



# Session1.4, Room Karam1 Digitalization / Artificial intelligence



Moderator: Mr. Joël Meierfeldt, Team Leader Bid Management, DB Engineering & Consulting GmbH, Germany







#### Session1.4 Digitalization / Artificial intelligence Speaker Lists;







## 11<sup>TH</sup>WORLD CONGRESS OF HIGH-SPEED RAIL

Marrakech, 7-10 MARCH 2023

## **Computer Vision for Intelligent Maintenance (Alboraq case)**

Mohamed, SEDKI Head of Projects, SIANA, Morocco Session4-1.4 Digitalization / Artificial intelligence







#### **Old-fashioned visual inspection**



What is Visual Inspection ?





When and where is Visual Inspection needed ?

Building



Automobile



Medical









Examen de Sortie Avant Libération RGVM

#### AGENT: Why not just stick to manual inspection?

Opérations	Résultat	Anomalies	Suites données
S'assurer qu'il n'y a plus de Noms sur le Tableau de répartition pour la rame à Sortir .			
Effectuer le tour de la rame et s'assurer que rien n'entrave son déplacement:			
<ul> <li>Coffres, trappes, oreilles d'éléphant fermées et verrouillées. Vérification de la partie visible des pantographes.</li> </ul>	Côté pair □ C □ NC Côté impair		
<ul> <li>absence d'alimentation extérieure branchée (boyau d'air, alimentation électrique)</li> </ul>	C NC		



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#### Although effective, the use of the old inspection method has several limitations.



Computer Vision for Intelligent Maintenance (Alboraq case)





#### The challenges that computer vision is addressing for visual inspection operations

#### Safety operations



- Increase reliability and ensure the safety of rolling stock through automated and regular real-time inspections.
- Reduce risks related to inspection environments.

Health safety 👗 🤱

- Reduce movement of operators during operations.
- Risky environment and walking distance

#### Cost

Reduce direct and indirect costs related to errors. or omissions during visual inspection.

Time ()

Reduce inspection time and duration.







## The concept - architecture for the deployment of computer vision at the industrial level and large scale deployment



Platform for orchestration and visual inspection operation.

Embedded artificiel intelligence model. Control and Communication APIs.

Camera (1) Processing box (2) Power supply box (3) Tripod (4)



Computer Vision for Intelligent Maintenance (Alboraq case)





#### A modular and mobile installation, ...



Resolution 1080p. Norm EN50155, IP66, IK08. 12VCC for power supply.

Router. Connectors, Ports. NVIDIA® Jetson's.





Power supply 100 to 240 VAC, 50 to 60 Hz.







# ..., designed by a robust, reliable and industrially deployable ecosystem approach





Tracking algorithms for tracking objects;

And Yolo v3,5,6 deep learning models for the detection of objects.

Computer Vision for Intelligent Maintenance (Alboraq case)





#### Mephedistation Management



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permissions

Gestion des ale	ertes	
Sélectionner une inst	allation	
JETSON ON SERVER	~	

#### Référentiel des données

Objet détecté	Туре	Désactiver/Activer	Alert par mail
זער"	Non conforme		Non 🗸
"1202"	Non conforme		Non 🗸
"1203"	Non conforme		Non
"1204"	Conforme		Non 🗸
"1209"	Non conforme		Non 🗸
"1210"	Non conforme		Oui 🗸
			Valider

#### Liste des destinataires des anomalies par mail

Nom et prénom	Email	Action

🛨 Ajouter un nouveau destinatair

Computer Vision for Intelligent Maintenance (Alboraq case)

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#### SAFaE: computer vision use cases and perspectives

- Control at departure and arrival of rolling stock
- Diagnosis of bows
- railway signalling detection
- Obstacle detection on track and depots







## THANK YOU

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# Living the digital rail journey, a new traveling experience

Amine, BENDAOUD IT project manager, ONCF, Morocco Session4-1.4 Digitalization / Artificial intelligence







#### General presentation

Impact of digitalisation on lifestyle

- ✤ Impact of IT evolution on the way of life
- Speed of change is becoming a major trend in all sectors

Railways digitization

- \* Adoption of technological innovations: a major factor in competitiveness
- Direct impact on the offer and difficulty in compensating for loss of customers

Opportunities offered by technology

- Cloud, interconnected sensors/diagnostic tools, IOT, Al/learning, big data
- \* Revolution on several railway processes (planning, operation, maintenance)

Benefits, constraints and challenges

- Operational efficiency, cost reduction, competitiveness, sustainability
- Lag in deployment compared to other sectors
- Budgetary, regulatory and organizational constraints

Living the digital rail journey, a new traveling experience





#### Automation of traffic management

#### Automation as a suggested solution

- Maximizing capacity to meet increasing passenger and freight demands
- Ensuring critical requirements: safety, reliability/timeliness, energy efficiency

ETCS: core element

- Use of wireless communication for train movement supervision (level 2+)
- The increase of the ETCS level allows an improvement of the update frequency





ETCS level 2 - source: ERTMS official website





#### Automation of traffic management

ATO : second pillar

- ETCS is a basic requirement but not sufficient for automated traffic management
- New possibilities following the introduction of ATO (Automatic Train Operation)
- Increasing GoA (level of automation) provides more benefits but with more challenges

Moving-blocks technology

- Algorithm based on information communicated by the train
- Calculating/transfer of the braking curve to the next train
- Location and length of blocks depending on the location and speed of the train



Grades of Automation - source: solving the digitization challenge for Europe's rail sector (pwc)









 Staff equipped with smart mobile devices

Living the digital rail journey, a new traveling experience





#### Benefits of digitization

Capacity

Safety

Performance

- Optimisation of planning and resource allocation
- Traffic management efficiency (automation)
- Improvement of resource availability conditions
- Reduction of manual processing errors
- Anticipating risks (AI)
- Improved incident management conditions
- Improvement of operational processes
- \* Real time information, facilitating decision-making
- Improved exchanges between systems and processes



Minimum line capacity increase rate following the deployment of mobile blocks



Rate of reduction in the risk of signal non-compliance due to human error through digital signals in train cabs

Living the digital rail journey, a new traveling experience





#### Benefits of digitization

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## Sustainability

- Improved energy efficiency by reducing unnecessary train stops
- Reduced paperwork and paper consumption
- Sustainable technologies that respect the environment
- Reduction of wear and optimization of maintenance



- Improved service/communication
  - Cost reduction and recovery
  - Opportunities for coordination with other modes of transport



Energy saving rate following the optimization of train speed and braking cases thanks to the deployment of ATO via ETCS





#### Challenges/constraints



ETCS share of total networks in % in Europe - source: solving the digitization challenge for Europe's rail sector (pwc)



# Organizational culture

- \* Difficulty in managing the intra-organizational clash of cultures
- \* Resistance to operational and organizational changes
- Digital technology considered non-priority asset class

Conflicts of interest

- Priorities differences (railway companies, regulators, OEMs, governments)
- Conflicting approaches by infrastructure managers and operators





#### Challenges/constraints



Minimum, average and maximum ETCS deployment costs (in millions of euros) per lane km - source: solving the digitization challenge for Europe's rail sector (pwc)







- Poorly adapted regulations/ lagging behind digital developments
- Need to implement new safety/security concepts
- Lack of legal clarity (responsibility in case of automated train incident)
- Significant investment, not suitable for OEM proprietary developments
- Operating costs for maintenance of new equipment
- Costs generated by the hybrid operation essential at the beginning
- Prejudice and lack of trust in the reliability of technology
- Impact on jobs and fear of investing in stranded assets
- Insufficient degree of standardization and depth of specificities

Living the digital rail journey, a new traveling experience





#### Conclusion

Facts

- Benefits of digitization in terms of sustainability, safety, performance and competitiveness
- \* Multifaceted challenges: financial, organizational and regulatory

Need to digitise

- \* All sectors are undergoing transformation thanks to new digital solutions
- \* Failure to invest in digitalisation could prove fatal for railway companies

Setting up a roadmap

- Make digitization a top priority
- $\boldsymbol{\diamond}$  Develop a detailed business case and a clear roadmap
- ✤ Introduce new ways of collaboration between stakeholders for automation and alignment of standards
- Stay focused on the main issue: ensuring a greener and more sustainable mode of transport





## THANK YOU

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## Cloud-edge Collaboration Based Big Data Platform for Intelligent HSR

LI Ping Researcher, CARS, China Session 1.4 and Digitalization/Artificial Intelligence







#### Beijing-Zhangjiakou high-speed railway-The first intelligent HSR



Cloud-edge Collaboration Based Big Data Platform for Intelligent HSR





#### Definitions and Key characters of intelligent HSR







#### Main Contents of intelligent HSR



Cloud-edge Collaboration Based Big Data Platform for Intelligent HSR





#### Big Data Platform for intelligent HSR







#### Cloud-edge Collaboration Based Big Data Platform





Cloud-edge Collaboration Based Big Data Platform for Intelligent HSR





#### Innovations on Intelligent Building Based on Big Data Platform



01 Parameterized Collaborative Design

构专业 暖通专业 给排水专业



03 Intelligent Construction of Subgrade, Bridge and Tunnel









#### Innovations on Intelligent Building Based on Big Data Platform



Cloud-edge Collaboration Based Big Data Platform for Intelligent HSR





#### Innovations on Intelligent Equipment Based on Big Data Platform







#### Innovations on Intelligent Operation Based on Big Data Platform



Cloud-edge Collaboration Based Big Data Platform for Intelligent HSR





#### Innovations on Intelligent Operation Based on Big Data Platform



Cloud-edge Collaboration Based Big Data Platform for Intelligent HSR





## THANK YOU

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## High Speed Train CBM and Predictive Maintenance In the era of Big Data Intelligent Systems

Antoni Munar Data Science Manager, Alstom Session 4-1.4 Digitalization / Artificial Intelligence







#### CONDITION BASED MONITORING AND PREDICTIVE MAINTENANCE

Holistic approach to achieve high availability at minimal costs

- Detection of faults
- Diagnostics of type and origin
- Prognostics of state and evolution (RUL)
- Optimal maintenance and logistics decisions







High Speed Train CBM and Predictive Maintenance in the era of Big Data Intelligent Systems

Jul 11

Time





#### PRODUCTIONALIZATION CHALLENGE ...







#### OPEN TO INNOVATION

#### Functional Variety & Complexity







#### RELIABLE VALUE ADDED ADOPTION





Embedded

Adopted

High Speed Train CBM and Predictive Maintenance in the era of Big Data Intelligent Systems













High Speed Train CBM and Predictive Maintenance in the era of Big Data Intelligent Systems



Modern MLOps



#### Hidden Technical Debt in Machine Learning Systems

D. Sculley, Gary Holt, Daniel Golovin, Eugene Davydov, Todd Phillips {dsculley, gholt, dgg, edavydov, toddphillips}@google.com Google, Inc.

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High Speed Train CBM and Predictive Maintenance in the era of Big Data Intelligent Systems





#### TAKE AWAYS: EFFECTIVE PREDICTIVE MAINTENANCE

FLEET SCALE
HOLISTIC END-TO-END
ASSET COMPREHENSIVE
OPEN FOR INNOVATION









#### TAKE AWAY

- ✤ BIG DATA PROCESSING TECHNOLOGIES
- ✤ADVANCED ALGORITHMS
- ✤ MODERN SOFTWARE TECHNOLOGIES

INTELLIGENT SYSTEMS

OPTIMAL MAINTENANCE & OPERATIONAL DECISIONS









## THANK YOU

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## DYNAMIC MAINTENANCE APPROACH BASED ON REAL TIME AND ARTIFICIAL INTELLIGENCE USING DIGITAL TWINS

José Antonio Marcos Head Manager of Smart Maintenance Engineering TALGO, Spain Session4-1.4 Digitalization / Artificial intelligence







#### TALGO 80 YEARS OF RAILROAD ENTREPRNEURSHIP



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1942 New concept TRAIN with maintenance services included, <b>from 1950s</b>	1968 Cross-border (4 Millon+ gauge changes in the last 10 years)	1973 + Confort - 25% Travel time	1989 Europe and USA	2000 HST New generation	2022 HST Efficient, accessible and ecological. Environmentally friendly HYDROGEN ready







# CHALLENGES AND MARKET REQUIREMENTS FOR HIGH-SPEED TRAINS







#### TALGO SMART MAINTENANCE 4.0



Jalge

DYNAMIC MAINTENANCE APPROACH BASED ON REAL TIME AND ARTIFICIAL INTELLIGENCE USING DIGITAL TWINS



#### SMIRT REAL TIME CONDITION BASED MAINTENANCE





**HIGH**SPEED

Morocco 2023









#### CBM BENEFICTS AND ROI FOR OPERATORS AND MAINTAINERS





✓ **Extension** Maintenance Intervals











#### DIGITAL TWINS TO IMPROVE PREDICTIVE MAINTENANCE

USE CASE: HVAC, Doors, batteries, motors.. Virtual replicas to simulate physical systems.

#### Advantages:

- Simulation learning to improve the prognostics.
- Synthetic data generation to improve machine learning models









#### DYNAMIC FLEET MAINTENANCE MANAGEMENT SYSTEM



Talgo

DYNAMIC MAINTENANCE APPROACH BASED ON REAL TIME AND ARTIFICIAL INTELLIGENCE USING DIGITAL TWINS





#### TALVI– Automatic Maintenance vehicle inspection In seconds, on track, in real time







#### TALVI– Automatic Maintenance vehicle inspection Video Demo









11

#### TSMART HELP DESK TO OPTIMIZE FLEET OPERATIONS









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## INTELLIGENT RAILWAY SAFETY MONITORING SYSTEM

Mehmet, TURŞAK Advisor to Director General, Turkish State Railways (TCDD), TURKEY Session4-1.4 Digitalization / Artificial intelligence

