Work Area *3.3 Smart Maintenance* Closure Presentation

09.12.2020

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#Horizon2020

Work Area Information

Title	Smart Maintenance
Total Cost	1.520 k€ (CFM+OC)
Funding	940 k€
Participants Contribution	
Timescales	Sep 2017 – Dec 2019
WA leader	DB
Participants	Ansaldo Bombardier CAF CP DB Siemens SNCF TCDD University of Huddersfield

Title	Budget	Timeline	Objective	Outputs / demonstration
IMPACT-2 WP6	1.050 k€	09/17 – 12/19	• Development of a Smart maintenance concept for the whole railway system • Development of the methodology for condition based maintenance (CBM) • Application for some modules of passenger trains • Normative input for standardisation	• Smart maintenance concept for the whole railway system • CBM results for passenger trains • Normative input for standardisation
SMaRTE Smart Maintenance	470 k€	09/17 – 10/19	Development and integration of predictive tools for current and future condition of train passenger components	Techniques to Support the Implementation of Smart Rolling Stock Maintenance

Work Area WA3.3 Smart Maintenance

Objectives of Work Area	Topic	MAAP Tasks	Projects
▪ Paradigm shift to condition-based maintenance ▪ Pushing the supervision of infrastructure by means of measuring devices within the vehicle and vice versa	Development of a Smart maintenance concept for the whole railway system	(2) Smart maintenance concept	IMPACT-2 WP6
▪ Less down time and increased availability of railway assets due to better prediction of component failures ▪ Reduced maintenance costs due to better planning and coordination of maintenance activities	Development and application of the methodology for condition based maintenance (CBM)	(1) Scope definition (3) Data selection (4) Data analysis and pattern recognition (5) Integration into maintenance plan	IMPACT-2 WP6 SMaRTE
▪ Pre-standardisation for diagnostic data of vehicle and infrastructure components	CBM data source and structures as well as normative input for standardisation	(6) Information identification (7) Standardisation	IMPACT-2 WP6

Collaboration Activities

Work Area Task	Activity	Project
(2) Smart maintenance concept	Matching CBM-concept with • CBM for traction components • CBM for infrastructure components • CBM for freight waggons and locomotives	PINTA IN2SMART FR8RAIL
(4) Data analysis and pattern recognition	• Providing diagnostic train data to the SMaRTE project • Development of CBM algorithmen by SMaRTE • Use of the SMaRTE results for the application of CBM	SMaRTE
(6) Information identification	Matching CBM concept and data flow with the Intelligent Asset Management system developed in IP3	IN2SMART
(7) Standardisation	Integration of the standardisation activities concerning Smart Maintenance into the rolling standardisation plan	IMPACT-2 WP5

Overall Smart Maintenance Concept

The four quadrants of smart maintenance

Vehicle monitors infrastructure

Infrastructure monitors vehicle

TD 3.6
TD 3.7
TD 3.8
Continiuous track monitoiring

TD 3.7

CCA Smart Maintenance

TD 1.x
Traction
Doors
Running gear

TD 5.x
Loco
Wagon

TD 3.7

Vehicle monitors itself

Infrastructure monitors itself

Documentation in IMPACT-2 Del. 6.5 Smart maintenance concept

Development and Application of CBM Methodology

Steps for development and implementation of Condition based maintenance (CBM)

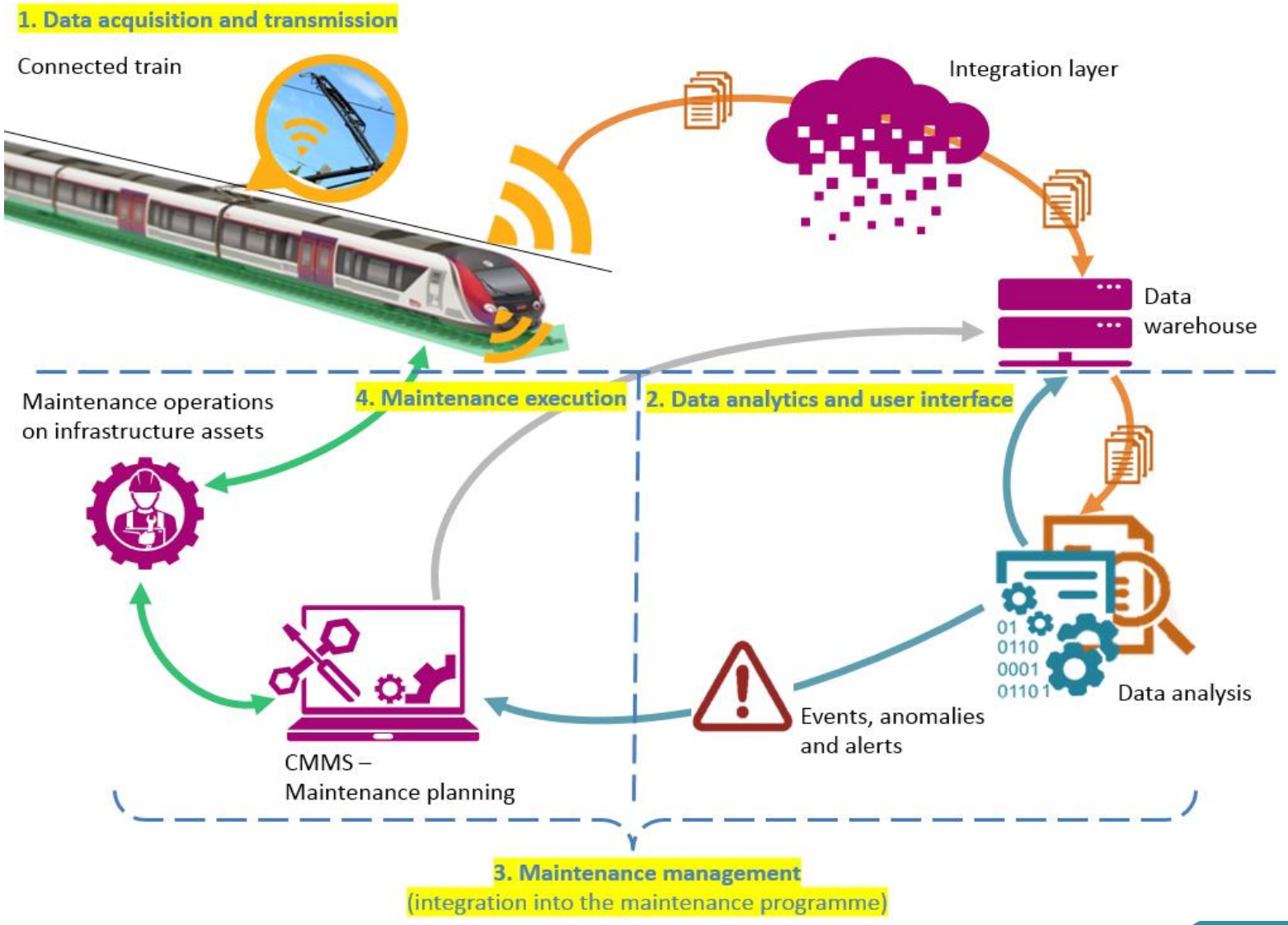
The methodology was applied for some vehicle modules
(Doors, Air compressor, line circuit breaker)

Documentation in

- IMPACT-2 Del. 6.4 CBM results for rail vehicles
- SMaRTE Del. 2.2 Techniques to Support the Implementation of Smart Rolling Stock Maintenance

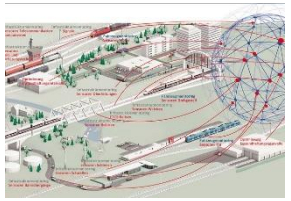
Smart Maintenance Vision

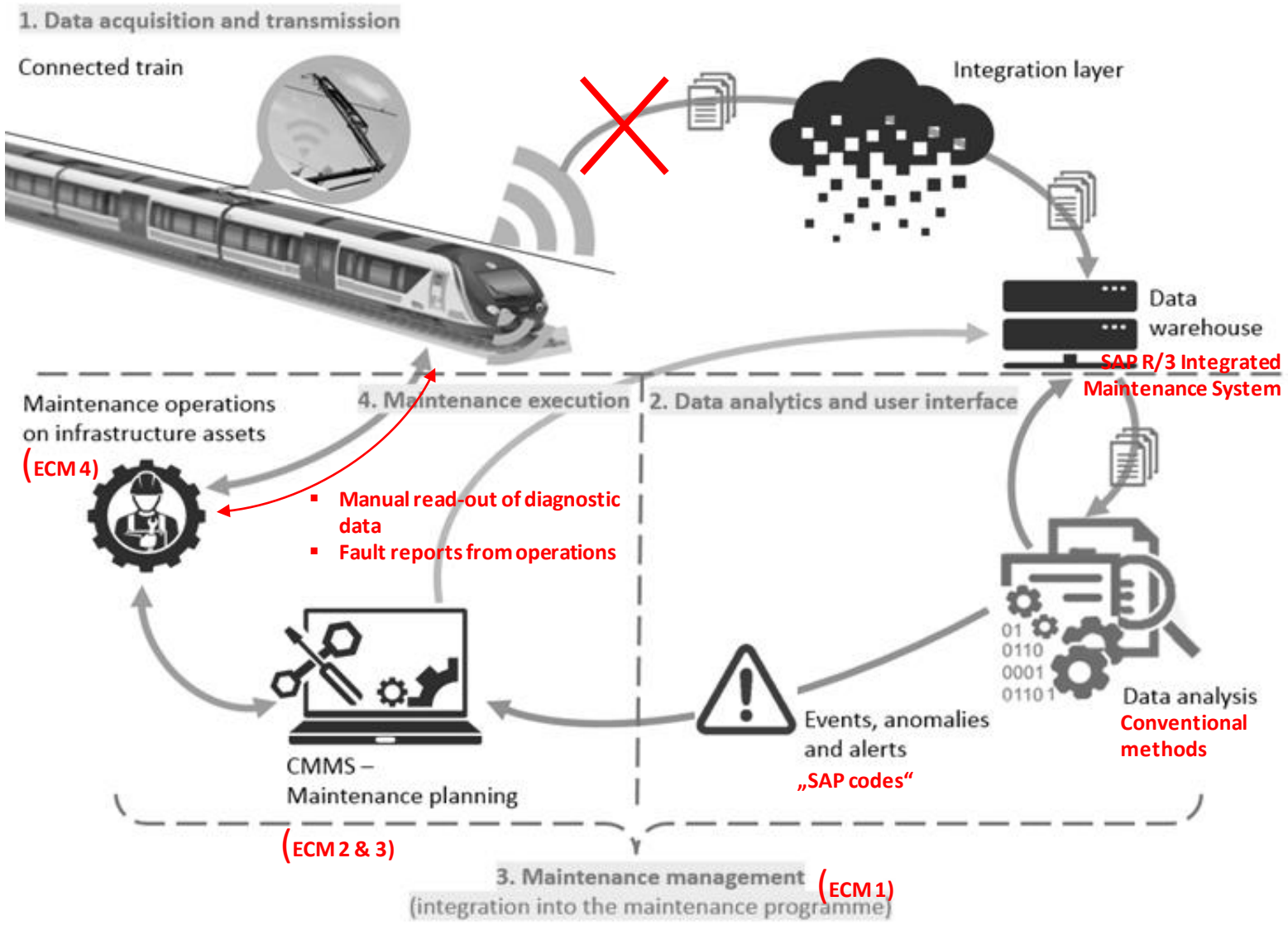
CLEAR TARGET VISION



Smart Maintenance Reality

CHALLENGING REALITY





Pre-Standardisation of CBM data

Two tasks were carried out to support the standardized data exchange

- Analising and the required data and data structure for CBM from different applications/ projects (IMPACT-2 Del. 6.2)
- Normative input for standardisation (IMPACT-2 Del. 6.3)

Example of vehicle data structure

Product group structure			Function groupe structure			Condition code			Position structure			
MPG	SPG	SSPG	ISI-category-group	ISI-part-category	ISI-Part-Name	Condition code	Signal	Grading / unit	Position code	Installation group	Installation point	Slot
N	B	006	N	SS	CRV	14-022	control command	Locked/ unlocked	2-8-0	Side wall R	Right vehicle side Door	All doors
Doors, entrances	External doors	Door securing	Mechanical parts specifically	Locks	Door lock	22-015	Functional condition	Locked/ unlocked	2-8-110	Side wall R	Right vehicle side Door	Door 11
						10-002	damaged condition	faulty	3-8-140	Side wall L	Left vehicle side Door	Door 14
						13-001	error message	Is disturbed	3-8-260	Side wall L	Left vehicle side Door	Door 26

For the standardisation approach various additional steps for further development are conceivable, these are described in the deliverables. These steps may also be performed in parallel.

Exploitation of Results

The results of the work were presented in 2020 at the CCA and IP-SteCos as well as in the ED Program Board in Nov 2020

Topic/ Task	Outputs	Exploitation
Smart maintenance concept	Common maintenance concept for assets of rolling stock, infrastructure and CCS (IMPACT-2 Del. 6.5)	• Considering the concept in other S2R projects dealing with CBM • Application by railway undertakings and infrastructure managers
CBM methodology and application	Methodology for application of CBM for some defined components (IMPACT-2 Del. 6.4)	• Application within other S2R projects dealing with CBM • Application by railway undertakings and infrastructure managers
Data structure standardisation	Normative input for standardisation of CBM data structures (IMPACT-2 Del. 6.2 and 6.3)	• Continuation of the standardisation within the S2R project LinX4Rail (**Conceptional Data Model**) • Standardisation of CBM data structures within European standards • Considering in the future vehicle IT / TCMS (Project **CONNECTA-3**, Task 5.6)

Work Area Roadmap

Work Area Task	TRL	2016	2017	2018	2019	2020	2021	2022
Scope definition								
Smart maintenance concetp								
Data selection & fromating								
Data analysis and pattern recognision								
Integraion into maintenance plan								
Information identification								
Standardisation								

Project	TRL	2016	2017	2018	2019	2020	2021	2022
IMPACT-2	2							
SMaRTE	2							

	Work area active
	Complete project
	On going project
	Planned project

Project	Summary of Output
IMPACT-2 WP6	• Smart maintenance concept for the whole railway system • CBM results for passenger trains • Normative input for standardisation
SMaRTE Smart Maintenance	Techniques to Support the Implementation of Smart Rolling Stock Maintenance