

## CONtributing to Shift2Rail's NExt generation of high Capable and safe TCMS PhAse 3

### D7.2 – Data Management Plan

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## **EXECUTIVE SUMMARY**

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CONNECTA-3 project will use and produce digital data. The Data Management Plan (DMP) is a key element of good data management which details how the existing data, and the new data generated from the project, will be handled during and after the end of the project. Specifically, it is a live document describing the type of data that will be collected, processed, stored and archived, as well as how the general data from the project will be shared and disseminated. It identifies key actions and strategies to ensure that data are findable, accessible, interoperable and re-usable (FAIR). Finally, note that each Work Package (WP) describes the type of data that will be used and generated, and how these data will be shared and preserved.

## ABBREVIATIONS AND ACRONYMS

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ATO	Automatic Train Operation
BMS	Bogie Monitoring Systems
CCS	Command and Control Systems
CCTV	Closed-Circuit Television
CFM	Call for Members
CTA3	CONNECTA-3 project
CVS	Concurrent Versions System
DbD	Drive by Data
DMP	Data Management Plan
DoA	Description of Action
DOORS	Dynamic Object Oriented Requirements System
EU	European Union
FAIR	Findable, Accessible, Interoperable and Reusable
FDF	Functional Distribution Framework
FMECA	Failure Mode Effects and Criticality Analysis
FOC	Functional Open Coupling
FTA	Fault Tree Analysis
FTP	File Transfer Protocol
GoA	Grade of Automation
HVAC	Heat, Ventilation and Air Conditioning
IEC	International Electrotechnical Commission
IP	Innovation Programme
IPR	Intellectual Property Rights
ITD	Integrated Technology Demonstrator
ITxPT	Information Technology for Public Transport
KPI	Key Performance Indicator
MAAP	Multi-Annual Action Plan
MCG	Mobile Communication Gateway
NG-TCMS	Next Generation TCMS
OCORA	Open CCS Onboard Reference Architecture
ORD	Open Research Data
RBD	Reliability Block Diagram



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ReqIF	Requirements Interchange Format
S2R	Shift2Rail
SC	Steering Committee
SDT	Safe Data Transmission
SDTv4	SDT Version 4
SIL	Safety Integrity Level
SysML	Systems Modeling Language
T2G	Train-to-Ground
TCMS	Train Control and Monitoring System
TCN	Train Communication Network
TD	Technical Demonstrator
TMT	Technical Management Team
TRL	Technology Readiness Level
TSN	Time Sensitive Networking
UML	Unified Modeling Language
WLCN	Wireless Consist Network
WLTB	Wireless Train Backbone
WP	Work Package

**TABLE OF CONTENTS**

---

Acknowledgements.....	2
Report Contributors.....	2
Executive Summary .....	3
Abbreviations and Acronyms .....	4
Table of Contents.....	6
List of Figures .....	7
List of Tables .....	7
1. Introduction .....	8
1.1 CONNECTA-3 Project Overview .....	8
1.2 Data Management Plan (DMP) Guiding Principles .....	10
1.3 CONNECTA-3 Data Management Policy .....	11
2. Data Management Plan .....	12
2.1 Data Summary .....	12
2.2 FAIR Data .....	13
2.2.1 Making data findable, including provisions for metadata .....	13
2.2.2 Making data openly accessible .....	13
2.2.3 Making data interoperable .....	14
2.2.4 Increase data re-use (through clarifying licenses) .....	14
2.3 Data Sharing .....	14
2.4 Archiving and Preservation .....	15
2.5 Data Security .....	15
3. DMP Review Process & Timetable.....	16
3.1 DMP Review in M25.....	17
3.2 DMP Review in M31 .....	17
4. Lessons learnt.....	18
5. Conclusions .....	20
References .....	21

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## LIST OF FIGURES

Figure 1: Project structure.....	9
Figure 2: CONNECTA project series structure (V-model).....	16

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## LIST OF TABLES

Table 1: Existing data used in CTA3 .....	12
Table 2: Data generated in CTA3.....	12
Table 3: Level of availability of additional CONNECTA-3 data ( <i>example</i> ).....	14
Table 4: Data sharing in CTA3.....	14
Table 5: Archiving and preservation of the data in CTA3.....	15

## 1. INTRODUCTION

The present Data Management Plan (DMP) details what data the project will generate, whether and how it will be exploited or made accessible for verification and re-use, and how it will be curated and preserved. This document should be considered in combination with:

- Articles 9.1, 9.2, 9.3 and attachment 1 of the Consortium Agreement.
- Section 3 (Articles 23, 24, 25, 26, 27, 28, 29, 30 and 31) of the Grant Agreement No. 101014811.

The DMP is organised per project WP in order to concretely describe the contribution of each WP to the final outcome, as well as the spin-off potential of each activity.

In order to understand the data of the project, a brief overview of the project is given below.

### 1.1 CONNECTA-3 PROJECT OVERVIEW

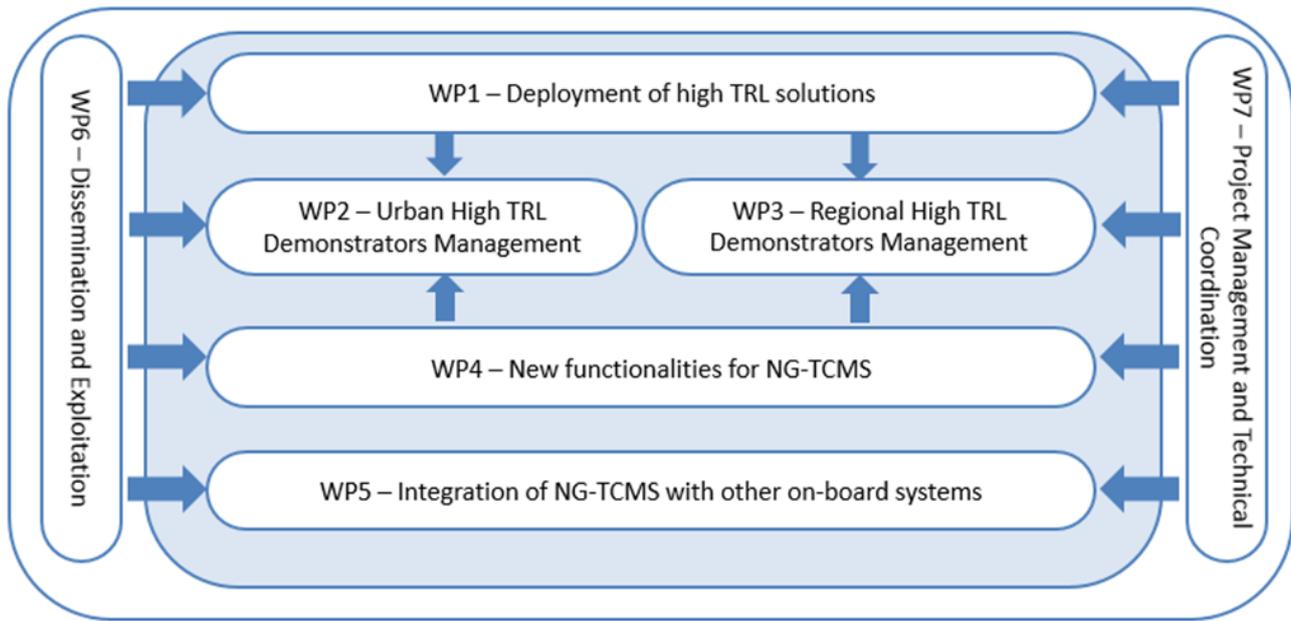
CONNECTA-3 aims at contributing to the Shift2Rail's next generation of TCMS architectures and components with wireless capabilities. The research and development work addresses the third phase of activities of the Shift2Rail Multi-Annual Action Plan (MAAP) on TD1.2 – TD Next Generation TCMS to reach higher TRL (up to TRL6/7 expected).

This project covers the implementation and validation of the new technological concepts, standard specifications and architectures for the train control and monitoring defined within CONNECTA-1 and prototyped in CONNECTA-2.

The project is developed in five main blocks of work, which both reinforce and extend the early work done in the previous projects:

1. A transversal common block to prepare the needed extensions, conformance testing and safety cases and certification procedures to reach TRL 6/7 in NG-TCMS technologies (WP1).
2. A second transversal block for the specification of new technologies not tackled in CONNECTA-2 regarding the IEC 61375-2-6 and the specification of integration of NG-TCMS with other on-board systems, with special attention to OCORA CCS (WP4, WP5).
3. A vertical block for deploying and testing technologies in an urban environment (heavy metro) laboratory and field tests (WP2).
4. A second vertical block, running in parallel, for deploying and testing technologies in a regional environment laboratory and field tests (WP3).
5. A project wide block to evaluate results (including KPI assessment), disseminate, communicate and exploit (WP6, WP7) as much as possible at this TRL7 level of achievements.

CONNECTA-3 will be divided into seven Work Packages (WP). Each WP contributes to the scope of the call S2R-CFM-IP1-02-2020. Figure 1 shows the organisation of the project.



**Figure 1: Project structure**

The goals of each WP are described below:

- **WP1:** Is aimed at the deployment of NG-TCMS solutions with a TRL up to TRL6/7. This includes the definition of actions to be performed to reach a higher TRL as well as to ensure interoperability and certification with the definition of conformance tests and the safety case definition. The respective documents will serve as input for WP2 and WP3 as well as for the standardisation. The deployment to be made are the Functional Distribution Framework (FDF), HW architecture prepared for SIL4, Safe Train Inauguration, SDTv4, Next Generation TCN architecture over TSN, Wireless Train Backbone (WLTB), Wireless Consist Network (WLCN), Mobile Communication Gateway (T2G), Functional Open Coupling (FOC), and Subsystem functions according to Application Profiles (BMS, Doors, HVAC...).
- **WP2:** Is focused on the management of High TRL demonstrator which will be divided in: Preparation of High TRL solutions tests in urban lab environments; Test of High TRL solutions in urban lab environments; Preparation of High TRL solutions tests in a real train unit from Euskotren operator; Test of High TRL solutions in depot and field tests; Re-commission the Euskotren's train unit to its original state. With the exception of Wireless Train Backbone (technology maturity for the moment does not allow achieving TRL6/7), technologies related to NG-TCMS (FDF, DbD, MCG, Application Profiles) will be tested and validated in real train unit.
- **WP3:** Is focused on the management of High TRL demonstrator which will be divided in: Preparation of High TRL solutions tests in relevant lab environments; Test of High TRL solutions in relevant lab environments; Preparation of High TRL solutions tests in field; Test of High TRL solutions in field. All tests not necessarily needing a real train environment will be performed in laboratory with the help of the Virtual Certification Framework on a demonstrator with simulated relevant environment (sub-systems, conventional train control,

coupled consists). Field tests on a real train will be done only for the technologies that cannot be comprehensively tested in a simulated environment (e.g. Wireless Consist Network).

- **WP4:** Is leading new specifications for the NG-TCMS in order to complement the already offered services regarding T2G and cybersecurity. More specifically, the WP is focused on the specification of additional functions for T2G communications not covered by the IEC 61375-2-6 (such as the CCTV) and the specification of the full interface based on SIP for the interoperability with the Adaptable Communication System. Furthermore, it is addressing a benchmarking activity of the current IEC 61375 series and other upcoming standards from different industries, as well as the preparation to handle the up-coming problems of cybersecurity.
- **WP5:** Is dealing with the definition of interfaces between the TCMS and other on-board systems. One of the main topics is the integration of ATO functionalities (up to GoA4) in form of Application Profiles and the FOC interface definition. Interoperability with CCS systems (OCORA), IT systems (ITxPT), Autonomous Functions (Doors) will be also studied. Finally, the availability of data and the exchangeability of subsystems without involvement of the train / TCMS manufacturer will be shown.
- **WP6:** Is seeking to ensure proper dissemination and promotion of the project results, in a way which is consistent with the wider dissemination and promotion activities of Shift2Rail. The objective is to ensure that the outputs of the project are delivered in a form which makes them immediately available for use by the complementary actions, and ensure that all important actors in the European railway sector are informed about the results.
- **WP7:** Is focusing on the project management and technical coordination. Its main objective is to ensure efficient coordination of the project together with the TMT (Technical Management Team) and the SC (Steering Committee). Moreover, this WP is coordinating the technical work of the various WPs in order to keep the alignment with the overall objectives of the project and with Shift2Rail activities, as well as monitoring the TD1.2 contribution to the overall KPI of Shift2Rail.

## **1.2 DATA MANAGEMENT PLAN (DMP) GUIDING PRINCIPLES**

The Data Management Plan of CONNECTA-3 is coordinated by WP7, and is articulated around the following key points:

- The Data Management Plan (DMP) described in this document has been prepared taking into account the template of the Guidelines on FAIR Data Management in Horizon 2020 [01], taking into account the Open Research Data (ORD) Pilot proposed by European Commission. The elaboration of the DMP will allow CONNECTA-3 partners to address all issues related to IPR protection and data. The DMP is an official project deliverable (D7.2) due in Month 3 (February 2021), but it will be a live document throughout the project. This initial version will evolve depending on significant changes arising and periodic reviews at reporting stages of the project.
- The consortium will comply with the Regulation (EU) 2016/679 regarding the General Data Protection Regulation, meaning that beneficiaries will ensure that -if applicable- all the data

intended to be processed are relevant and limited to the purposes of the research project (in accordance with the 'data minimisation' principle).

- Procedures that will be implemented for data collection, storage, access, sharing policies, protection, retention and destruction will be in line with EU standards as described in the Grant Agreement and the Consortium Agreement, particularly in Article 18 (“Keeping Records - Supporting Documentation”); Article 23 (“Management of Intellectual Property”); Article 24 (“Agreement on background”); Article 25 (“Access Rights to Background”); Article 26 (“Ownership of Results”); Article 27 (“Protection of Results - Visibility of EU funding”); Article 30 (“Transfer and Licensing of Results”); Article 31 (“Access Rights to Results”); Article 36 (“Confidentiality”); Article 37 (“Security-related Obligations”); Article 39 (“Processing of Personal Data”); Article 52 (“Communication between the parties”); and “Annex I – Description of Work” of the Grant Agreement.

### **1.3 CONNECTA-3 DATA MANAGEMENT POLICY**

CONNECTA-3 Data Management Plan applies the FAIR (Findable, Accessible, Interoperable and Reusable) Data Management Protocols. This document addresses, for each data set collected, processed and/or generated in the project, the following elements:

- **Contribution reference and naming:** Internal project Identifier for the data set to be produced. This identification code contains the following six fields: [Project] – [Domain] – [Type] – [Owner] – [Number] – [Version]. Where:
  - [Project] is CTA3 for all CONNECTA-3 documents;
  - [Domain] is the relevant domain in the Cooperation Tool (WP, Task or project body);
  - [Type] is one letter defining the document category;
  - [Owner] is the trigram of the deliverable leader organisation;
  - [Number] is an order number within a domain allocated by the Cooperation Tool when the document is first created;
  - [Version] is the incremental version number, automatically incremented at each upload.
- **Standards and metadata:** Reference to existing suitable standards will be added if any.
- **Contribution description:** Description of the data that will be generated or collected.
- **Data sharing:** Description of how data will be shared, including access procedures, necessary software and other tools for enabling reuse, and definition of whether access will be open or restricted to specific groups.
- **Archiving and preservation:** Description of the procedures that will be put in place for long-term preservation of the data.

## 2. DATA MANAGEMENT PLAN

### 2.1 DATA SUMMARY

CONNECTA-3 will make use of different type of data, which are listed in the following table:

**Table 1: Existing data used in CTA3**

Code	Description of Dataset/Digital Output	Units and Format	Size	Ownership
CTA3-1.1	Measurement data	Format: raw data, text files, proprietary formats (e.g. .mat, .xls, ...). Units: e.g. Hz, bits/s, samples/s, m, s, ...	Data from former measurement campaigns	Partner which generated the measurement data
CTA3-1.2	Software	E.g. .c, .m, ...	Variable	Partner institution

Data generated in this project include the following types:

**Table 2: Data generated in CTA3**

Code	Description of Dataset/Digital Output	Units and Format	Size	Ownership
CTA3-2.1	Measurement data	Format: raw data, text files, proprietary formats (e.g. .mat, .xls, ...). Units: e.g. Hz, bits/s, samples/s, m, s, ...	From several MB to GB	Partner institution who executes the measurement
CTA3-2.2	Software (Code): Simulations, scripts, etc.	E.g. .c, .m, ...	Several MB	The rightful owner according to the contract of purchase
CTA3-2.3	Source files for RBD/FTA Calculations	Excel files	Unknown	Partner institution who executes the calculations
CTA3-2.4	Source files for FMECA	Excel files	Unknown	Partner institution who executes the calculations
CTA3-2.5	DOORS requirements	DOORS database	Several MB	Shared between the contributing partners
CTA3-2.6	SysML / UML diagrams	MagicDraw, Enterprise Architect... formats	Several MB	Partner producing the diagrams

CTA3-2.7	Test logs	Several formats: Text, raw data...	From several MB to GB	Partner institution who executes the tests
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## 2.2 FAIR DATA

CONNECTA-3 project will work to ensure as much as possible that its data will be 'FAIR', that is, findable, accessible, interoperable and reusable, according to the points below.

### 2.2.1 Making data findable, including provisions for metadata

CONNECTA-3 project is part of the European Shift2Rail initiative, and therefore, it is expected to deposit the generated results in the *Cooperation Tool* online repository. Within this repository, the deliverables marked as *public* will be accessible via the Shift2Rail website. Each public deliverable goes with a unique identification code (as explained in Section 1.3), a deliverable title and a short description of its content which helps to find the desired content.

Each task leader is responsible for ensuring that the dissemination level of each deliverable is correctly set. Equally, the deliverables will use references according to their dissemination level. This means that public deliverables should not refer to confidential documents which invalidate their correct understanding.

### 2.2.2 Making data openly accessible

In order to ease the future works within the Shift2Rail TD1.2, CONNECTA-3 will make available all data which are identified as appropriate (public and confidential) to future projects. The CONNECTA-3 Steering Committee is responsible for IPR issues that may appear and any confidential data disclosure needs for its positive decision.

Task leaders will collect data from each task and the IPR Committee will review and approve all data that are identified as appropriate for open access. This process will be carried out on an ongoing basis to facilitate the publication of appropriate data as soon as possible.

Any additional data beside the foreseen deliverables that may be shared should be evaluated by the CONNECTA-3 consortium. The CONNECTA-3 Steering Committee will assess such justifications and make the final decision, based on the examination of the following elements regarding confidentiality of datasets:

- Commercial sensitivity of datasets.
- Data confidentiality for security reasons.
- Conflicts between open-access rules and national and European legislation (e.g. data protection regulations).
- Sharing data would jeopardise the aims of the project.
- Other legitimate reasons, to be validated by the IPR Committee.

When it is determined that a database should be kept confidential, the reasons for doing so will be included in an updated version of the DMP. Table 3 illustrates an example of a level of accessibility of CONNECTA-3 data for future Shift2Rail TD1.2 projects.

**Table 3: Level of availability of additional CONNECTA-3 data (example)**

Dataset number	Task number	Dataset name	Open / Restricted	Reason for Restriction
1	T2.1 T2.2 T2.3 T2.4	High TRL technology integration, installation guidelines and test report of Urban demonstrator	Restricted	IPR Sensitivities across datasets
2	T5.1 T5.2	Report on new Application Profiles and alignment of NG-TCMS architecture with OCORA	Open	N/A

### 2.2.3 Making data interoperable

The data type and unique identifiers for the data produced by CONNECTA-3 were introduced in Sections 1.3 and 2.1. For further data generated during the project, this information will be outlined in subsequent versions of this document. In that case, information on data and metadata vocabularies, standards or methodology to follow to facilitate interoperability will be defined.

### 2.2.4 Increase data re-use (through clarifying licenses)

CONNECTA-3 project will generate valuable data for future Shift2Rail TD1.2 projects. The goal is that the experimental results obtained in CONNECTA-3 will be the basis for future projects starting in 2023.

As the project progresses and data are identified and collected, further information on increasing data re-use will be outlined in subsequent versions of the DMP.

## 2.3 DATA SHARING

Table 4 summarizes the data sharing mechanisms to be used within CONNECTA-3 project.

**Table 4: Data sharing in CTA3**

Code	Data sharing
CTA3-2.3 / 2.4 / 2.6	Cooperation Tool (project’s online repository).
CTA3-2.5	DOORS requirements will be shared as ReqIF exchange format, together with the Microsoft Word version, and stored in the Cooperation Tool (project’s online repository) for sharing.
CTA3-2.2	Generated source code and executable files may be shared with the project partners additionally through an online repository (CVS like) or FTP.
CTA3-2.1 / 2.7	Produced test logs and measurement data may be shared with the project partners additionally through FTP, in case its size rises over 20 MB; otherwise, the Cooperation Tool will be used.

## 2.4 ARCHIVING AND PRESERVATION

Data shall be specifically selected for archiving based on the criteria which may be useful for on-going and future Shift2Rail activities.

During the life of CONNECTA-3, data extraction from the Cooperation Tool will be supported. Table 5 summarizes the archiving and preservation policies to be used.

**Table 5: Archiving and preservation of the data in CTA3**

Code	Archiving and preservation
CTA3-2.1 / 2.2 / 2.5 / 2.7	Regular backup of data on server, managed by IT departments.
CTA3-2.3 / 2.4 / 2.6	Data will be stored in the Cooperation Tool, which already has its backup procedures.

## 2.5 DATA SECURITY

The research outputs of the project will be publicly available within the Shift2Rail website of the project ([https://projects.shift2rail.org/s2r\\_ip1\\_n.aspx?p=CONNECTA-3](https://projects.shift2rail.org/s2r_ip1_n.aspx?p=CONNECTA-3)), unless the result is marked as *confidential* in the Grant Agreement.

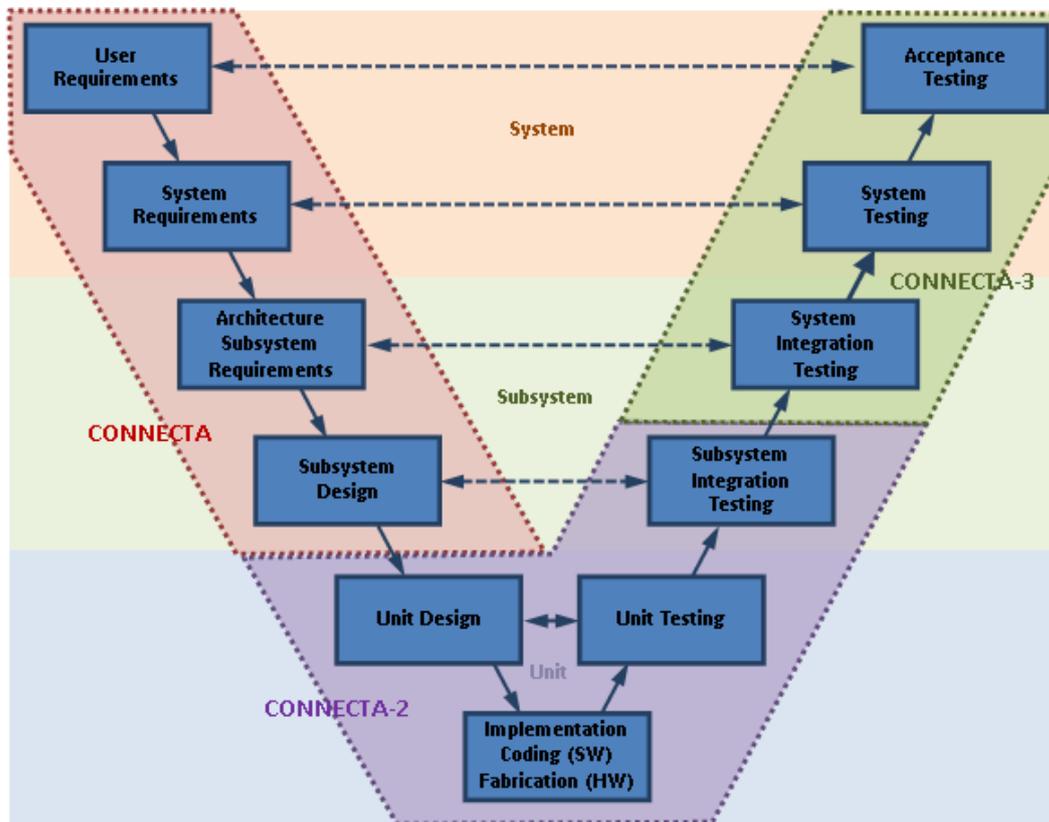
The reasons to consider the results as confidential are the following ones:

- Protection of intellectual property rights regarding new processes, products and technologies that would impact the competitive advantage of the consortium or its members.
- Commercial agreements as part of the procurements of components or materials that might foresee the confidentiality of data.
- Members background knowledge that might foresee the confidentiality of data.

### 3. DMP REVIEW PROCESS & TIMETABLE

Shift2Rail TD1.2 MAAP (deployed by CONNECTA-1, CONNECTA-2 and CONNECTA-3 projects) is based on the V-Model illustrated in Figure 2. This model must be contextualised to Shift2Rail, and in particular to the MAAP. CONNECTA-3 does not cover the whole life cycle of the new TCMS generation. It takes the output from CONNECTA-2 and scales the TRL for the technologies under deployment up to TRL6 and 7.

Hence, the “V” can be split into three parts, each of them corresponding to a different call or phase. While the specification, system architecture and subsystem design correspond to CONNECTA-1, the implementation of the components and integrating them into subsystems are allocated to CONNECTA-2, and finally, putting everything together on the Integrated Technology Demonstrator (ITD) for system testing in CONNECTA-3.



**Figure 2: CONNECTA project series structure (V-model)**

Due to the continuous iterative process between design and testing phases of the developed technologies, it may be needed to review and reconsider certain aspects related to the design specifications and implementations accomplished in CONNECTA-2 project (in any case, these will be improvements supposing minor changes). In order to keep the specification and implementation of the NG-TCMS updated along the whole MAAP, in subsequent releases of the DMP, this section will include any additional documents (not foreseen initially in the project proposal) which amend or complement any specifications and/or implementation proofs already released. Particularly, an updated version of the DMP will be released in Months 25 and 31.

### **3.1 DMP REVIEW IN M25**

This section is temporally empty until M25 of the project (it will be released in deliverable D7.3 – First Review of Data Management Plan).

### **3.2 DMP REVIEW IN M31**

This section is temporally empty until M31 of the project (it will be released in deliverable D7.4 – Final Review of Data Management Plan).

## 4. LESSONS LEARNT

The Data Management Plan has undergone an evolution process throughout the three projects comprising the CONNECTA series. Particularly, CONNECTA-3 project constitutes the third phase of Shift2Rail TD1.2 MAAP, taking the output from CONNECTA-2 and scaling the TRL for the NG-TCMS technologies under deployment up to TRL6/7. The knowledge gained and the template employed in the predecessor projects for the DMP have been inherited in CONNECTA-3. Thus, many of the concepts have been reused, but they have been updated according to the Guidelines on FAIR Data Management in Horizon 2020 [01], taking into account the Open Research Data (ORD) Pilot proposed by European Commission. Likewise, the DMP has been adapted to the goals described in the CONNECTA-3 DoA.

In summary, the good experience in the preceding projects has motivated and allowed maintaining the same DMP structure, but it is worth highlighting the most relevant aspects and the lessons learnt until reaching this last stage of the CONNECTA project series:

- The continuous iterative process between the design and testing phases of the NG-TCMS technologies developed so far in CONNECTA-2 (in order to improve and refine the design specification and implementation of these technologies), has had no impact on the proposed DMP structure. In fact, it has not been needed to release any additional deliverables not foreseen initially in the Grant Agreement so as to amend or complement any specifications and/or implementation proofs already released. Depending on the evolution of CONNECTA-3 project, it might be necessary to review and reconsider certain specific aspects related to the design specification and implementation. In that case, and in order to keep the NG-TCMS development updated along the whole MAAP, the possible impact and/or any additional documents (not foreseen initially in the Grant Agreement) which amend or complement any specifications and/or implementation proofs already released will be included in subsequent releases of the DMP in Months 25 and 31. This fact shows the feature of the DMP as a live document throughout the project, which will evolve depending on significant changes that may arise.
- Apart from that, the elaboration of other documents related to the dissemination of the research work performed during the lifespan of CONNECTA-3 project will be also explicitly indicated in future releases of the DMP.
- Regarding the measurement data expected to be generated in CONNECTA-3, the main difference with respect to CONNECTA-2 lies in the fact that tests will not only be accomplished in an urban laboratory environment, but also in field by using a real train unit.
- As far as the FAIR Data Management is concerned, it must be remarked that CONNECTA-3 project is also committed to the compliance with the principles of Findable, Accessible, Interoperable and Reusable. An important effort has been made in CONNECTA-2 project in order to ensure that:
  - data can be easily found thanks to the proper management and use of the *Cooperation Tool* online repository, where all the generated results have been deposited with the appropriate dissemination level (public, confidential);



Contract No. H2020 – 101014811



- data are accessible and reusable for future projects, managing the IPR issues and confidential data disclosure needs.

## **5. CONCLUSIONS**

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The purpose of the Data Management Plan (DMP) is to support the data management life cycle for all data existing, generated, collected, processed, stored and disseminated in CONNECTA-3 project. The DMP is not a fixed document, but it is expected to evolve and mature during the lifespan of the project. Hence, updated versions of the DMP will be released in Months 25 and 31 to fine-tune it to the data generated and the uses identified by the consortium, since not all data or potential uses are clear at this stage of the project.

## REFERENCES

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- [01] Guidelines on FAIR Data Management in Horizon 2020 (Open Research Data Pilot by European Commission). Available in:  
[https://ec.europa.eu/research/participants/data/ref/h2020/grants\\_manual/hi/oa\\_pilot/h2020-hi-oa-data-mgt\\_en.pdf](https://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-data-mgt_en.pdf)