

# Drone Applications in Railway Environment





# DRONE APPLICATION IN RAILWAY ENVIRONMENT

100 YEARS ANNIVERSARY



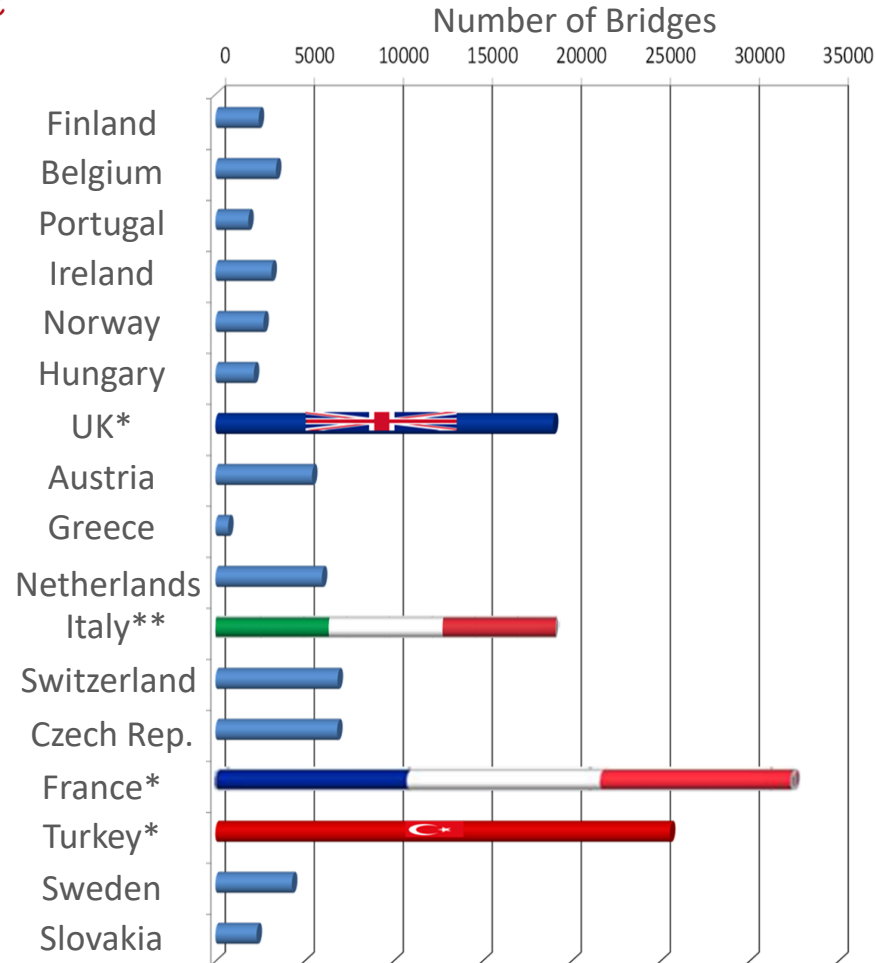
## CONTEXT



Infrastructure Managers have to manage and *monitor railway infrastructure*.



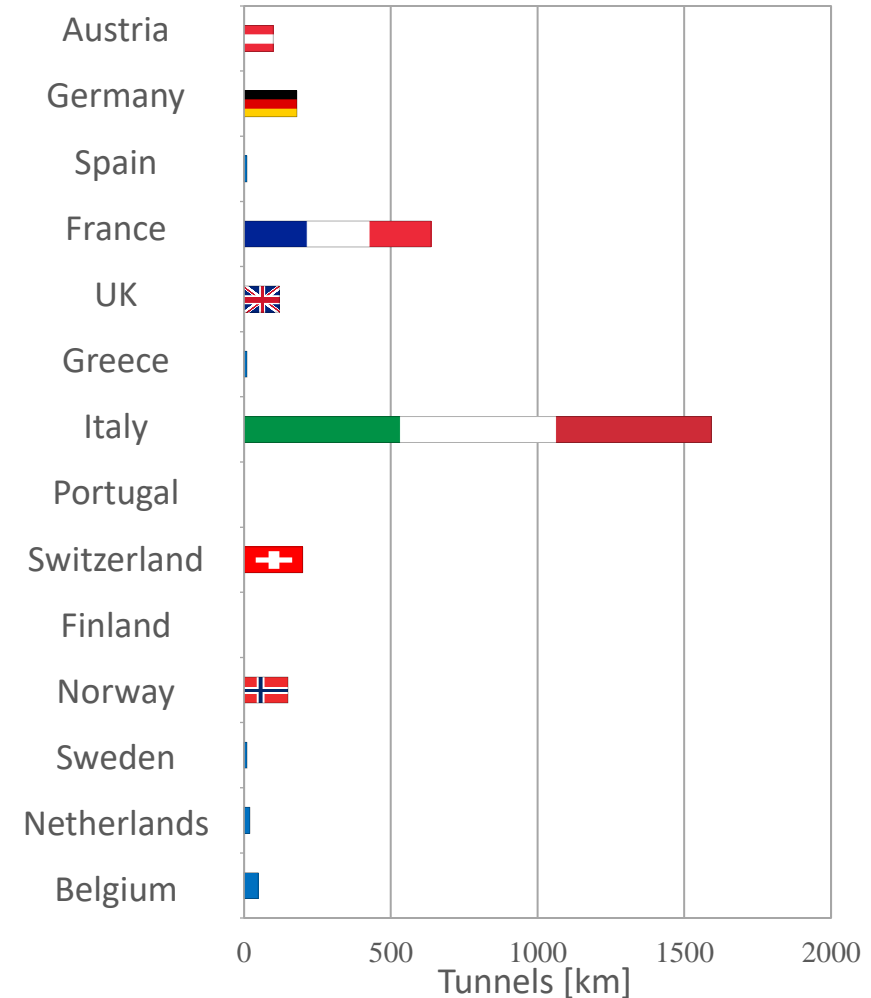
## BRIDGES IN EUROPE



\* Bridges with span  $\geq 2m$  \*\* Bridges with span  $\geq 3m$



## TUNNELS IN EUROPE



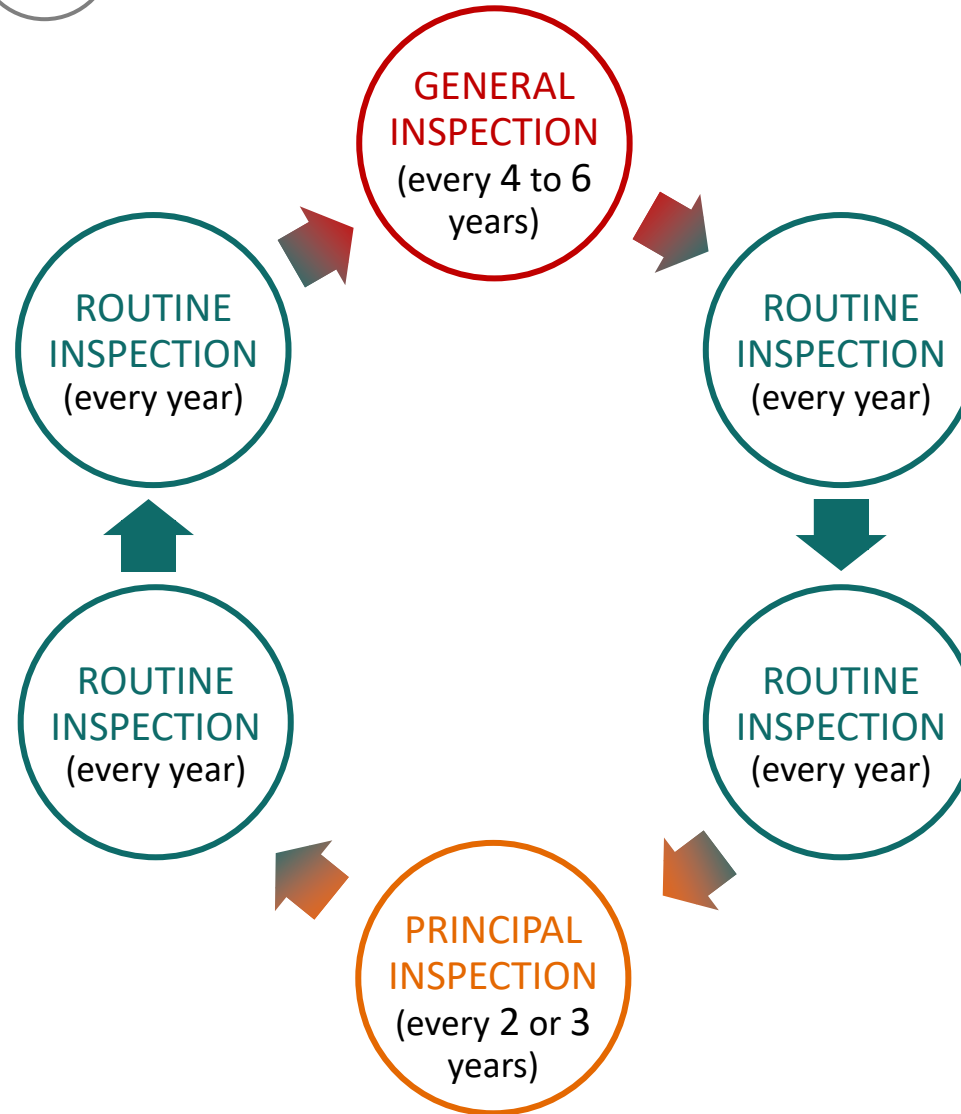


# DRONE APPLICATION IN RAILWAY ENVIRONMENT

## BRIDGE INSPECTIONS



### CYCLE OF BRIDGE INSPECTIONS



**GENERAL INSPECTION:**  
*“The most detailed inspection covering all parts of the bridge within **touching distance**”*  
 The inspection is carried out with **special vehicles** such as lifting platforms and by-bridges



**PRINCIPAL INSPECTION:**  
*“In-depth visual inspection focusing on safety. The principal inspection may bring to light a need for further in-depth inspections, not necessarily covering the entire structure, but rather focusing on a particular component or problem area.”*

UIC CODE

7 7 8 - 4

2nd edition, March 2011  
Translation

R

Defects in railway bridges and procedures for maintenance

Méthodes de maintenance et pathologie des ponts ferroviaires  
Instandhaltungsmethoden für Eisenbahnbrücken einschließlich Schadensbeschreibung



UNION INTERNATIONALE DES CHEMINS DE FER  
INTERNATIONALER EISENBAHNVERBAND  
INTERNATIONAL UNION OF RAILWAYS

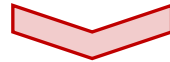


# DRONE APPLICATION IN RAILWAY ENVIRONMENT

## BRIDGE INSPECTIONS

### DRONE APPLICATION

Some bridges, due to *soil morphology* and to their *geometrical features*, are difficult to inspect even with the *aid of special vehicles*.



*Unmanned vehicles* (drones) could provide a *support* to the inspector to perform *bridge inspections*.



### OUTPUTS

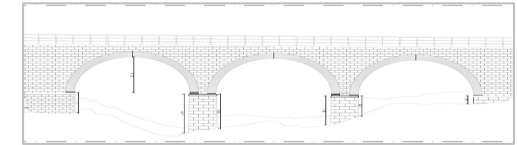
#### 3D MEASURABLE MODEL



#### PHOTOS / VIDEOS



#### PLAN / SECTIONS



#### DEFECT DETECTION



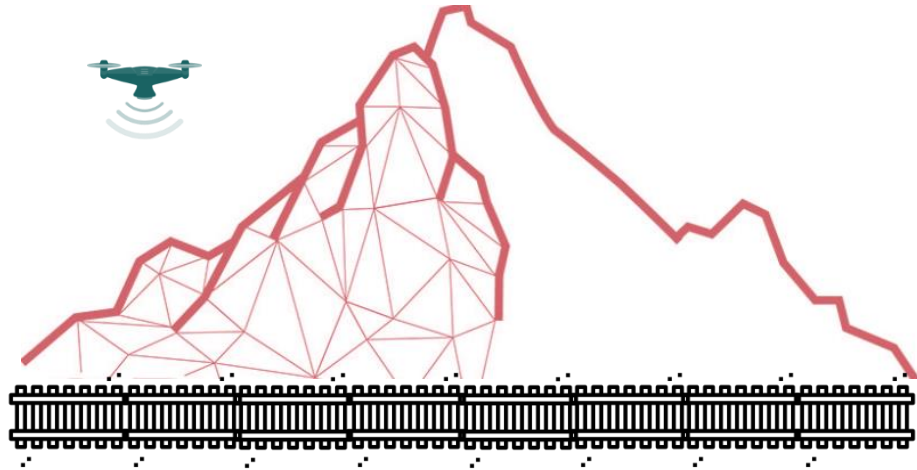
OGGETTO DI INTERESSE SULLA CAP.		FOTO	
C18	FRATURA LONGITUDINALE		
<p><b>DEFINIZIONE:</b> Fratture longitudinali, nella direzione di marcia, in cui il concreto si spaccava longitudinalmente, anche in presenza di armatura, per effetto di tensioni dovute alla dilatazione del materiale.</p> <p><b>CAUSE:</b> Spaccatura dovuta a tensioni dovute alla dilatazione del materiale, in presenza di armatura, per effetto di tensioni dovute alla dilatazione del materiale.</p> <p><b>DIAGNOSI VISIVA:</b> Osservazione visiva di ogni elemento dell'opera.</p>			
B	2	Fratture di grado 2	Fratture di grado 2
K <sub>1</sub>	INTERNO VALIGIATURA	K <sub>1</sub> = 0,5	Fratture di grado 2
	FRONTE	K <sub>1</sub> = 1,0	Fratture di grado 2
	FRONTE	K <sub>1</sub> = 1,5	Fratture di grado 2
	Fratture di grado 2	K <sub>1</sub> = 1,5	Fratture di grado 2



# DRONE APPLICATION IN RAILWAY ENVIRONMENT

## LAND SURVEYS AND SECURITY

### Slope analysis by digital terrain models



Drones are used to estimate the *qualities of a rock mass* near the railway.

### Vegetation monitoring along the railway



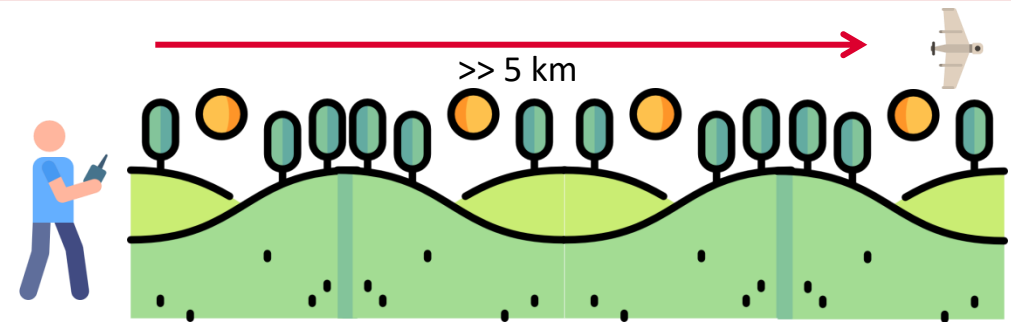
It is possible to *detect the vegetation* and *estimate the areas of vegetation to be cut*.

### Monitoring of railway assets



Drones are used to avoid *thefts* and *damages* along the railway.

### BVLOS Activity



BVLOS activity is used to inspect *long stretches of railway*.

## UIC – DRONE4RAIL PROJECT (BRIDGES)

**SCOPE:** Harmonized methodology for the use of drone technology for bridge inspections in the European railway field

### PROJECT LEADERS:

- Hans-Jörg Stark – SBB
- Andrea Vecchi – RFI



Total Duration: **34** months from 03/2019  
*Delay due to COVID-19*



Total Budget: **160** k€

### STATUS OF THE PROJECT

➤ **WP1** «State of the art» - **WP1 Leader:** Didier Van De Velde - Infrabel

Status WP > *completed*

END DATE > *October 2020*

➤ **WP2** «Experimental studies » - **WP2 Leader:** Salvatore Lorelli - DB

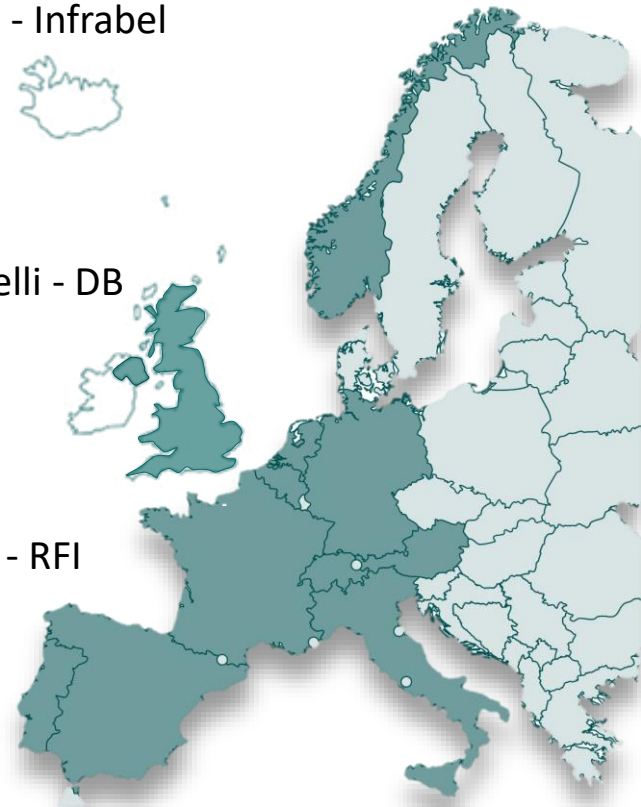
Status WP > *completed*

END DATE > *December 2021*

➤ **WP3** «Guideline Definition» - **WP3 Leader:** Andrea Vecchi - RFI

Status WP > *completed*

END DATE > *January 2022*



NETWORK RAIL	United Kingdom
DB	Germany
ADIF	Spain
IP	Portugal
RFI	Italy
BANENOR	Norway
INFRABEL	Belgium
ÖBB	Austria
SBB	Switzerland
SNCF	France
PRORAIL	Netherlands



# DRONE APPLICATION IN RAILWAY ENVIRONMENT



## UIC – DRONE4RAIL PROJECT (PLAIN TRACK)

UIC PROJECT

*Harmonized methodology for drone / UAV use for plain track*

WP1

State of the Art

WP2

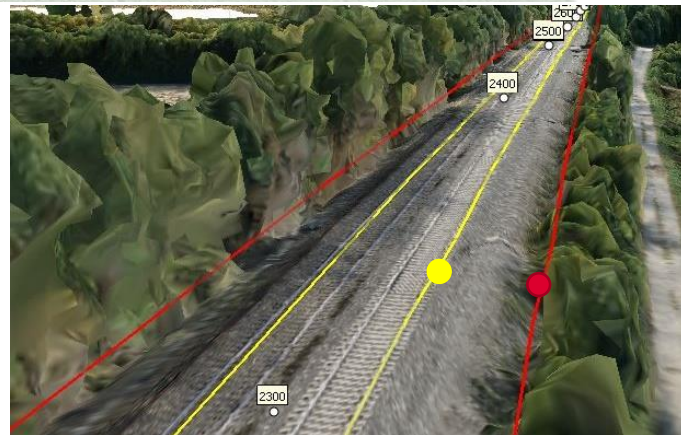
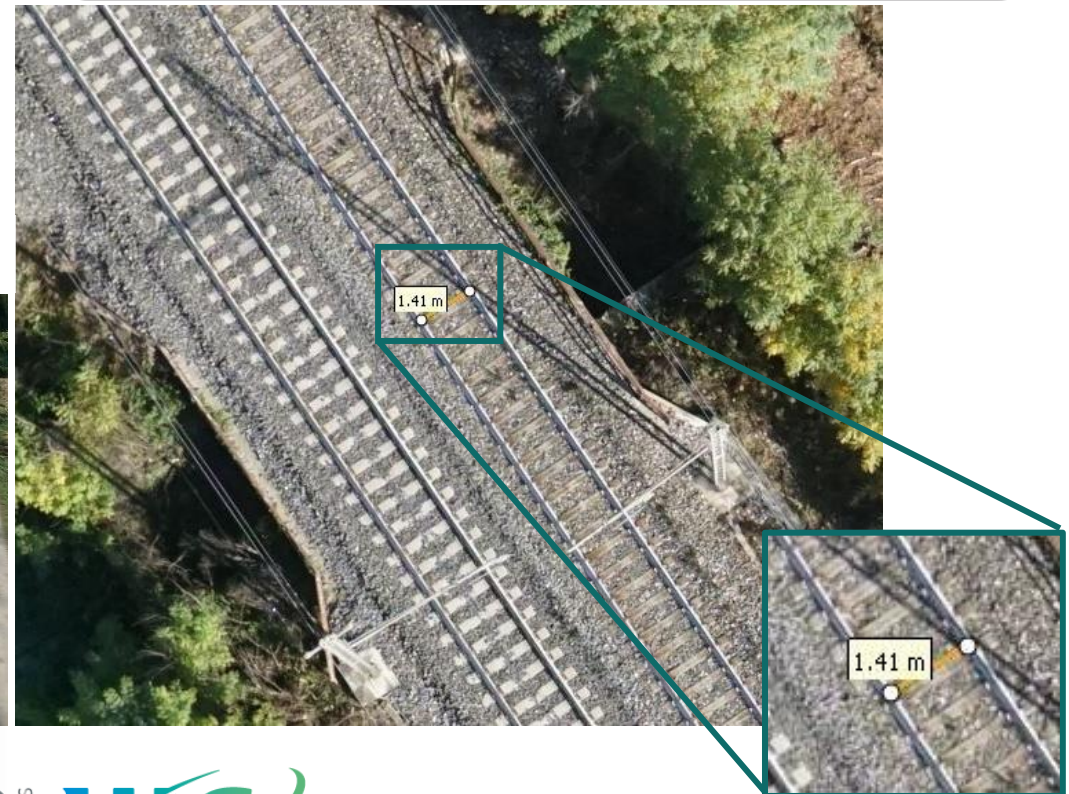
Experimental Studies

WP3

Definition of a Guideline



3D MODEL



MEASUREMENTS



# DRONE APPLICATION IN RAILWAY ENVIRONMENT

## REGULATIONS

During the UIC Drone4Rail Project, *Specific Operations Risk Assessment (SORA)* analysis has been carry out by an external consultant (Airhub).



The *Specific Assurance and Integrity Level (SAIL)* has been defined. This parameter consolidates the ground and air risk analyses and represents the level of confidence that the UAS operation will remain under control.

SAIL = II



### EUROPEAN REGULATIONS

Regulation (EU) **2019/947**

Regulation (EU) **2019/945**





# Thank you for your kind attention





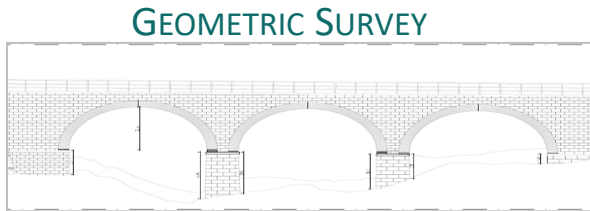
# DRONE APPLICATION IN RAILWAY ENVIRONMENT



## BRIDGE INSPECTIONS - RESULTS

### TO DATE - OUTPUTS

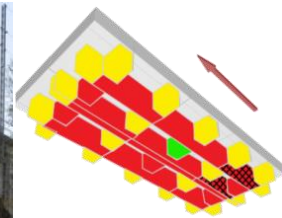
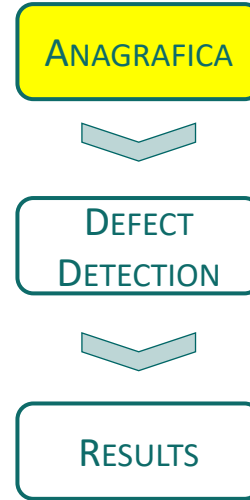
3D MEASURABLE MODEL



PHOTOS CATALOGUED ACCORDING TO BMS (BRIDGE MANAGEMENT SYSTEM)



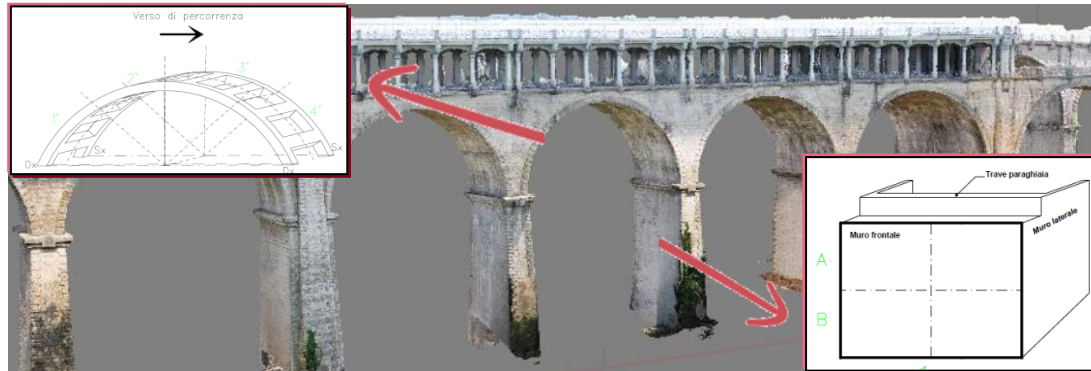
Bridge Management System  
DOMUS



C18		PUNTO C18	
Definizione: Isola di ponte, sulla quale si trova il binario di stazione. L'isola è costituita da una struttura in cemento armato che sorregge il binario.			
Attività: Ispezioni visive e fotografiche per individuare eventuali danni strutturali e di manutenzione.			
Descrizione attività: Ispezioni visive e fotografiche per individuare eventuali danni strutturali e di manutenzione.			
B	2	Passivo di ponte	0,00
SISTEMI VALUTAZIONE		Passivo di ponte	0,00
K <sub>1</sub>		Passivo di ponte	0,00
K <sub>2</sub>		Passivo di ponte	0,00
K <sub>3</sub>		Passivo di ponte	0,00

### ONGOING ANALYSES

Software to manage and to detect automatically defects



Development of AI algorithms for defect detection

