XIX INTERNATIONAL SIIV SUMMER SCHOOL

Transportation Infrastructures towards Green Transition

Il valore delle infrastrutture sostenibili per la transizione green

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The value of sustainable infrastructures for the green transition

Lecture Outline

RFI promotes sustainable infrastructures that can support green transition through approaches and metodologies applied in the design, construction and management phases and throught new technologies.

1. Sustainable infrastructure to generate value in territories
2. Sustainable infrastructure to support the green transition
3. Digital tools for developing integrated, smart and resilient infrastructure:
- BIM for integrated asset management during the life cycle of the work;
- Digitization to support the realization of the work: digital construction sites;
- Digitization for the monitoring and maintenance of bridges.

Nicoletta Antonias, Daria Piccioni

RFI S.p.A.– Gruppo Ferrovie dello Stato Italiane

01

Sustainable infrastructures to generate value in territories

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The Global Sustainable Development Strategy
An exceptional opportunity to seize

The new vision of infrastructure development includes ***Sustainability*** as a ***foundamental driver to lead the ongoing transition***

Mobility
Transition towards **sustainable and integrated mobility**

Green Transition
Energy efficiency

Tourism&Culture
Investment in **tourism and cultural heritage**

Infrastructure
Building and **restructuring efficiently** in terms of energy resources

Mobility
Accelerating the transition towards **sustainable and smart mobility**

Mims
Ministero delle infrastrutture e della mobilità sostenibili

Consiglio Superiore dei Lavori Pubblici

Linee guida
per la redazione del progetto di fattibilità tecnica ed economica da porre a base dell'affidamento di contratti pubblici di lavori del PNRR e del PNC

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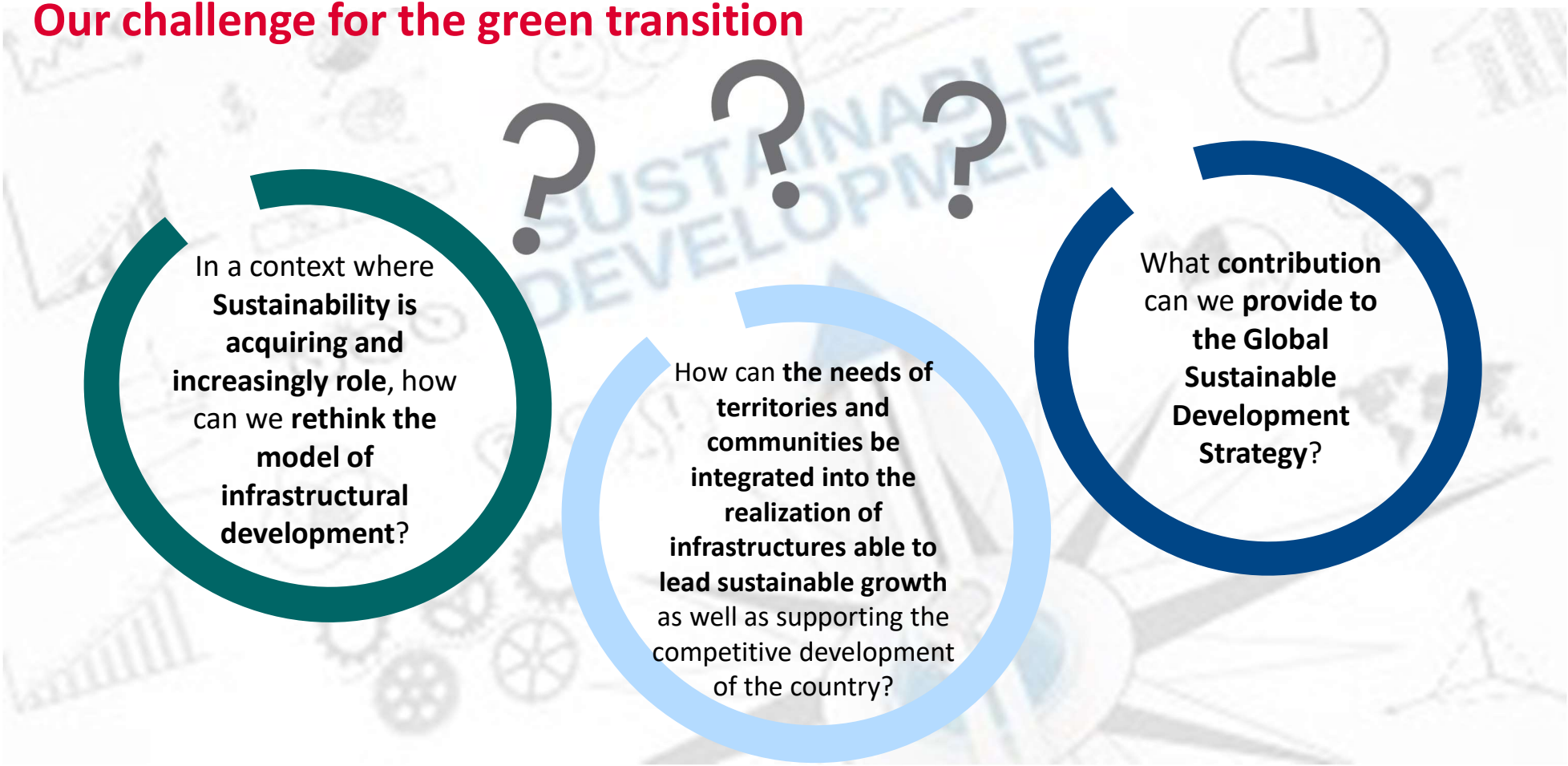
The role of mobility in the sustainable development of territories

Within the current framework of social and economic policies, mobility plays a fundamental role. Europe has undertaken a concrete path aiming at implementing a new sustainable and smart model of infrastructural development.

The development of more efficient, interconnected, and inclusive transportation systems is essential for achieving the commitments defined at international level in the context of sustainability.

Transportation infrastructures provide a substantial contribution to global sustainable development strategies that aim to address social, economic, and territorial inequity through improved accessibility and territorial integration. They represent the backbone of the national economic and social development.

Our challenge for the green transition



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Sustainability as a key value in the FS Group vision

VISION FS Group aims to create projects and services that can generate value for the community in a long-term perspective, by implementing an integrated and sustainable mobility and logistics offering

E

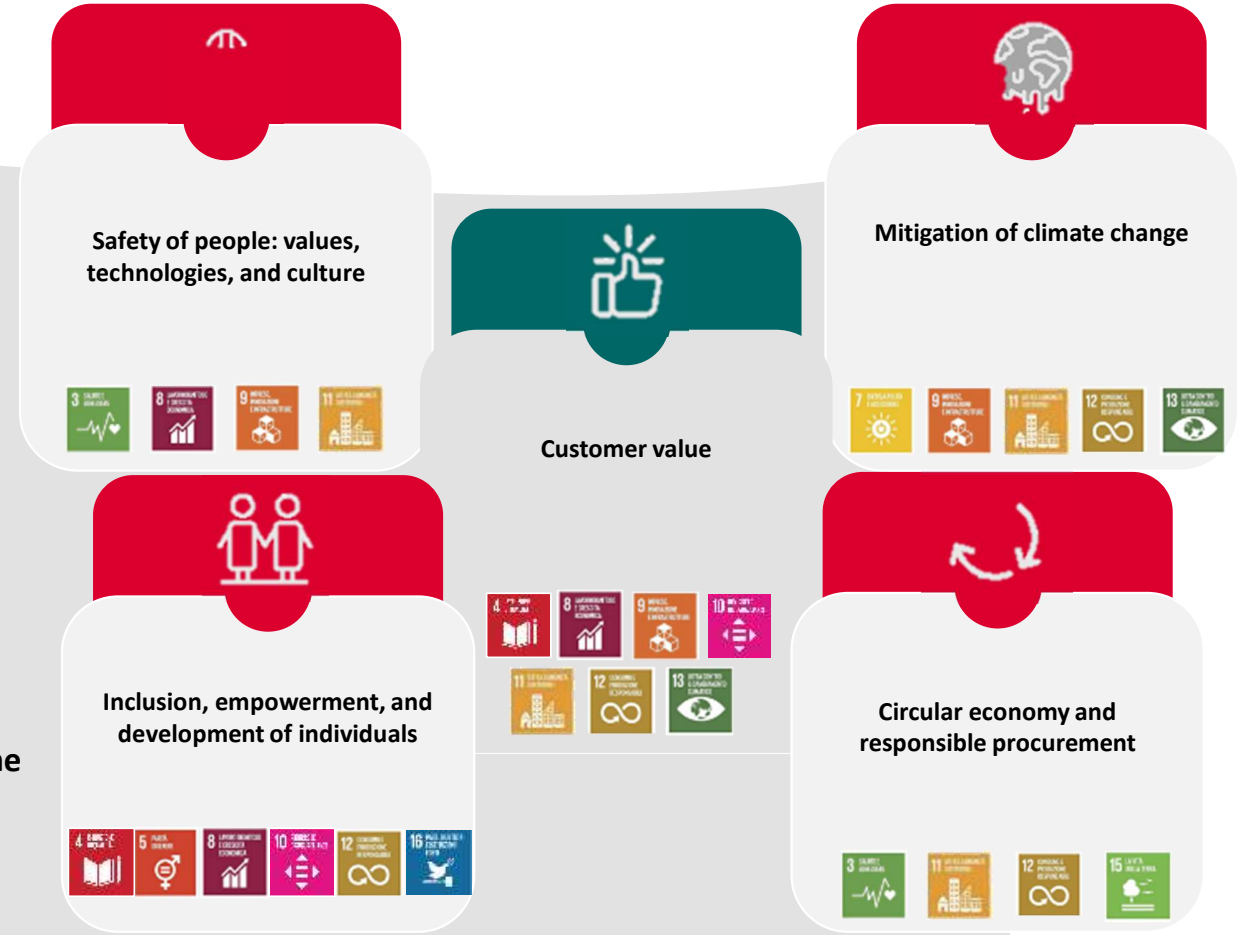
Preserving natural equilibriums through a sustainable development model

S

Meeting the needs of people, promoting **safety,** and fostering **relationships with communities**

G

Enhancing various capitals by organizing activities and processes to **create value, in the medium and long term, for all stakeholders**



An integrated approach to implement a systemic vision of sustainability

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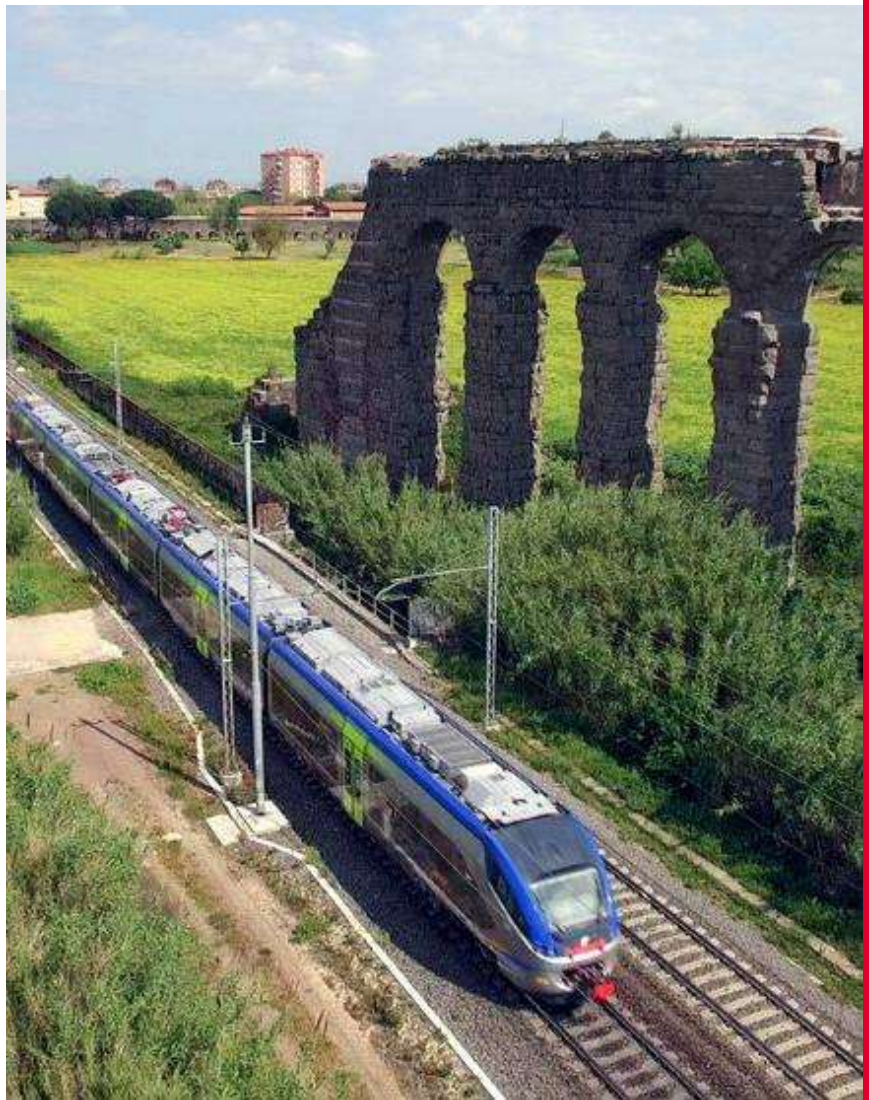
Infrastructures BEYOND the new sustainable mobility scenario…

- ✓ ***active components*** **of the processes of landscape structuring, transformation and territory upgrading**
- ✓ ***elements able to trigger*** **new economic, social and environmental development trend**, in the areas impacted by projects realization

The infrastructure works enable new connections between territories and sustainable mobility scenarios, but first of all improve the quality of life and increase the development and attractiveness of places, creating actual benefits and opportunities in a long term perspective



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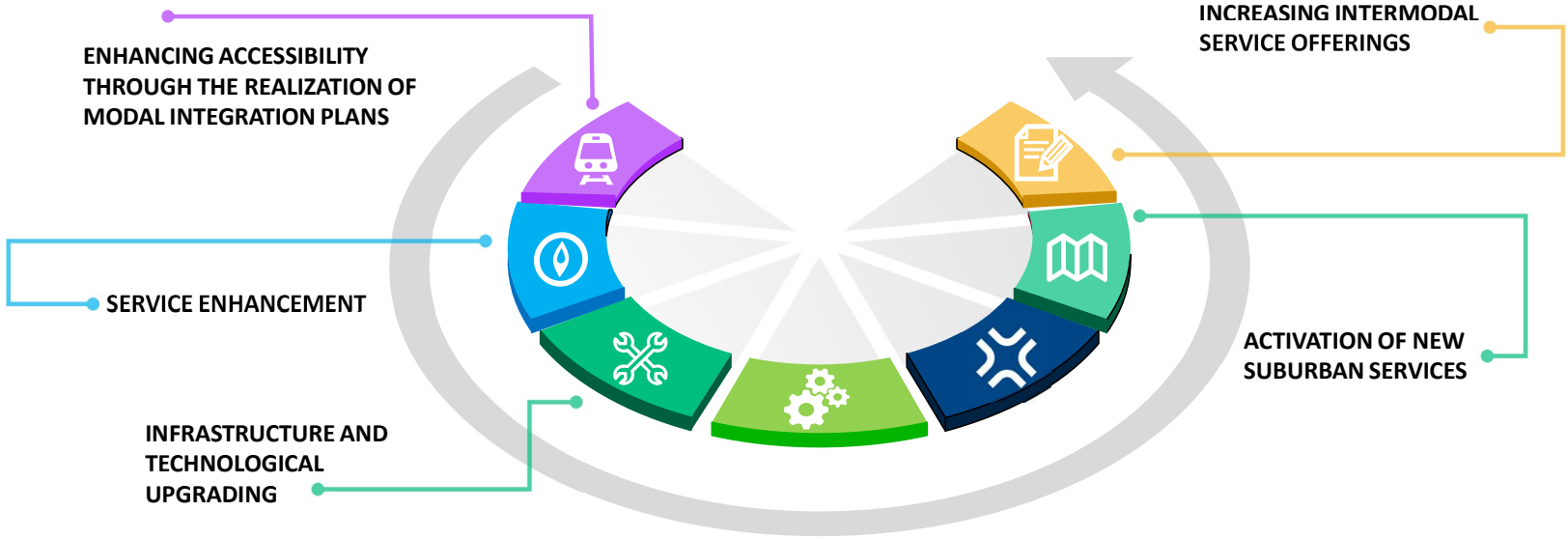
Enabling new mobility scenarios to build "polycentric and sustainable" territories



An integrated and efficient mobility system supports a sustainable transformation by increasing accessibility and territorial integration, creating new connections, and enhancing the quality of life for citizens

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PNRR: a booster for sustainable infrastructures!

The **PNRR represents an extraordinary opportunity to promote sustainable mobility, stations, and infrastructure** as key elements that significantly contribute to the country's development by supporting a healthy and sustainable growth in line with the current global challenges

- ✓ *Infrastructure as a key element of a complex system of relationships and connections*
- ✓ *Infrastructure to connect new projects aimed at transforming cities and territories*
- ✓ *Mobility as a catalyst for social life and an enabler of territorial cohesion*
- ✓ *The Station as a gateway to access territory services*

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The value of Sustainability for a new model of infrastructural development

Sustainability not only represent ***the essential driver for the develoment of "RIGHT" projects****, but also a* ***planning tool promoting the collaboration with the territory, offering an opportunity to create value for future generations***

Sustainability Studies and Analyses **for…**

Understanding ***the identity value of the territory*** and exploring ***opportunities for enhancing the territory and landscape***

Providing a ***clear insight into the potential of the infrastructure project to generate value***

Assessing ***the benefits generated by the project through*** the objective measurement of ***specific Sustainability indicators***

Hearing and ***communicating to stakeholders the benefits induced*** by the project's realization

Highlighting, in a forward-looking perspective, ***the potential of places***, whether already expressed or not yet developed, ***in the context of sustainable development***

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THE EXAMPLE OF THE HIGH-SPEED NAPLES-BARI: FIRST CERTIFIED SUSTAINABLE INFRASTRUCTURE

The Naples-Bari High-Speed Rail Line: An Example of Sustainable Infrastructure

In 2019, RFI achieved Envision certification with the highest level of recognition (Platinum) for the final project of the Frasso Telesino-San Lorenzo and Apice-Hirpinia sections

A project that includes a new conception of infrastructure as generative elements capable of triggering effective growth opportunities for the territories and communities involved.

The use of the Envision Protocol allowed the objective measurement of the project's sustainability level, highlighting the broader meaning of the project's integration into the territory and returning to the community the full sense of transformation and benefits induced by the design and realization of sustainable infrastructures.

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In 2021, RFI was among the winners of the Pimby Green 2021 Award (*Please in my backyard*), an award for the "culture of action" that enhances innovative forms of dialogue and participation with the territory to identify development opportunities capable of creating value and employment

PREMIO PIMBY GREEN

The Envision Certification System

Envision™ is the first **rating system** for designing and implementing sustainable infrastructure

- ✓ Created by the American Institute for Sustainable Infrastructure in collaboration with Harvard University, the Envision certification system was developed to meet the needs of local American governments for a **model capable of ensuring increasing levels of sustainability for infrastructure projects**.
- ✓ The Envision protocol allows **objective measurement of the sustainability** by providing a comprehensive assessment of environmental, energy performance, social, and economic aspects through credits.

Accredited resources as ***Envision Sustainability Professionals*** (ENV SP) to support designers, clients, and agencies

Guidelines for the application of the Envision protocol to the railway transportation infrastructure sector, validated by the *Institute for Sustainable Infrastructure*

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64 Credits - 5 Categories

Quality Of Life
14 Credits

WELLBEING
QL1.1 Improve Community Quality of Life
QL1.2 Enhance Public Health & Safety
QL1.3 Improve Construction Safety
QL1.4 Minimize Noise & Vibration
QL1.5 Minimize Light Pollution
QL1.6 Minimize Construction Impacts

MOBILITY
QL2.1 Improve Community Mobility & Access
QL2.2 Encourage Sustainable Transportation
QL2.3 Improve Access & Wayfinding

COMMUNITY
QL2.1 Advance Equity & Social Justice
QL2.2 Preserve Historic & Cultural Resources
QL2.3 Enhance Views & Local Character
QL2.4 Enhance Public Space & Amenities

QL0.0 Innovate or Exceed Credit Requirements

Leadership
12 Credits

COLLABORATION
LD1.1 Provide Effective Leadership & Commitment
LD1.2 Foster Collaboration & Teamwork
LD1.3 Provide for Stakeholder Involvement
LD1.4 Pursue Byproduct Synergies

PLANNING
LD2.1 Establish a Sustainability Management Plan
LD2.2 Plan for Sustainable Communities
LD2.3 Plan for Long-Term Monitoring & Maintenance
LD2.4 Plan for End-of-Life

ECONOMY
LD3.1 Stimulate Economic Prosperity & Development
LD3.2 Develop Local Skills & Capabilities
LD3.3 Conduct a Life-Cycle Economic Evaluation

LD0.0 Innovate or Exceed Credit Requirements

Resource Allocation
14 Credits

MATERIALS
RA1.1 Support Sustainable Procurement Practices
RA1.2 Use Recycled Materials
RA1.3 Reduce Operational Waste
RA1.4 Reduce Construction Waste
RA1.5 Balance Earthwork On Site

ENERGY
RA2.1 Reduce Operational Energy Consumption
RA2.2 Reduce Construction Energy Consumption
RA2.3 Use Renewable Energy
RA2.4 Commission & Monitor Energy Systems

WATER
RA3.1 Preserve Water Resources
RA3.2 Reduce Operational Water Consumption
RA3.3 Reduce Construction Water Consumption
RA3.4 Monitor Water Systems

RA0.0 Innovate or Exceed Credit Requirements

Natural World
14 Credits

SITING
NW1.1 Preserve Sites of High Ecological Value
NW1.2 Provide Wetland & Surface Water Buffers
NW1.3 Preserve Prime Farmland
NW1.4 Preserve Undeveloped Land

CONSERVATION
NW2.1 Reclaim Brownfields
NW2.2 Manage Stormwater
NW2.3 Reduce Pesticide & Fertilizer Impacts
NW2.4 Protect Surface & Groundwater Quality

ECOLOGY
NW3.1 Enhance Functional Habitats
NW3.2 Enhance Wetland & Surface Water Functions
NW3.3 Maintain Floodplain Functions
NW3.4 Control Invasive Species
NW3.5 Protect Soil Health

NW0.0 Innovate or Exceed Credit Requirements

Climate and Resilience
10 Credits

EMISSIONS
CR1.1 Reduce Net Embodied Carbon
CR1.2 Reduce Greenhouse Gas Emissions
CR1.3 Reduce Air Pollutant Emissions

RESILIENCE
CR2.1 Avoid Unsuitable Development
CR2.2 Assess Climate Change Vulnerability
CR2.3 Evaluate Risk & Resilience
CR2.4 Establish Resilience Goals and Strategies
CR2.5 Maximize Resilience
CR2.6 Improve Infrastructure Integration

CR0.0 Innovate or Exceed Credit Requirements

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Why Envision?

Envision promotes a universal approach to sustainability

Envision provides methods for an objective assessment of the sustainability features of the project

Envision is an effective tool to provide stakeholders with a clear and comprehensive overview of the benefits related to the project's realization

Envision is an objective tool for assessing the sustainability of infrastructure projects by competent authorities

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The Envision assessment

ENVISION PLATINUM

Envision® Scoring Summary

Frasso Telesino-S.Lorenzo

HIGHEST SCORE	QUALITY OF LIFE	LEADERSHIP	RESOURCE ALLOCATION	NATURAL WORLD	CLIMATE & RESILIENCE
95%	55%	16%	41%	65%	

Apice - Hirpinia

HIGHEST SCORE	QUALITY OF LIFE	LEADERSHIP	RESOURCE ALLOCATION	NATURAL WORLD	CLIMATE & RESILIENCE
89%	65%	22%	43%	33%	

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The genesis of a sustainable infrastructure

The value of dialogue and synergy with stakeholders: the example of the Naples-Bari High-Speed Rail Line

A project that includes a new conception of infrastructure as generative elements able to triggering effective growth opportunities for the territories and communities involved

Implementation of **effective territorial governance** through **Memoranda of Understanding** between RFI, MIT, and Regions for the development of the entire itinerary, aimed at sharing specific commitments and establishing institutional consultation tables under the coordination of the competent Regions

Envision PLATINUM

"The Naples-Bari as a project that CONNECTS rather than crosses the territories"

Engagement with territories:

Consultation tables with local authorities to develop shared solutions

CUR table

Synergistic table between the Campania Region and the University to measure the economic and social effects of the infrastructure

Information sessions with the communities to explain the reasons behind the solutions adopted

The infrastructure as an active component of the development processes of economic and social dynamics in the territories

The realization of the Napoli-Bari interventions presents a concrete opportunity to enhance the internal connections of the Southern Italy, promoting the integration of the South-Eastern railway infrastructure with the connecting routes to the North of the country and Europe, addressing social and territorial inequalities through greater cohesion and integration.

Positive impacts in terms of accessibility, demographics, and macroeconomic indicators.

QUALITY OF LIFE: MOBILITY

QL2.1 Improve Community Mobility and Access

Gathering the needs, requirements, and goals of the involved communities, as well as the social impacts, both positive and negative, that the project will have on the quality of life by proactively addressing long-term social, economic or environmental changes that affect the communities' quality of life.

CRESME

UNIVERSITÀ DEGLI STUDI DEL SANNIO

Territorial socio-economic analysis and evaluation of the impact of the Naples-Bari High-Speed Rail Line

Specific documents such as **Economic and Social Analyses and Sustainability Studies** can define sustainability indicators of the intervention from the perspective of the common interest. These documents achieve this by quantifying the environmental and social effects generated by the project.

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Italian high-speed rail has changed people's lifestyles and mobility in Italy, reducing distances and bringing citizens closer together

The ten-year experience of high-speed rail between Torino, Milano, and Napoli

In 10 years (**2008-2018**), **high-speed rail** contributed a total of **42 billion euros to the national GDP.**

In provinces equipped with high-speed rail, under the same initial conditions (such as propensity to export goods and attract tourism, etc.)**, high-speed rail has contributed to a GDP growth of around 5% over the last 10 years.**

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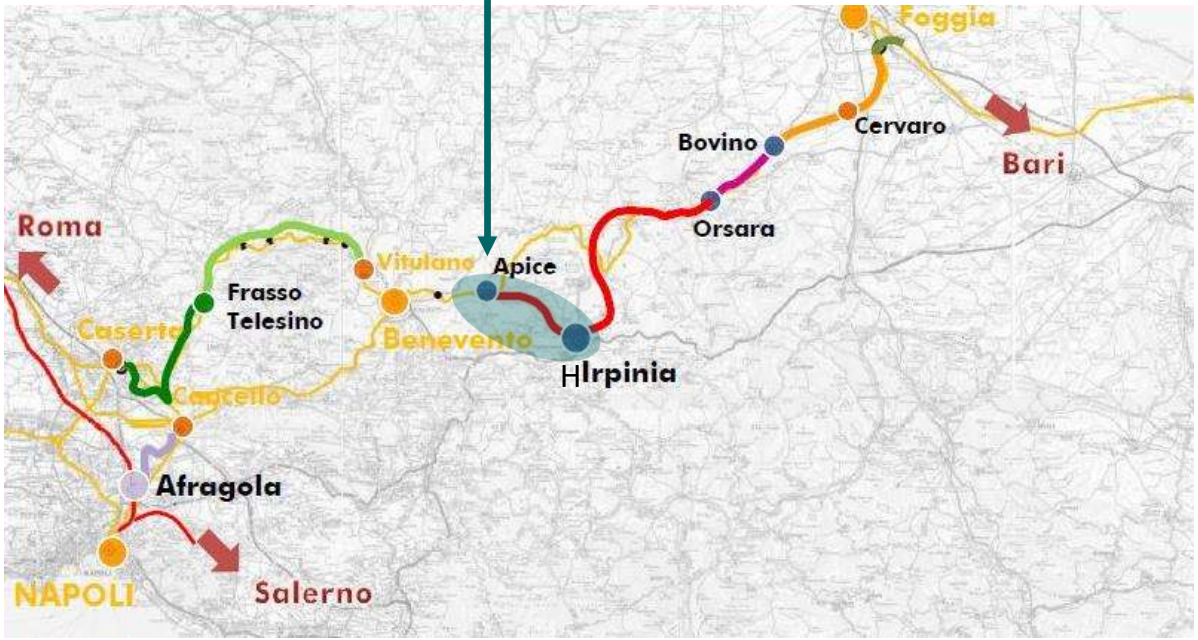
Source: Cascetta, E., Cartenì, A., Henke, I., & Pagliara, F. (2020). Economic growth, transport accessibility and regional equity impacts of high speed railways in Italy: ten years ex post evaluation and future perspectives. Transportation Research Part A: Policy and Practice, 139, 412-428.

The construction site to increase local economic development

Naples-Bari high-speed rail line: Apice-Hirpinia section



+ 50%

Southern Italian companies engaged in the construction of the new line

+ 50%

Suppliers involved in the Project **based in Campania**

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An opportunity to understand the territory

The construction of large infrastructures can become an exceptional opportunity for scientific research aimed at understanding the historical processes of land use and habitation, leading to the **enhancement of archaeological heritage.**

QUALITY OF LIFE: COMMUNITY

QL3.2 Preserve Historic and Cultural Resources

A synergistic effort is carried out with the competent authorities to harmonize the preservation of ancient heritage with the interests of infrastructure development. In particular, specialized studies and analyses are conducted to assess potential interference between the project and the archaeological context, defining activities to ensure understanding, protection, and preservation of findings.

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An opportunity to get to know the territory

Section	Archaeological investigation areas	Work area	Excavated volumes	WORK FORCE
Napoli - Cancello	96	299.500 mq	49.500 mc	185
Cancello - Frasso	107	87.000 mq	32.600 mc	68
Frasso - Vitulano	62	65.000 mq	8.480 mc	40
Apice – Hirpinia	108	100.000 mq	10.500 mc	63
Hirpinia - Orsara	31	852 mq	1.776 mc	25
Orsara - Bovino	61	1.171 mq	2.368 mc	20
Bovino - Cervaro	11	27.000 mq	29.674 mc	38
	476	**580.523 mq**	**134.898 mc**	**439**

The commitment to promote Green Infrastructures

Promoting **Restoration Ecology** projects to implement landscape structuring processes

NATURAL WORLD: ECOLOGY

NW3.1 Enhance Functional Habitats

Ensuring the functionality of ecosystems and biodiversity and defining actions for habitat protection, including interventions aimed at:

- Identification of design solutions characterized by MINIMAL INTERFERENCE WITH NATURAL VEGETATION
- Restoration of natural corridors affected by the project's construction or establishment of new ones through the RECONNECTION OF ECOLOGICAL FRAGMENTATION
- INTRODUCTION OF NEW VEGETATION INSTALLATIONS for the ecological recovery of the disturbed natural surface
- CONSERVATION OF THE ECOLOGICAL AND HYDRAULIC QUALITY OF INTERCEPTED WATERS and enhancement of the ecosystem value of the riparian corridor at the crossing works in the project
- Selection of design solutions and site location for REDUCING LAND CONSUMPTION

Efficient use of resources to promote circular economy processes

Maximizing the reuse of excavation materials generated on-site for:

- reduce the quantities of external supplies (**internal reuse within the project**)
- **regenerate degraded areas**

Example Apice-Hirpinia

Produzione complessiva (m^3 in banco)	Riutilizzo interno (m^3 in banco)	Riutilizzo Esterno (m^3 in banco)	Materiali in esubero - Rifiuti (m^3 in banco)
2.869.245	529.420	2.325.201	14.624

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RESOURCE ALLOCATION: MATERIALS

RA1.5 Balance Earthwork On Site

Adopt design choices aimed at reducing the overall quantity of materials to be sourced for the construction of the railway infrastructure through extensive reuse of excavation materials. This approach enables a reduced resource consumption and minimizes traffic flows for transporting soil to external sites.

Designing a sustainable construction site

- minimizing the interference of works with the natural environment and the built environment
- protecting and enhancing cultural, landscape, environmental, and biodiversity assets
- minimizing land consumption and construction phase interference
- promoting sustainable resource use within a circular economy framework
- maximizing the utility and long-term value of the designed infrastructure with a focus on resilience
- implementing environmental management systems and environmental monitoring to oversee the construction phase

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QUALITY OF LIFE: WELLBEING

QL1.6 Minimize Construction Impacts

Environmental design plays a crucial role in improving interaction with the relevant territory and the involved populations, especially during the construction phase. This phase represents a particularly critical and complex moment, particularly regarding the potential environmental repercussions in the targeted area. To address this, specific design documents are developed, such as the Construction Environmental Project and Environmental Monitoring Project, aimed at identifying significant environmental aspects related to construction activities, as well as mitigation measures and necessary environmental monitoring activities to ensure proper site environmental management.

Sustainable procurement during the construction phase

Sustainability criteria in the tender documents

- Integrate the new bidding processes to promote the implementation of sustainability policies by the Contractor on the construction site

Contractual requirements

- Encourage sustainable choices for the construction phase
- Implement and execute an environmental management system in accordance with the UNI EN ISO 14001 standard
- Ensure compliance with the DNSH principle

PNRR Projects

RESOURCE ALLOCATION: MATERIALS

RA1.1 Support Sustainable Procurement Practices

Through contractual requirements, transfer to the construction companies involved in the implementation of the project the guidelines and elements of sustainability developed in the field of environmental design to implement and enforcing sustainability policies on site in order to promote a sustainable construction site model.

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A concrete contribution to carbon neutrality

A sustainable infrastructure presents a concrete opportunity to contribute to sustainability goals aimed at reducing air emissions of CO2 and pollutants caused by road traffic through the process of modal shift from road to rail.

CLIMATE AND RESILIENCE: EMISSIONS

CR1.2 Reduce Greenhouse Gas Emissions

Application of various innovative sustainability methodologies:

- **Methodology for measuring greenhouse gas emissions** in accordance with the UNI ISO 14064-1:2006 standard to quantify CO2 emissions related to infrastructure construction activities
- **Life Cycle Assessment methodology** in accordance with the UNI EN ISO 14040 standard to quantify the environmental and energy impacts of the entire "railway system"

The relevance of Stakeholder Engagement in development "shared projects"

A new perspective

Infrastructure projects enable new connections between territories and sustainable mobility scenarios, but most importantly, they contribute to enhancing social well-being and supporting development by increasing the attractiveness of territories. They play a role in shaping a transformation of both territories and communities, all within a long-term perspective

Plan and design interventions and infrastructural works from the early stages by promoting the involvement of the territories and communities involved in order to achieve the "right project"

Key aspects

Implement structured models of Stakeholder Engagement through listening initiatives starting from the planning phase

Match the design and implementation features of the project with the opportunities and needs of the territory

Promote transparent and inclusive decision-making processes

Communicate the meaning of the project with an effective language

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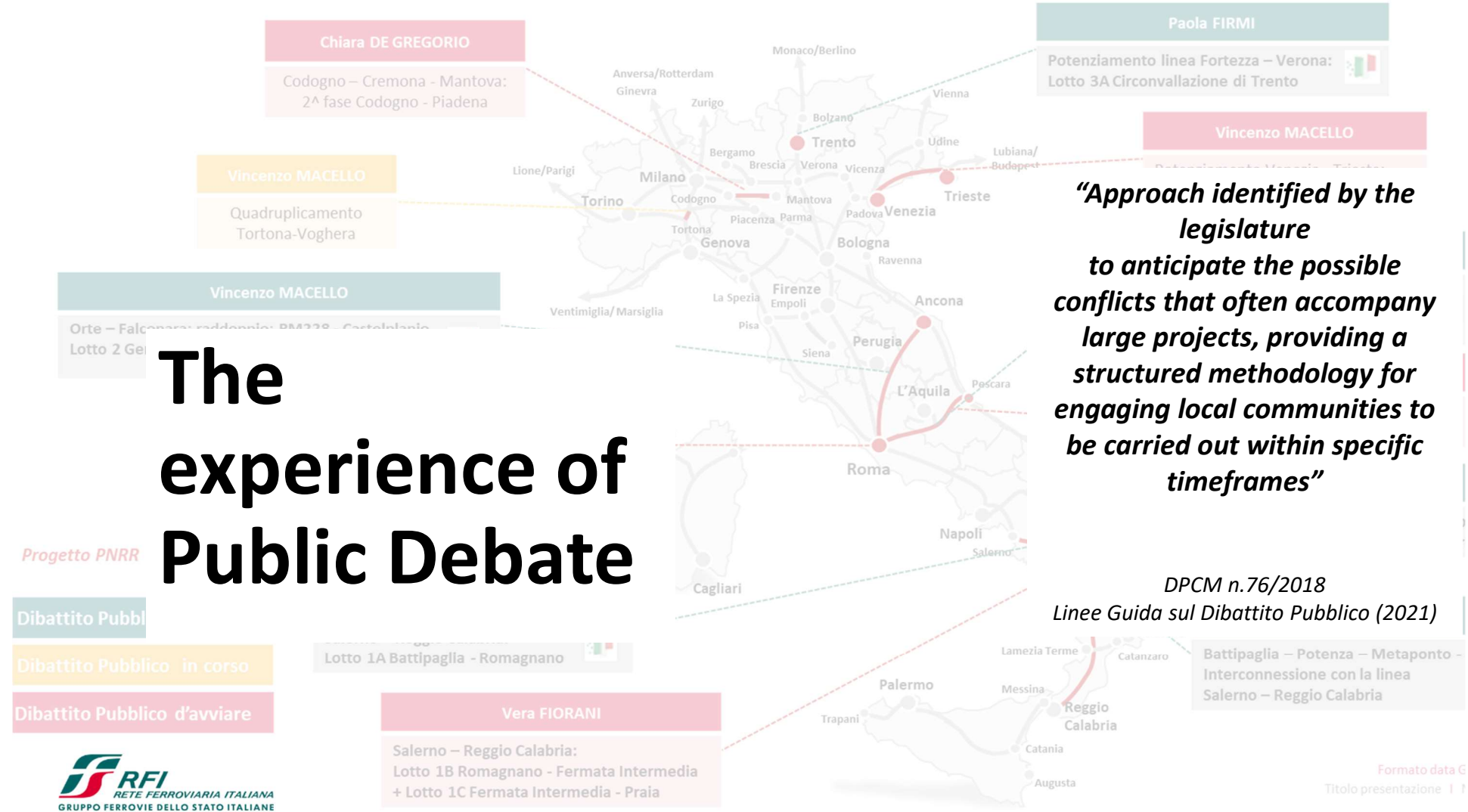
The experience of Public Debate

"Approach identified by the legislature to anticipate the possible conflicts that often accompany large projects, providing a structured methodology for engaging local communities to be carried out within specific timeframes"

DPCM n.76/2018
Linee Guida sul Dibattito Pubblico (2021)



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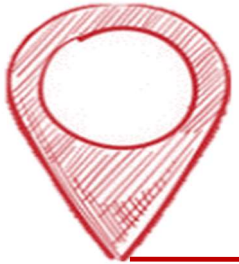
Creating a 'participatory ecosystem'



Promoting a diligent, proactive, and transparent approach towards stakeholders in all stages of planning and managing the investment, considering the social and media impact of specific infrastructure interventions

The stakeholder engagement:

- as an effective tools to gather more information about the territorial, social, and environmental context;
- for the timely identification of critical issues;
- for the identification of opportunities to enhance the strengths of the territory and therefore create shared value for communities;
- as a useful tool to maintain a stable relationship with communities

… to promote shared projects

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Promoting engagement with stakeholders from the early stages

Hearing and consulting stakeholders from the early stages allows the identification of the most suitable solution in terms of territorial integration, enhancement of the peculiar features of the areas involved, increased accessibility, inclusion, and utilization of the territories, with the goal of fostering greater cohesion and community well-being

Stakeholder Engagement Plan

To correctly direct the involvement activities, it is important to develop a Stakeholder Engagement Plan that outlines the specific objectives of involvement for each phase of development, taking into account the social and territorial context of reference and the key issues of interest.

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Developing a sustainable infrastructure that meets the community needs

PUBLIC DEBATE BUT NOT ONLY …

Listening to needs and expectations

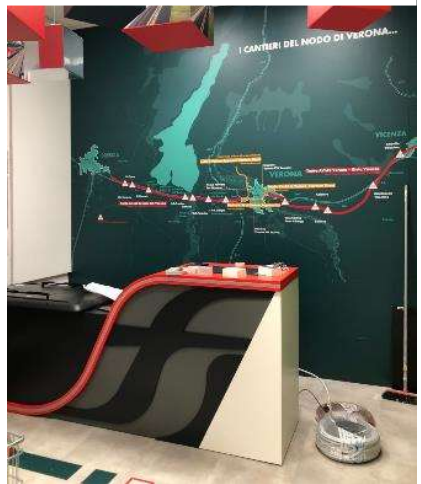
Proactively promote a process of listening and discussion with the community to develop the “right" project

Co-planning with the territory

Start operational working tables with local authorities and communities to develop concrete solutions regarding the shared key topics

Effective communication

Implement initiatives and information measures to share with stakeholders the benefits of the transformation generated for the territory and communities



A constant synergy

Maintain a constant dialogue with citizens, associations, local authorities with the aim of developing a scenario of interventions that can guide the sustainable development of the territories in a unique long-term perspective

Implement an effective Stakeholder Engagement model

Promote a common strategy that focuses on shared social responsibility and allows the creation of synergies aimed at combining Territory, Mobility and Social Innovation for the sustainable growth of communities

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02

Sustainable infrastructure to support green transition

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Participation in Tables and Working Groups for RFI's ESG transition

Development of projects, including innovative ones, particularly focused on *circular economy, green infrastructures and restoration ecology*, sustainable materials and *carbon footprint*, through national and international working groups (UIC, AIS,..) and specific initiatives within European funding programs (Horizon calls, Life, ...)

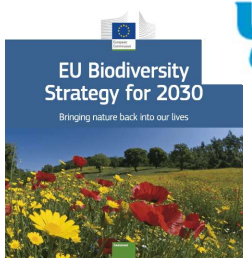
Some ongoing initiatives

AIS (Italian Sustainable Infrastructure Association) tables

RFI is engaged in leading several tables within the the AIS Working Groups.

UIC (Union Internationale des Chemins de fer) tables

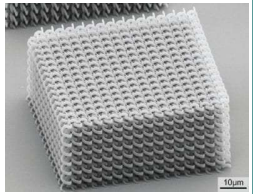
Project Ecosystem valuation for Railways» (ECOV4R) which aims to define a scientific framework to promote an approach based on ecosystem services



SILENT Project (Life Programme)

The project provide the development and testing of an innovative low acoustic barrier made with recycled materials using metamaterial technology

Project funded and in progress



Pollinetwork Project (Life Programme)

The project provide the realization of experimental interventions for the restoration of nature functional to the conservation of three groups of pollinating insects (diurnal Lepidoptera, Wild Apoidei, Sirfidi)

Project in progress of submission to the EC

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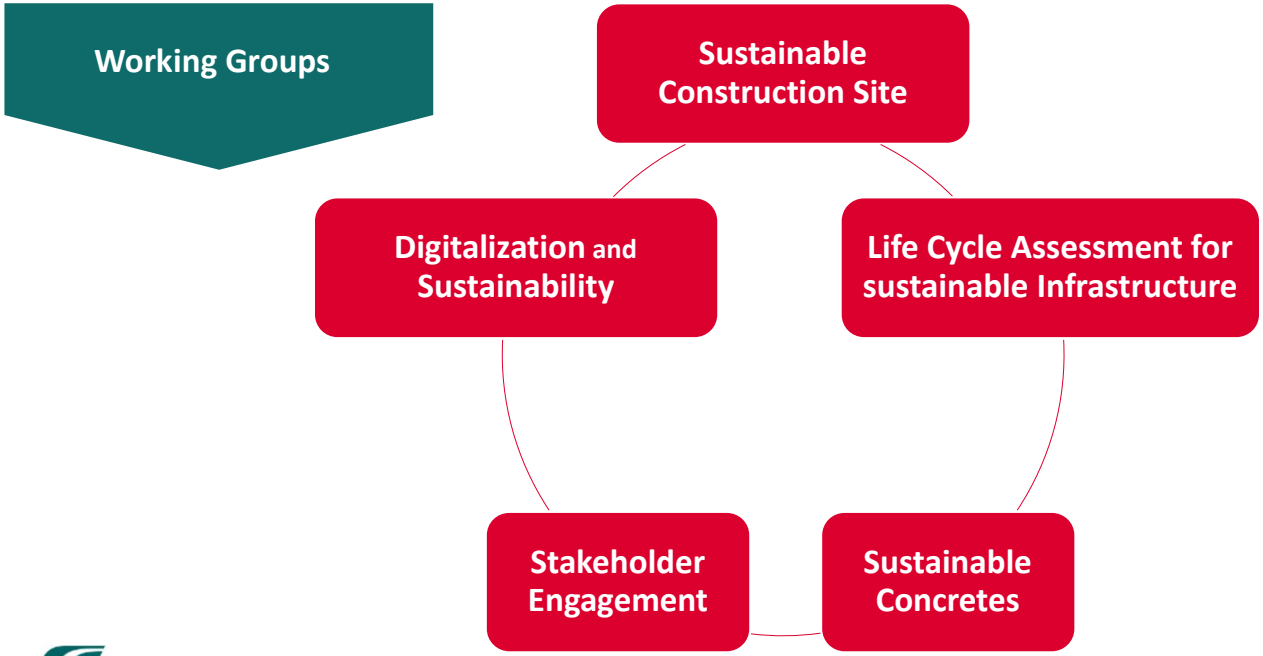
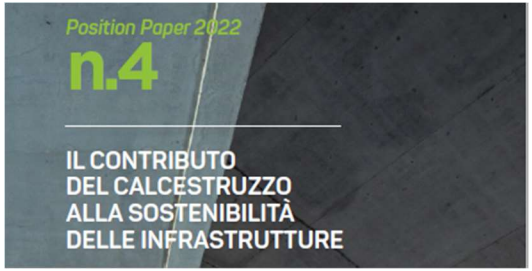
AIS (Italian Sustainable Infrastructure Association) tables

RFI actively participates in the activities of the **AIS Working Groups with the aim of sharing experiences and best practices** with other important Clients and Sector Operators (Construction materials Manufacturers, category associations, etc.) in order to define common guidelines and policies throughout the entire value chain of the process of design, construction and management of the works, **concretely promoting the realization of sustainable infrastructures**.





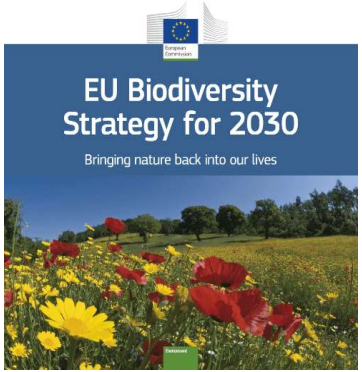
RFI's commitment to the UIC working group

RFI is committed within the Union Internationale des Chemins de fer (UIC), the worldwide association that brings together all operators in the railway sector, to share and promote best practices and initiatives, including innovative ones, aimed at guiding the evolution of the railway sector with a view to environmental, economic and social sustainability.

UIC Project «Ecosystem valuation for Railways» (ECOV4R)

RFI participates in the ECOV4R project which aims to define a scientific reference framework to:

- Promote an approach based on ecosystem services by implementing strategies for integrated management of soil, water and living resources that encourage the conservation and sustainable use of natural resources;
- Promote investments in green infrastructure and in *nature-based solutions,* oriented towards enhancing infrastructure resilience, through adopting actions that increase the adaptability of railway infrastructure to the effects of climate change;
- Define a methodology for developing quantitative indicators to monetize the benefits in terms of ecosystem services related to the development and management of railway infrastructure.



RFI activities on ecosystem services

Our vision on sustainable infrastructures to integrate green infrastructures and Nature Based Solutions

Our approach aims to improve ecosystem performance in order to **INCREASE THE RESILIENCE OF THE TERRITORIAL SYSTEMS** involved by the infrastructural works, among the transformative processes induced by climate change

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- Identification of design solutions that **REDUCE INTERFERENCES WITH THE NATURAL VEGETATION**
- Reconstitution or creation of the biological corridors involved by the infrastructural works, by means the **RECONNECTION OF FRAGMENTED VEGETATION**
- **DESIGN OF NEW VEGETATION SYSTEM**, taking into account the ecological value of the natural surface
- **PRESERVATION OF THE QUALITY AND THE ECOLOGICAL AND HYDRAULIC FUNCTIONALITY OF THE WATERS** and enhancement of the ecosystem value of the riparian corridor
- Choice of the most appropriate location of the construction site areas to **REDUCE SOIL CONSUMPTION**
- Redevelopment of abandoned quarries by means the reuse of material, with **BENEFITS TO SOIL RESTORATION AND RESTORATION ECOLOGY**

Analysis and studies to know healt condition and conservation of ecosystems and biodiversity are carried out, **to guarantee the functionality of the environmental system and related vulnerability**

Relevant studies and best practice in Italy

NATIONAL PLAN FOR THE ECOLOGICAL TRANSITION

MAIN GOAL
Land consumption "0" to 2030

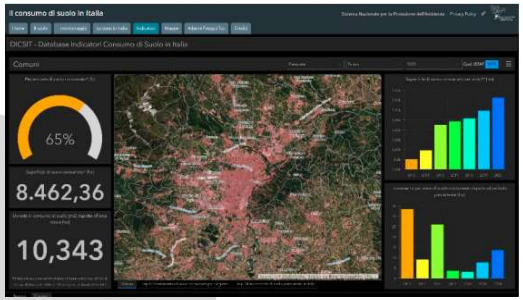
NATIONAL STRATEGY FOR BIODIVERSITY 2030

STRATEGIA NAZIONALE BIODIVERSITÀ 2030

MAIN GOAL
ecosystems on the planet are restored, resilient and adequately protected to 2050

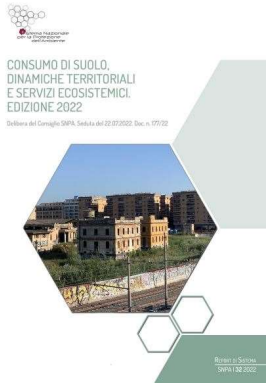
ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

The study of soil ecosystem services is useful for evaluating the effects produced by soil consumption.
From 2016 ISPRA Report promove the soil value as a non-renewable and limited resource.



HIGHER INSTITUTE FOR ENVIRONMENTAL PROTECTION AND RESEARCH

RFI CONTRIBUTES TO THE COLLECTION OF NATIONAL DATA AND MONITORING OF SOIL CONSUMPTION



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ACADEMIC RESEARCH

CIRBISES
CENTRO DI RICERCA INTERUNIVERSITARIO "BIODIVERSITÀ, SERVIZI ECOSISTEMICI E SOSTENIBILITÀ"

"Biodiversity, Ecosystem Services and Sustainability" Research Center for the study, conservation and management of plant diversity, by means innovative research programs.

IN LINE WITH CIRBISES RESEARCHES, RFI PRODUCES DETAILED STUDIES AND ANALYSIS ACCORDING TO THE ECOSYSTEMS AND HABITATS INVOLVED

UNIVERSITÀ DEGLI STUDI DI MILANO BICOCCA

Department of Environmental and Earth Sciences

The railway landscape is a refuge for many native species, incorporating microhabitats not present in other urban landscapes. Railway areas should be included in green network planning to improve connectivity and support nature in urban landscapes.

OTHERS

Tuscan-Emilian Apennine National Park MAB UNESCO

Sustainability credit trading platform (www.creditisostenibilita.it).
Economically remunerate ecosystem services, such as atmospheric carbon storage, generated by sustainable forest management.

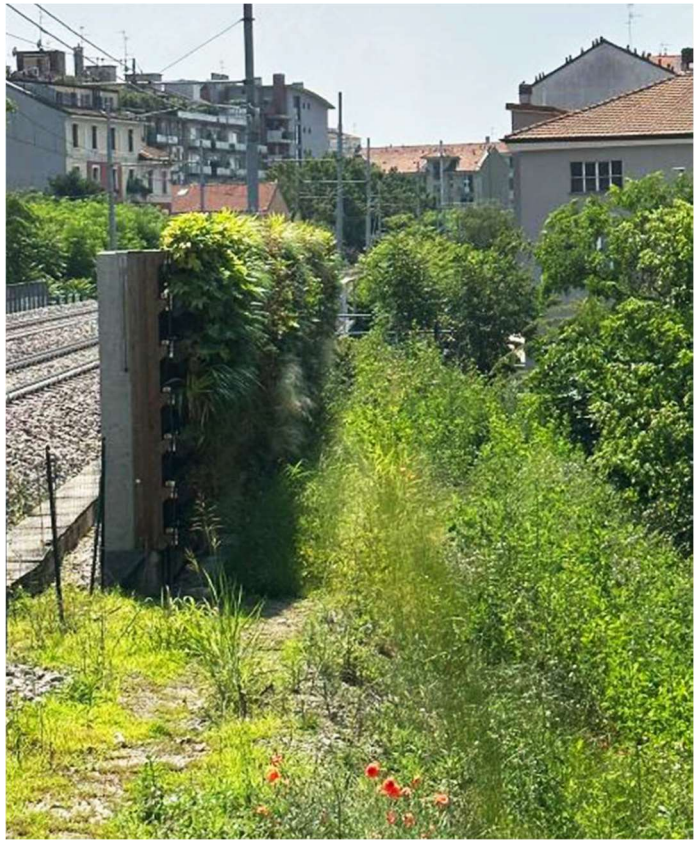
SILENT Project (LIFE Programme)

Innovative and green solutions for noise impact mitigation

RFI is engaged, with other industrial and scientific partners, in the development of the LIFE project – «Sustainable Innovations for Long-life Environmental Noise Technologies»

Programme for the Environment and Climate Action (LIFE)
CALL: Circular Economy and Quality of Life - Standard Action Projects (SAP)

Realization of measures for noise impact mitigation through experimentation and the adoption of **sustainable barriers made from recycled materials using the technology of metamaterials** which refers to artificial materials that have physical characteristics (such as sound absorption) linked not to the material type but to the structural geometry.
The experimentation will allow the evaluation of the acoustic and performance-related effectiveness of the barriers, as well as their sustainability, also from a circular economy perspective.



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PolliNetWork Project (LIFE Programme)

Restoration and management of nature for the conservation of pollinators

RFI is engaged, together with other industrial and scientific partners, in the development of the PollinetWork project

Programme for the Environment and Climate Action (LIFE)
CALL: Nature & Biodiversity - Standard Action Projects (SAP)
(LIFE-2021-SAP-NAT) – *Project included in the Reserve List*

Implementation of experimental projects for the **restoration of nature and the management of different types of natural and semi-natural environments in protected natural areas** - Natura 2000 sites, farms, linear infrastructures (roads, railways, electricity grid), **functional for the conservation of three groups of pollinating insects** (diurnal Lepidoptera, wild Apoidea, Sirfidi)

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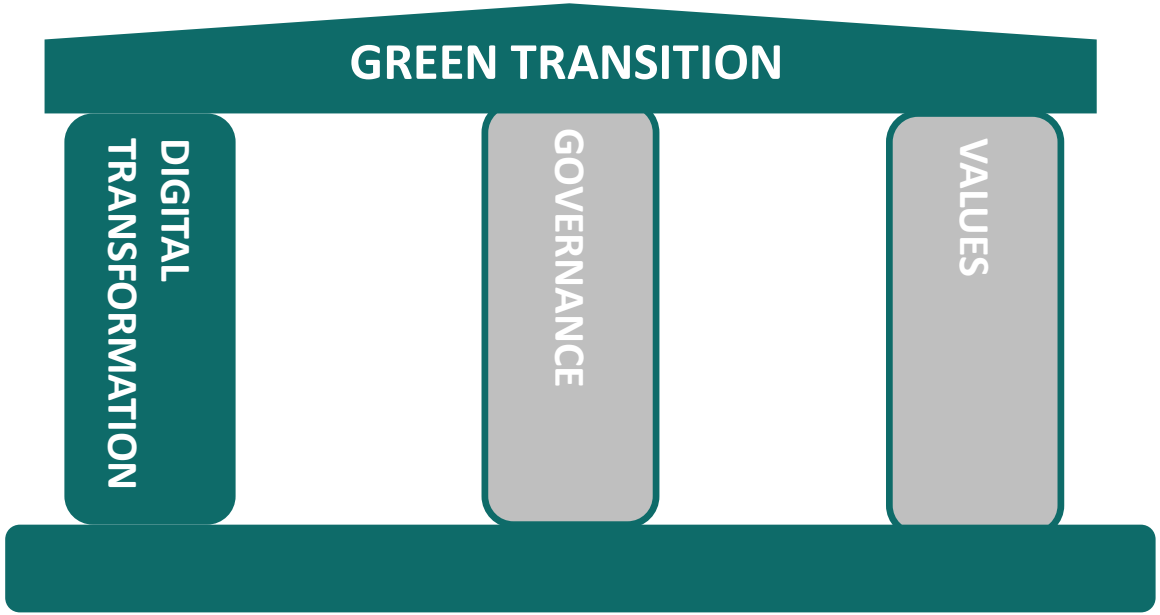
The role of technologies for sustainable development

Technologies as catalysts of sustainability

Digital Sustainability highlights the **role of digital technologies as tools for developing a sustainable future** and indicates the direction that digital technologies should take, being developed based on sustainability criteria



Digitalization becomes an opportunity to rethink the entire model of infrastructural development in a sustainable way

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03

Digital tools for developing integrated, smart and resilient infrastructure

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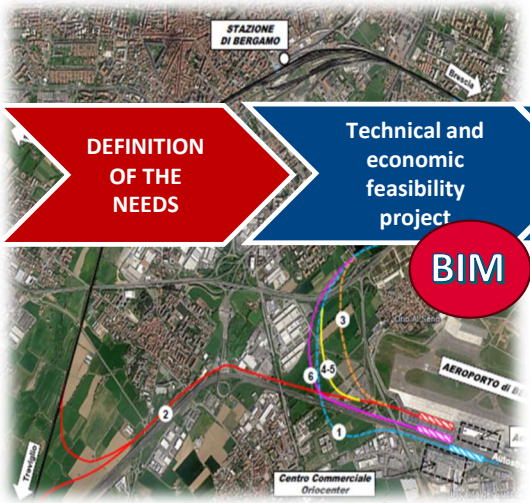
BIM for integrated asset management during the life cycle of the work

Different steps of an investment

Incidence of BIM in the actual process

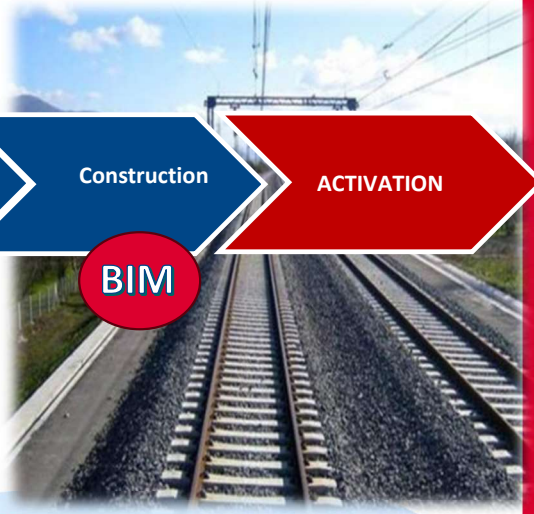
From the design idea …

… to the track!



DEFINITION OF THE NEEDS → Technical and economic feasibility project → Authorization process → Design verification → Negotations → Executive Design → Construction → ACTIVATION

BIM (Technical and economic feasibility project) · BIM (Design verification) · BIM (Executive Design) · BIM (Construction)



MAIN STAKEHOLDERS

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IS THE MAIN OPERATOR FOR RAILWAYS AND IS THE INFRASTRUCTURE MANAGER

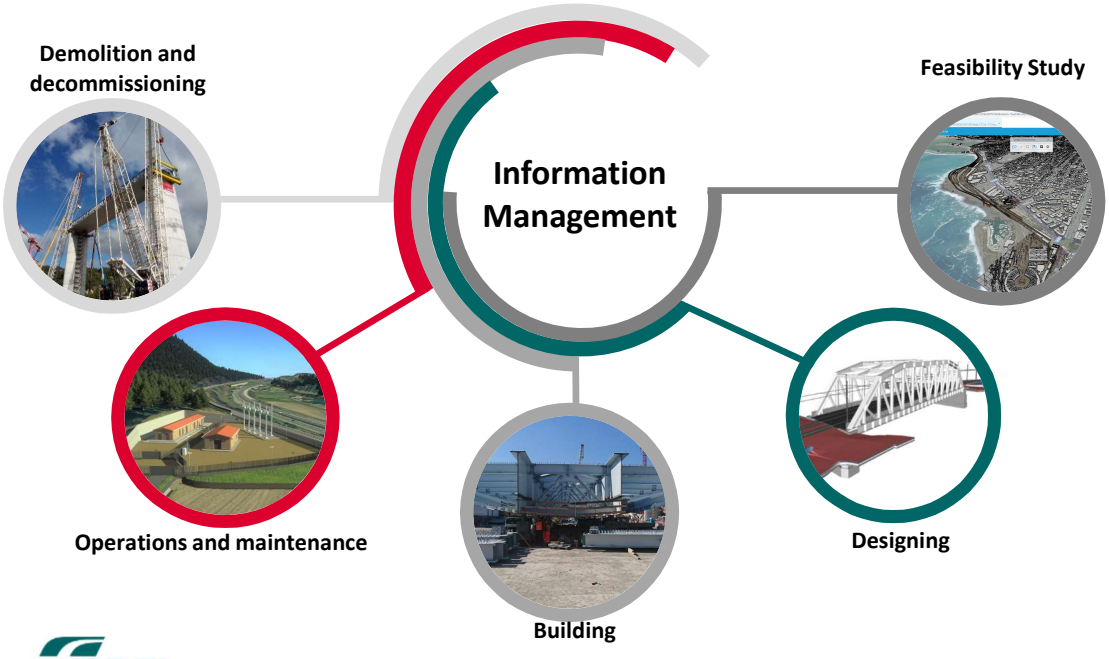
RFI MANAGES LINEAR AND COMPLEX INFRASTRUCTURES

AND IS RESPONSIBLE OF THE ENTIRE LIFE CYCLE OF THE PROJECT

BIM & Information Management

BIM process: from design to demolition

Information management during the project's life cycle



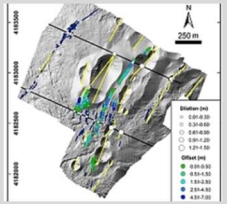
INPUT

- Caratteristiche Tecniche
- Dati Prestazionali
- Dati Dimensionali
- Materiali
- Dati prestazionali LCA

UNI EN ISO 19650-1: 2019
UNI EN ISO 19650-2: 2019

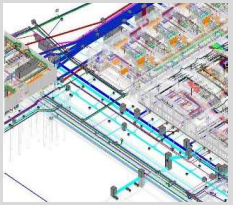
UNI EN ISO 19650-2: 2019

FIELD DATA



- Modifiche Tecniche
- Modifiche Dati Geometrici
- Lavorazioni
- Trasporto
- Materiali
- Tempi e costi

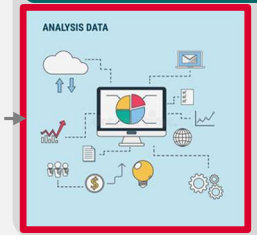
AS BUILT



- Rilievo opere esistenti
- Censimento e database sottoservizi
- Certificazioni Accettazione Materiali
- Schede Tecniche Prestazionali
- Dati Produttore
- Dati Manutenzione

UNI EN ISO 19650-3: 2021
UNI EN ISO 17412-1: 2021

MAINTANANCE DATA



- Dati produttore
- Censimento e database sottoservizi
- Dati manutenzione

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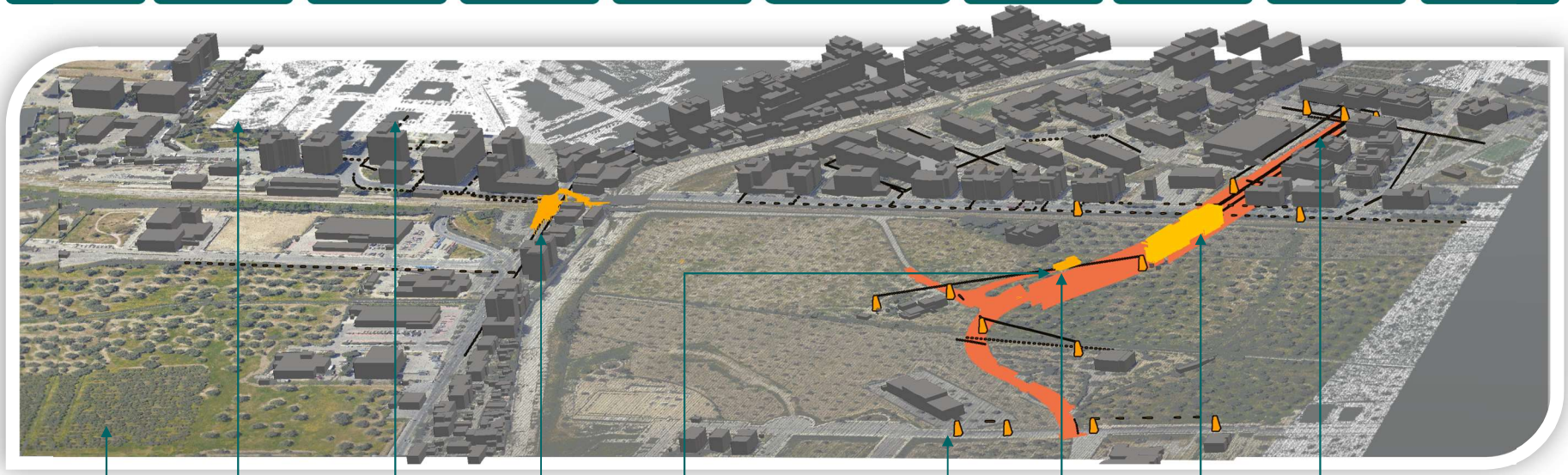
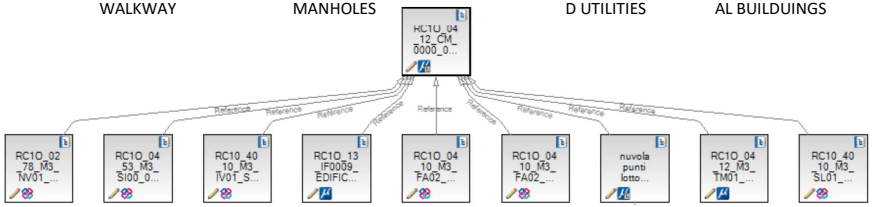
BIM methodology for an integrated design

Integration of disciplines and life cycle of the model

Assembled model of the work

Ortophoto	Point Cloud	Complex terrain model	Buildings model	Road System model	Bridge Model	Underpass Model	Underground utilities model	Hydraulic model	Technological builduing model





During the design phase, a federated model of the railway infrastructure is generated. In the federated model all disciplinary models contribute (eg: terrain, structure, MEP, etc.).

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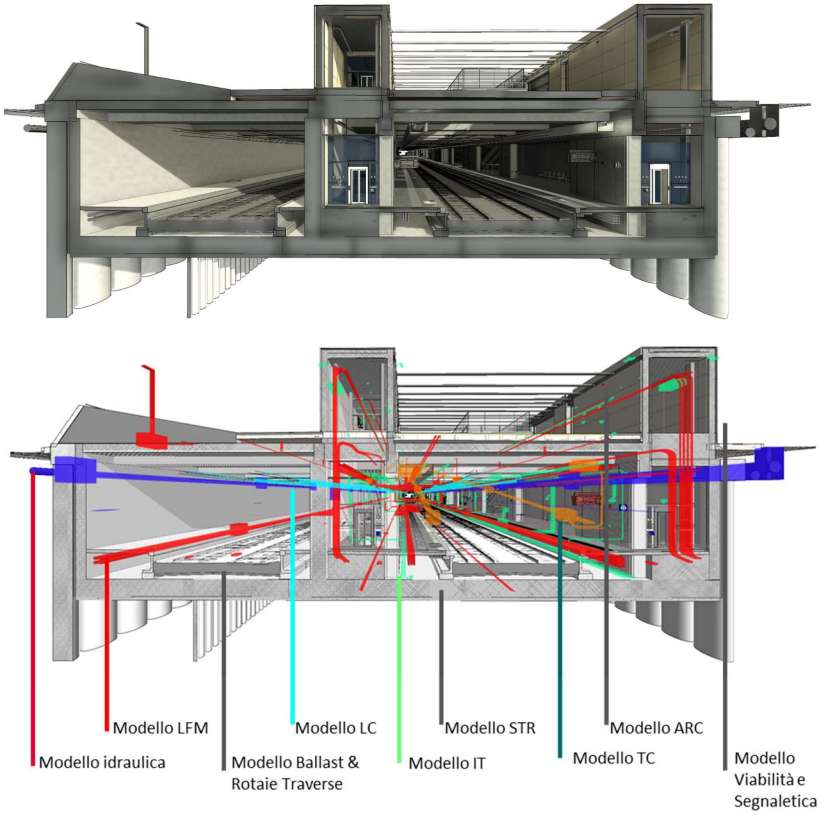
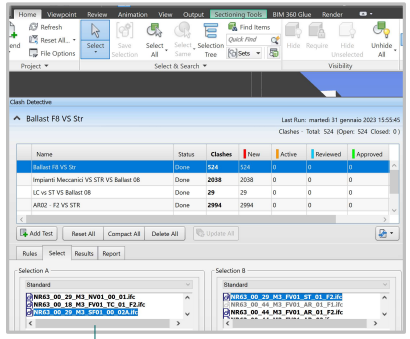
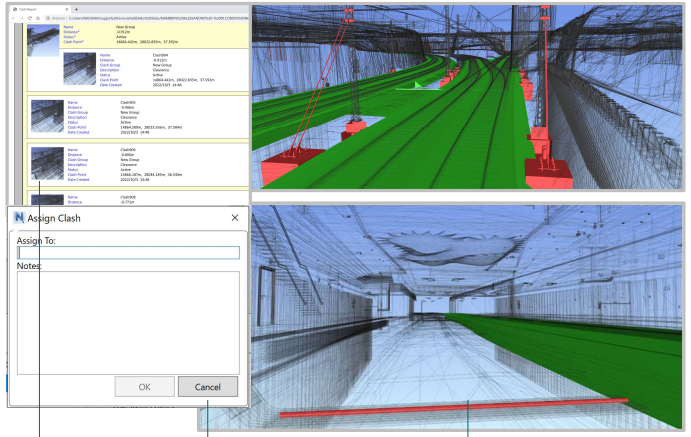
BIM methodology for an integrated design

Coordination and control of design





Rule setting for clash detection



Clash description: location, status...

Attribution of the clash to the person in charge

Interference visualitation

Data Control

- Tracciatura e storico dell'evoluzione del progetto senza perdita di informazioni
- Condivisione in tempo reale delle informazioni di progetto
- Certificazione dell'informazione e dei ruoli che concorrono a definirla
- Creazione di tipologici funzionali ad efficientare la progettazione

Qualitative aspects

- Verifica delle interferenze prima della fase realizzativa
- Minimizzazioni delle varianti in corso d'opera
- Minimizzazione extracosti nella fase esecutiva e di cantiere

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Data sharing and collaboration modalities

Sharing data environment

What is?

A regulated data sharing and exchange environment between the various players in the Supply Chain (UNI 11337)

What good is?

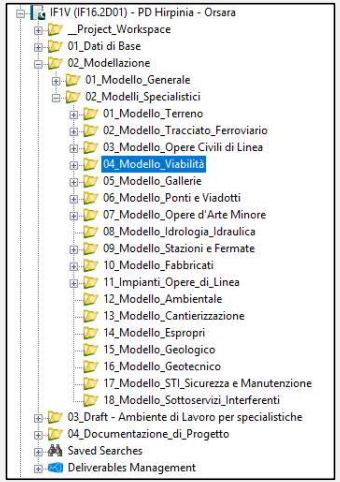
Allows to manage advanced file sharing by collaborating all in one environment

Working mode

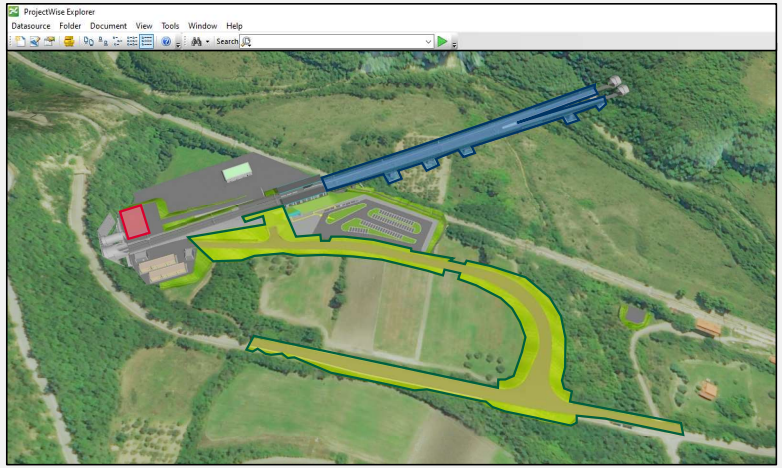
Managing models in a properly configured scenario

Advantages about using ACDat

- Shared workink mode
- Standardizerd process
- Integrated interdisciplinary modeling
- Enabling third parties to use the platform



Modello Federato gestito all'interno della Piattaforma di Collaborazione e Condivisione Dati



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Digitization to support the realization of the work: digital construction sites

Digitization of the construction site

Digital processes applied to construction phases

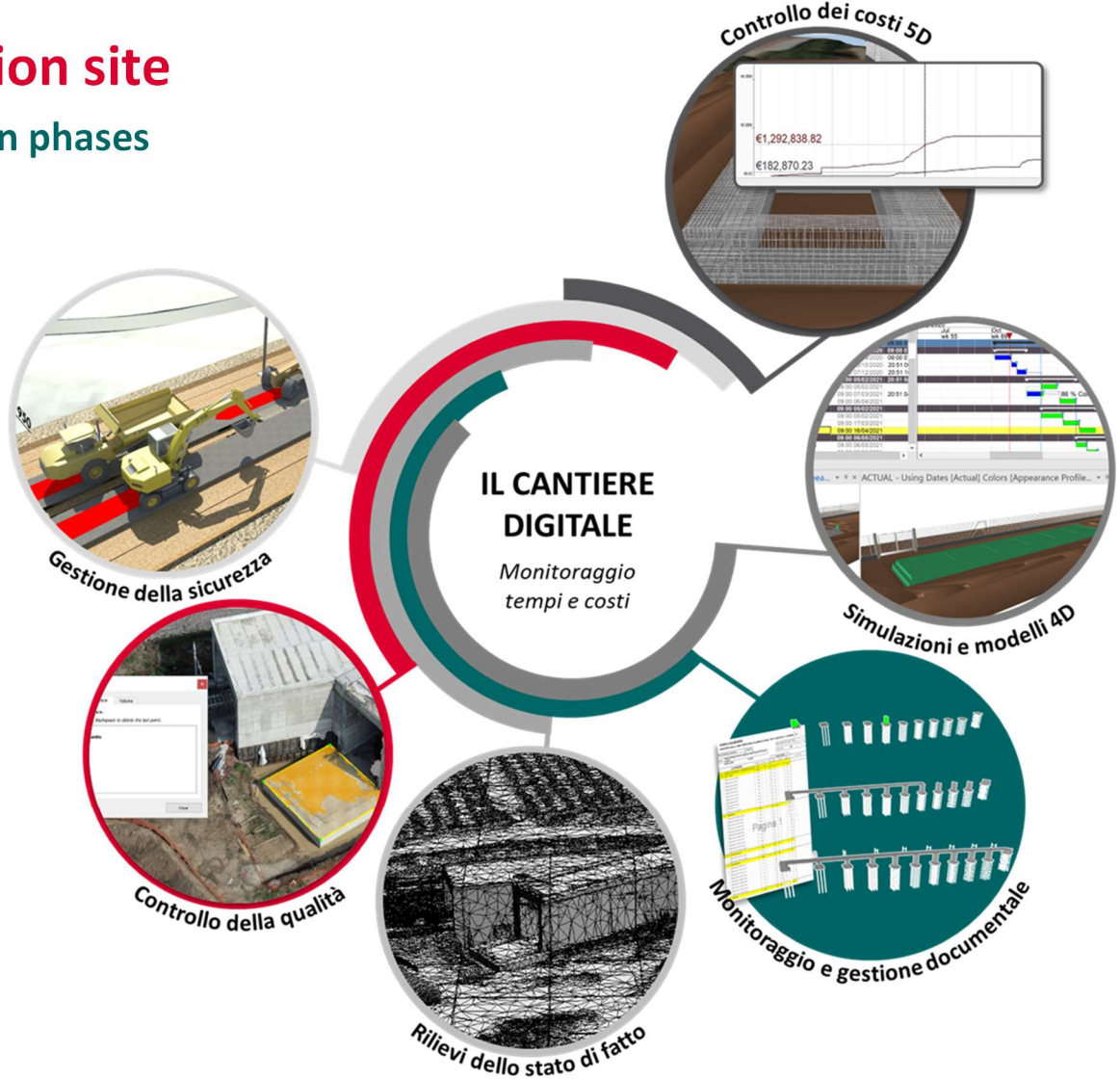
Objectives of the Digitalization of the construction site

Improve the understanding of the time schedule and facilitate the identification of problems

Having more effective control of the construction site activities

Improve communication of construction methodologies through simulation of construction stages

Simplify monitoring and management of site documents



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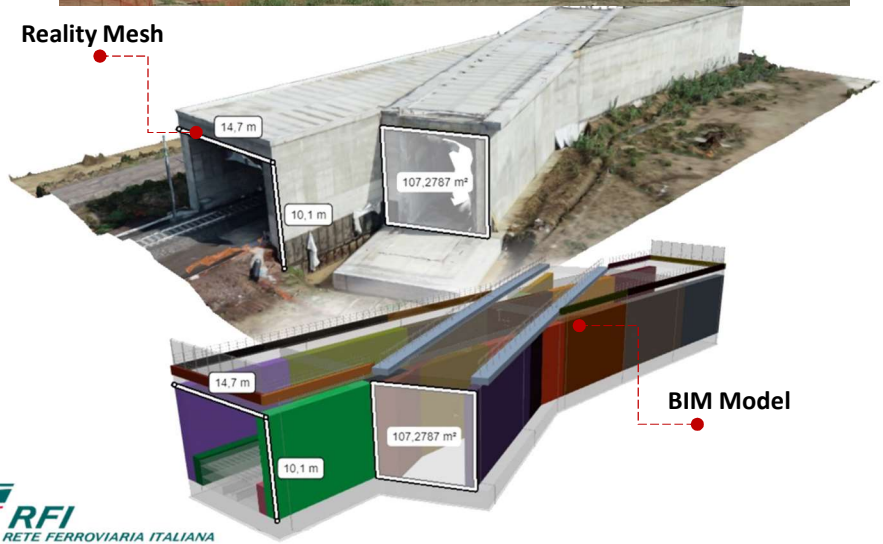
Construction site digitization

Progress Monitoring - Comparison of Surveys and Project BIM Models.

Starting from a survey, a point cloud can be obtained, through which back-office progress monitoring can be performed

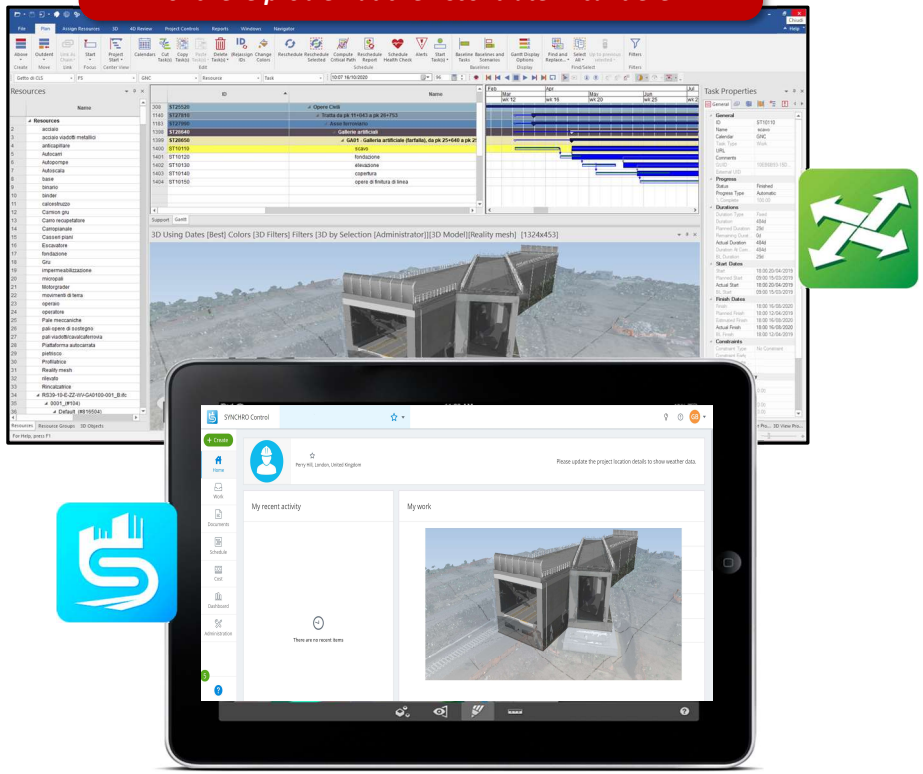
1. Site

2. Reality Mesh



3. BIM Model

È possibile caricare i modelli 4D su piattaforme dedicate, per vederne il modello, il cronoprogramma associato, nonché le problematiche riscontrate in cantiere



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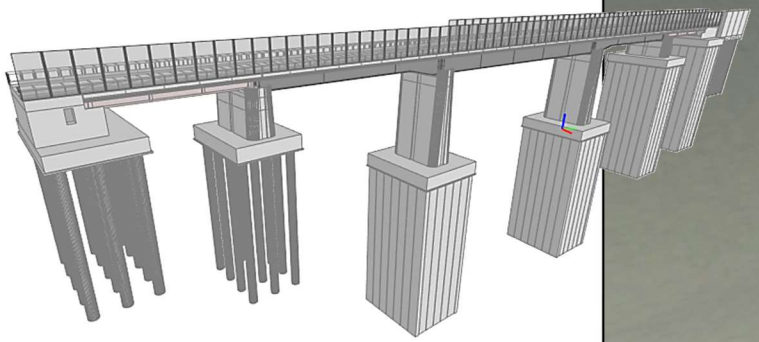
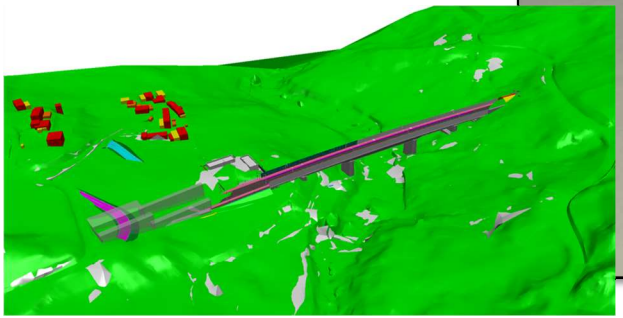
Construction site digitization

4D Modelling

Constructive Sequence VI02
IF27 Apice-Hirpinia





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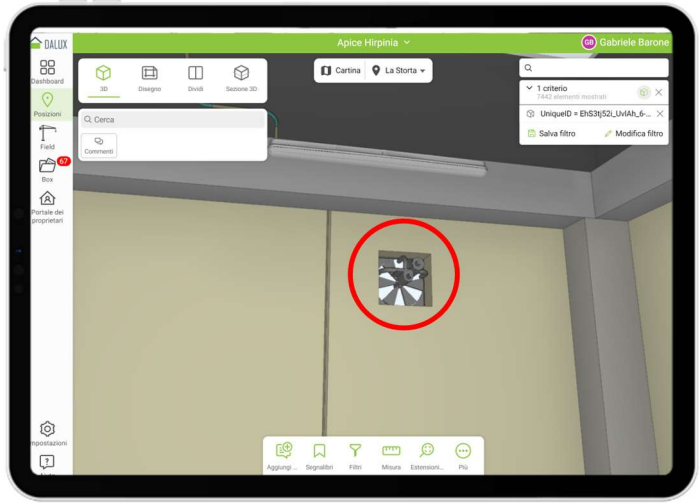
Construction site digitization

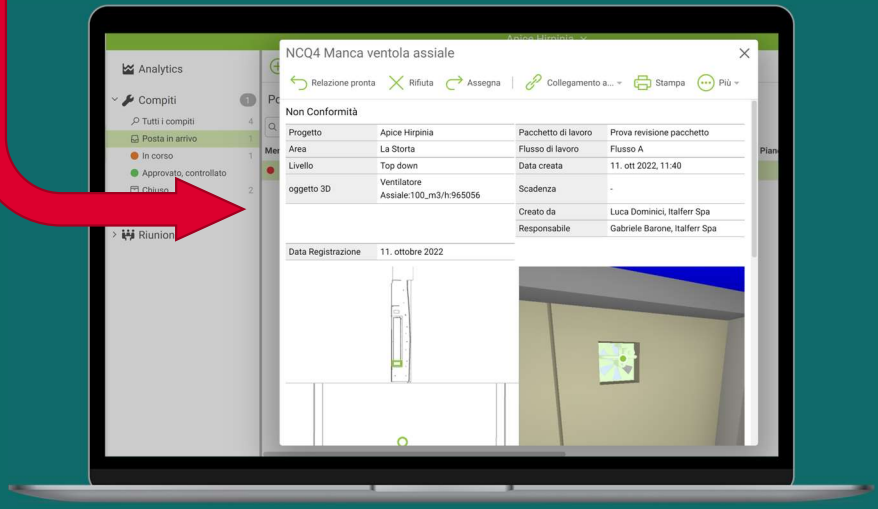
Tools to support the construction manager



- *Quick addition of photos, notes and location (in the model and GPS)*
- *Direct assignment to the head of the NC*
- *Immediate notification of the problem with corresponding timelines for resolution*

Management of Non Compliance

Arch. Luca Dominici, ing. Andrea Fabbri



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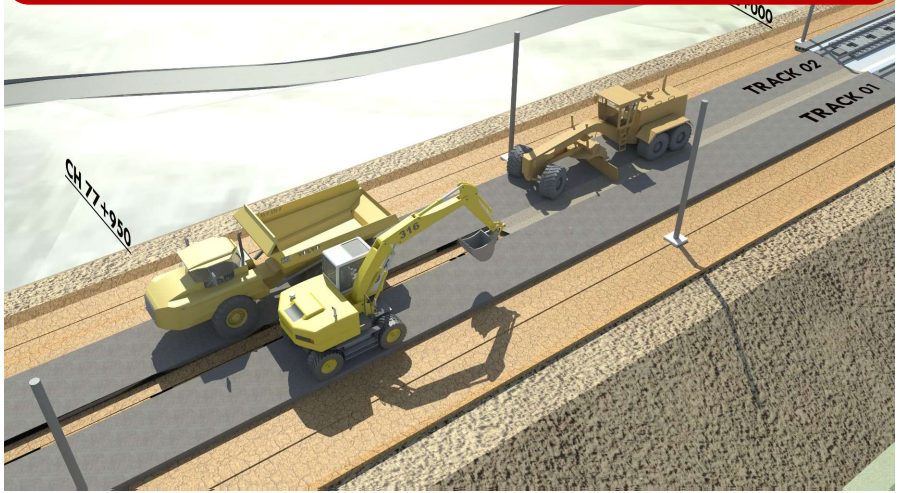
Construction site digitization

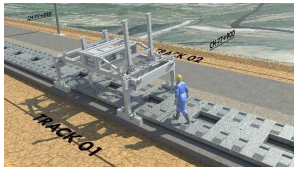
4D models for the management of safety – Dynamics Clash detection

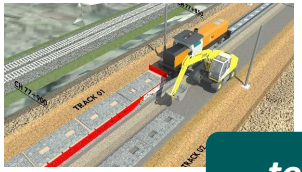
From the design…

Ad-hoc systems for the management of construction phases, in compliance with safety regulations

With the help of dynamic interference detection, safety can be better controlled during on-site operations







…to the construction

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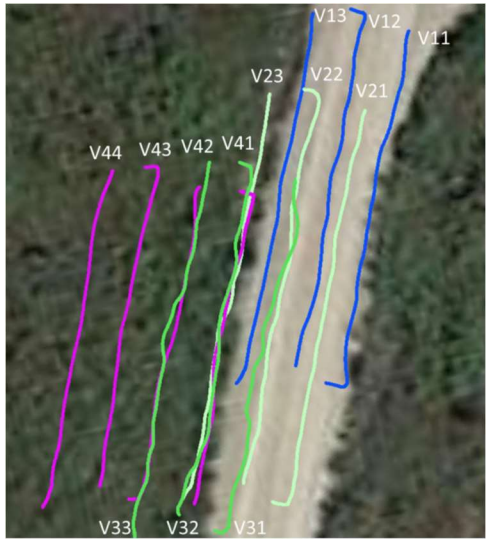
Construction site digitization

Management and surveys

Inspecting with drones is useful for –difficult to reach pleaces- in order to ensure the safety of the workers and obtaining the survay of the site area

BUT ALSO

Survey by drone equipped with a 200 MHz and 70 MHz antenna, which flies autonomously, emitting electromagnetic waves reflected in the presence of cavities or obstacles.



GPR lines obtained with drone. Airbone GPR to an altitude from 0,5 m and 1,0 m

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Digitization for the monitoring and maintenance of bridges

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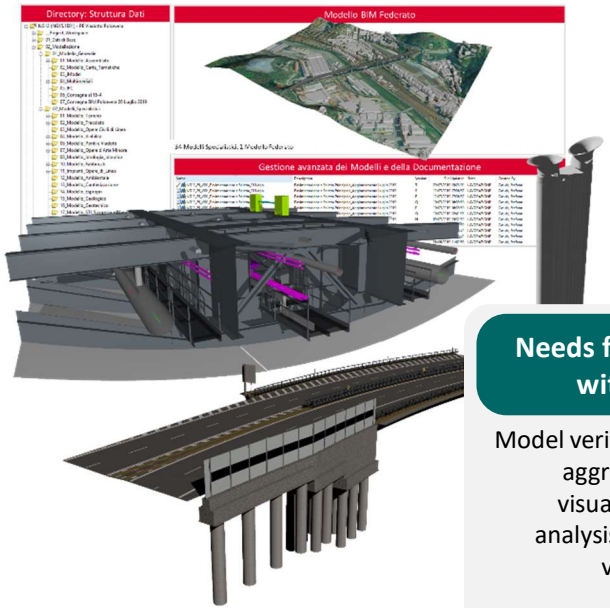
Digitization for the monitoring and maintenance of bridges

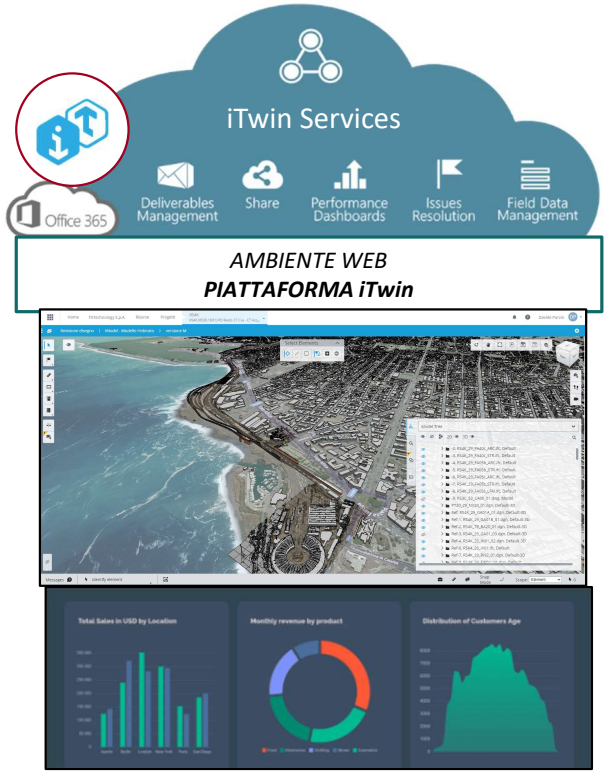
From design templates to the preparation of a digital twin

BIM model of infrastructure in design phase



Needs for confrontation with outsiders

Model verification activitiesData aggregationContext visualizationGIS data analysisPresentation and visualization



- AGGREGATION OF INFORMATION
- COMMUNICATION & SHARING
- REPRESENTATION & UNDERSTANDING
- CONTROL & MONITORING
- DEVELOPMENT AND INTEGRATION

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Digitization for the monitoring and maintenance of bridges

Digital Twin

A dynamic digital representation of physical assets, processes or systems that uses data collected from numerous sources and combines them with data from simulation, machine learning, and artificial intelligence models

In the infrastructure sector, the aim of Digital Twin is:

1. **To improve efficiency and security of the assets**
2. **To increase the quality of services**
3. **To create a new value and business opportunities**

3 LAYERS

Digital Master: virtual model or prototype of the physical system/process being digitally represented, including its variants and configurations

Digital Shadow: Projection into the virtual world of the physical system/process (includes operation and maintenance rules, standards)

Digital Twin: includes additional intelligent features for analysis, simulation, control and automation from data from the digital shadow and provides feedback to the physical system.

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Digital Twin: the process logic

The information flow

BIM MODEL

a_n T w_f ΔV d_n UR

Attention class update on the entire infrastructure

BIM 7D model update Maintenance Program

DIGITAL TWIN OF INFRASTRUCTURE

AI

Analisi strutturali

ML

Data correlation and interpretation system

Processing and identification of maintenance activities

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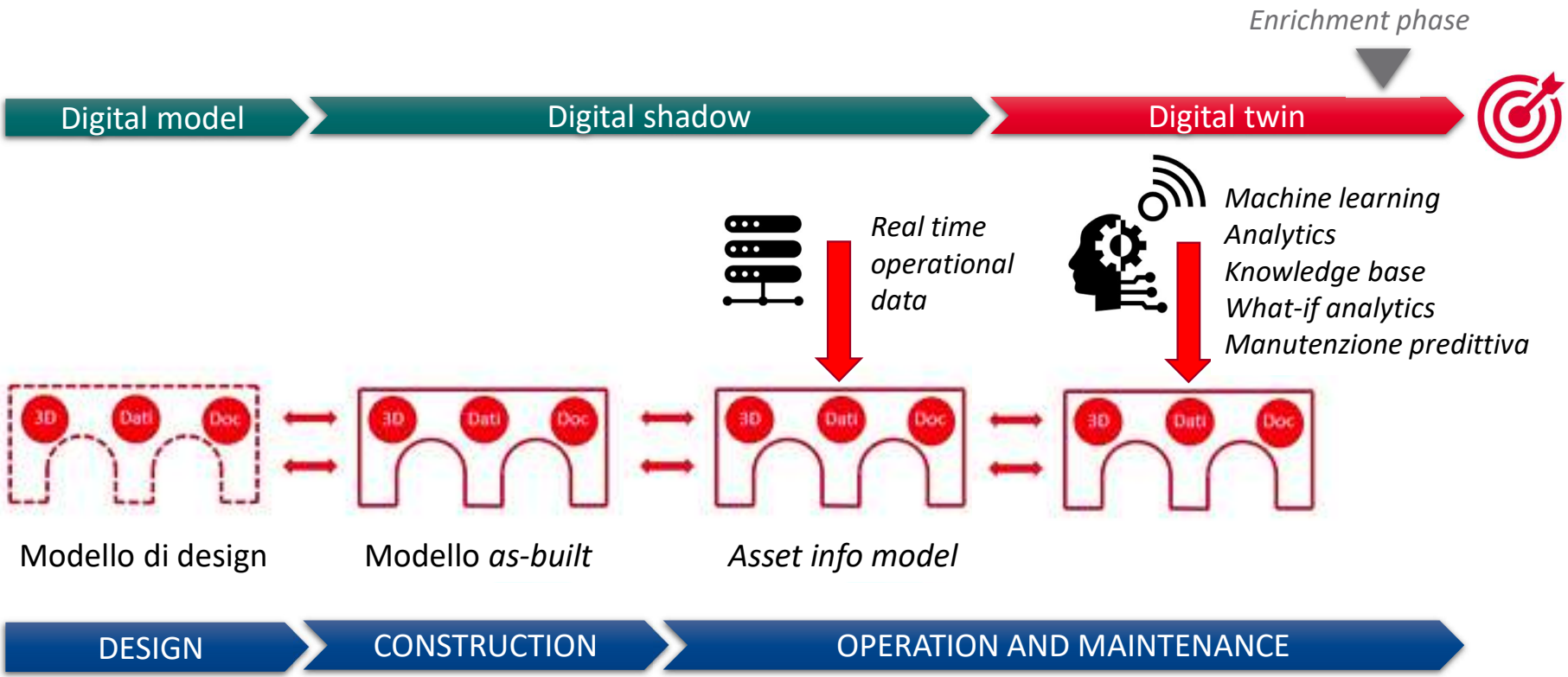
Digital Twin for management of control of bridges

Trial site: Borratino viaduct – DD Roma - Firenze



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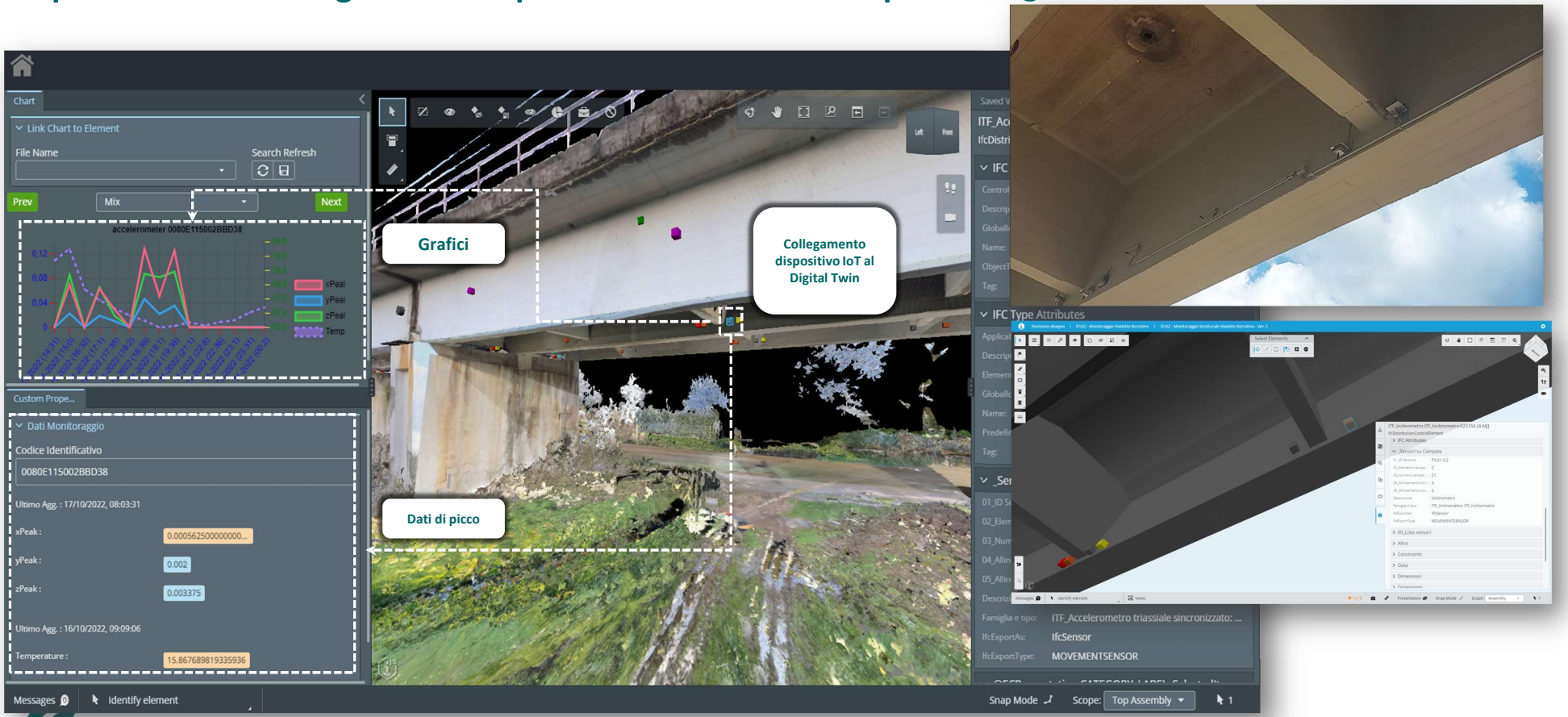
Digital Twin for management of control of bridges

Acquisition and reading of data acquired from the field and processing



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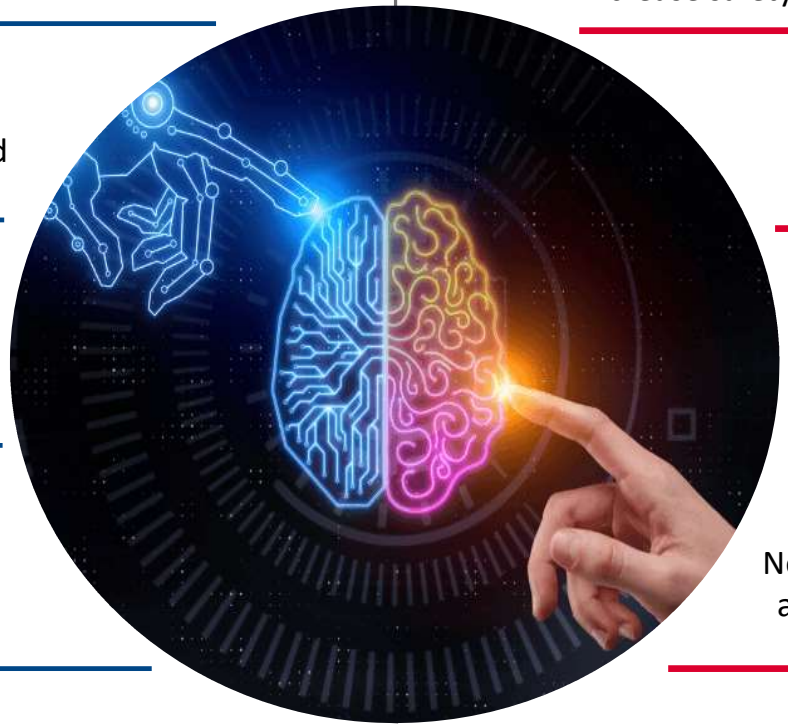
Benefits of Digital Twin

BENEFITS FOR THE CORPORATE

- Enhance real time monitoring
- Optimization of resourcesand reduction of operating costs
- Increase efficiency of processes
- Supporting decision-making processes



BENEFITS FOR STAKEHOLDER

- Increase safety of operations
- Increased reliability and availability of assets
- Increase quality of services
- New business models and opportunities of value creation

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Infrastructure Management: Monitoring and Maintenance Strategy

Bridge inspections

MAINTENANCE ON CONDITION | PREVENTIVE MAINTENANCE | PREDICTIVE MAINTENANCE

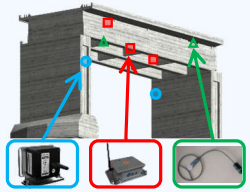
VISUAL INSPECTION

ORDINARY ACTIVITY

VISUAL INSPECTION WITH DRONES SUPPORT

TO DATE

VISUAL INSPECTION WITH DRONES SUPPORT MONITORING SYSTEMS AND ARTIFICIAL INTELIGENCE (AI)



NEXT STEP

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THANK YOU
FOR YOUR ATTENTION!

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