions
  - different and disparate systems used by the TMCs making interoperability difficult in some cases – lack of interoperability
  - VMS infrastructure reduces the amount of operational corridor strategies
    - insufficient VMS infrastructure to display corridor management strategy
    - VMS not always available for corridor management (messages with higher priority take precedence)
    - physical VMSs are a temporary solution until other technologies like V2X are more widespread
  - data sharing and privacy
- Quality limitations:
  - inaccurate data or not timeliness data of the occurring incident event has an event on the TM measure
- Budgetary constraints:
  - limited funding for transportation projects
- Policy and regulatory barriers:
  - delays and inefficiencies in regulations and policies
  - different traffic codes, different laws, different strategies and policies.

5.2.2 Minimum Requirements

The responses to the second question "*What do you think are the minimum requirements for optimal mobility management along a corridor?*" were clustered together in following categorization.

- Organisational:
  - policy framework
  - common goals / common objectives and vision shared among the stakeholders
  - definition of clear rules of engagement and roles between the stakeholders
  - coordination between the various stakeholders involved in the management of the territories crossed by the digital corridor. Not only motorway environment but the urban and peri-urban environment as well.
  - understand the ecosystem related to Digital Corridor Management
  - corridor management strategy (incorporate all parties)
  - definition of a roadmap, initially focusing on (few) main objectives / stepwise approach / initially focus on the primary (high impact) incidents/events that can occur along the corridor
  - integrated multimodal approach: involvement of public and private transport, different modes of transport
  - transport plan to promote multi modal transport
- Operational:
  - ease of operation: work for operators needs to be as easy as possible, otherwise the system will be used less
  - need to share information/data between the different stakeholders
  - fully equipped and well-resourced Traffic Management Centre
- Technological requirements:
  - digitalization of processes
  - presence of distributed platforms for the management of the same corridor a broader level
  - advanced traffic signal systems
  - real-time traffic monitoring and management to respond to incidents quickly
  - integration of smart transportation technologies
  - multi-modal connectivity
  - transportation demand management (TDM)
  - ITS technology
  - integrated public transport network
  - advanced Traveller Information Systems (TIS)
  - mature road incident management (IM) system that incorporates road operators, authorities, roads agencies, emergency response teams
- Quality requirements:
  - data quality and availability for analytics (common ground to take decisions)
- Data governing principles

5.2.3 Solutions

The third question "*What technological and organizational solutions do you think could greatly benefit mobility management along a corridor?*" resulted to following conclusions.

Technological solutions:

- distribution of C-ITS cooperative services accompanied by the distribution of Road Side Units (RSUs) in order to facilitate the exchange and collection of information between the road user and the infrastructure (C-V2X)
- adequate ITS infrastructure coverage along the desired corridor
- creating useful data for enhancing traffic and mobility statistics, as well as useful for improving road network operations
- adoption of standards / harmonized profiles both for real-time and static data (e.g. DATEX II)
- interoperable and interconnected Traffic Management Systems (TMS)
- advanced traffic analytics
- uniform web based application for network management (within same organization)
- modern, easy to use surface to display information to operators/end users
- increase reach by using multiple parallel distribution channels (VMS, navigation, radio, …) and new technologies (X, C-ITS, …)
- common, reliable data base (within same organization)
- big data analytics capability to identify travel demand trends
- improvement of existing cross-border TMPs (digitalization and info sharing with regional authorities)
- improvement of infrastructure
- improvement of information sharing also via MaaS
- mobility-as-a-service (MaaS)
- apps for real-time transit information, ride sharing, and trip planning
- improvement of real-time information through C-ITS information
- Vehicle-to-Infrastructure (V2I) and Vehicle-to-Vehicle (V2V) communication
- autonomous vehicles (AVs)
- bike-sharing and scooter-sharing
- smart traffic lights and infrastructure
- smart parking systems.

Organizational solutions:

- identification of issues having a cross-border relevance
- creation at management level of a permanent "steering committee" for corridor management with representatives of all stakeholders
- creation at technical level of a working group working on interoperability of systems and defining common standards/protocols
- reorganization of all TMCs into single overarching (same) organization
- uniform processes and workflows for corridor management (within same organization)
- when project involves a multitude of involved actors, it needs someone who is in charge and who pushes the project
- definition of shared common procedures, clearly defining who-does-what in different scenarios

- information sharing among stakeholders at local/regional as well as cross-border level
- involvement of private and public stakeholders
- involvement of OEMs
- standardized way of exchanging information / data among different stakeholders, TMCs, etc. via NAPs for instance
- policy and strategy
- strategic planning
- adequate resourcing and training
- corridor management standard operating procedures (SOP)
- divert road users towards other transport modes (trains, …) via different public channels (radio, twitter, …). Divert freight transport towards other transport models (rail, inland waterways).

6 Conclusion

6.1 Overall conclusions

The participants agreed on a definition for Digital Corridor Management and discussed what this definition further implies. An overview of a DCM ecosystem and pre-requirements was given. The various interactions with the participants led to some very interesting results which showed how, regardless of the geographical location of the infrastructures they manage, everyone is faced with the same issues. It was therefore not difficult to understand, from the experiences reported by each of them, that the primary requirement in the management of a digital corridor is certainly that of having an adequate infrastructure, which means dense, modern and effective.

Secondly, it is essential to plan activities jointly among the stakeholders involved and in a strategic manner, also thinking in a sustainable and multimodal manner.

In order to achieve maximum efficiency, it is also necessary to digitise processes as far as possible by applying common standards and protocols for the benefit of interoperability (both when management concerns local events along the corridor, but mainly between stakeholders involved across borders).

Furthermore, when implementing measures, special attention must be paid to optimising communication to the users, the population and the stakeholders involved, because their involvement can certainly increase their acceptance of the measures applied.

Harmonisation of processes also needs appropriate attention, because it also promotes more effective management and increased user acceptance: many different systems create confusion.

6.2 Deployment Guidelines

For TMP deployment guidelines we refer to the relevant chapter in the **EU EIP Reference Handbook for Harmonised ITS Core Service Deployment in Europe** released in October 2021 (see section 7.1).

For reference we could also refer to the relevant Deployment Guideline document of the **EasyWay / EIP / EIP+** projects (see section 7.2). However, these Deployment Guidelines are no longer in effect as they were replaced/consolidated into the EU EIP Reference Handbook.

The chapter on Traffic Management Plan for Corridors and Networks explains among others the 3 TMP phases:

- TMP Elaboration
- TMP Operation
- TMP Evaluation.

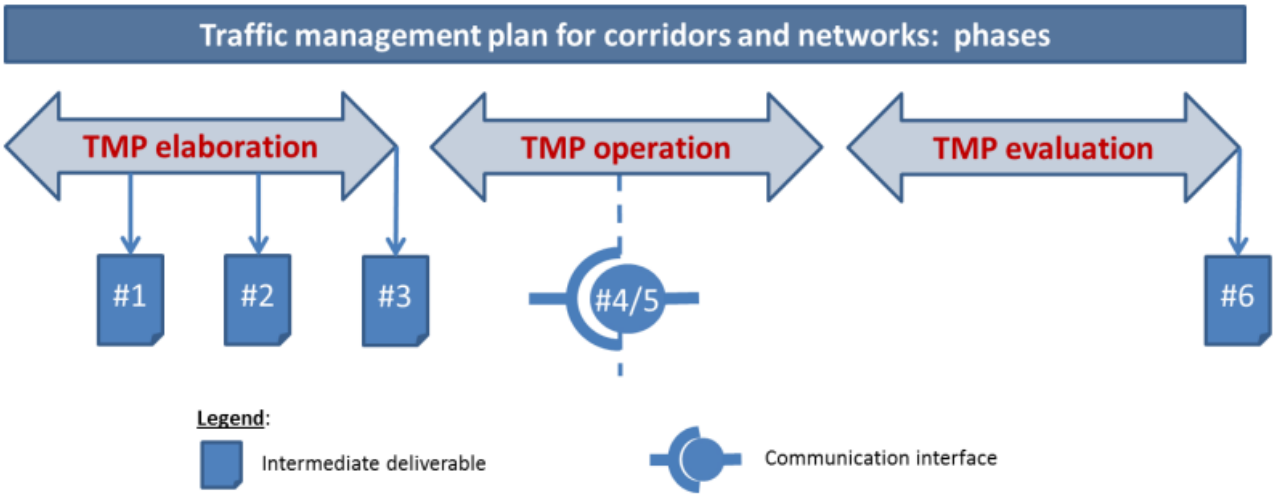


Figure 1: EU EIP Traffic management plan for corridors and networks – phase concept

Each phase is then decomposed into sub-phases with intermediate deliverables. More details can be found in the deployment guidelines.

7 Further Reading

Background reading about Digital Corridor Management can be found in:

7.1 EU EIP Reference Handbook - Traffic Management Plan for Corridors and Networks – Deployment Guideline TMS-07

The EU EIP Reference Handbook for Harmonised Core ITS Service Deployment in Europe can be found at http://www.itsreferencehandbook.eu/.

Chapter 4.8 from page 230 onwards deals with **TMS-07 Traffic Management for Corridors and Networks**.

> Note: The Reference Handbook replaces the EasyWay ITS Deployment Guidelines (2012/2015).

7.2 Easyway/EIP/EIP+ - Traffic Management Plan for Corridors and Networks – Deployment Guideline TMS-DG07

Although replaced by chapter 4.8 in the EU EIP Reference Handbook the Easyway Deployment Guideline, updated by EIP / EIP+ in 2015, might be useful further reading material.

The **TMS-DG07 Traffic Management for Corridors and Networks** guideline and fact sheet can be found at https://www.its-platform.eu/dgs2012/.

7.3 DATEX II TMP

A webinar on '**Collaborating ITS Services to support joint traffic management based on Traffic Management Plans**' can be found at DATEX II 2021 webinar. This recorded webinar explains how Traffic Management Plans (TMP) specified in CEN TS 16157-8 can be exchanged in DATEX II format via the Collaborative ITS Service (CIS) service based on ISO TS 19468 and ISO TS 14827-4.

> *) CEN TS 16157-8:2020 Intelligent transport systems - DATEX II data exchange specifications for traffic management and information - Part 8: Traffic management publications and extensions dedicated to the urban environment.
>
> ISO TS 19468:2022 Intelligent transport systems — Data interfaces between centres for transport information and control systems — Platform-independent model specifications for data exchange protocols for transport information and control systems.
>
> ISO TS 14827-4: Intelligent transport systems — Data interfaces between centres for transport information and control systems — Part 4: Data interfaces between centres for Intelligent transport systems (ITS) using XML (Profile B).

7.4 TM2.0

Traffic Management 2.0 is an ERTICO innovation Platform on interactive traffic management which aims to enable, facilitate and accelerate the information exchange among traffic management stakeholders across Europe. Some taskforces on Traffic Management Plans Exchange were

established in the past. Some final reports on task forces TF8 (2015-2016) and TF13 (2016-2017) are available on the TM2.0 website:

- TM 2.0 TF8 TMPs Exchange phase I Final Paper Report
- TM 2.0 TF13 TMPs Exchange phase II Final Paper Report

7.5 SOCRATES$^{2.0}$

System of Coordinated Roadside and Automotive Services for Traffic Efficiency and Safety, abbreviated as SOCRATES$^{2.0}$ was an EU co-funded (2017-2021) research & development project with the aim of putting TM2.0 ideas into practice. It had public and private sector partners and conducted pilots in 4 cities: Amsterdam (the Netherlands), Antwerp (Belgium), Copenhagen (Denmark) and Munich (Germany).

One technical aspect SOCRATES$^{2.0}$ dealt with, besides the organisational aspects such as the cooperation framework, etc. is the development of a DATEX II-based messaging concept for the specific use cases and pilot sites, and updated DATEX II profile specifications. One of these extensions is a DATEX II extension for TMP Plan for smart routing and avoidance.

Interesting reading is the SOCRATES$^{2.0}$ Consolidation Report and in particular:

- section 2 ‘Setting the stage for interactive traffic management’ which presents some aspects that facilitate the concept of interactive traffic management: the cooperation framework, common formats for digital data exchange and means for communicating with road users.
- section 3 ‘Initiating Solutions of interactive traffic management’ gives recommendations for concrete implementations of the concept, based on learnings from the project deployments.
- and section 4 ‘Enablers and Bottlenecks for interactive traffic management’ which compiles lessons learned about selected enablers and bottlenecks with the goal to enable the concept on a wider scale.

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