Civil Infrastructures Research Group

Prof. José C. Matos

jmatos@civil.uminho.pt

Universidade do Minho

Team

Ana Margarida Bento
(Post-doc Researcher)

- ✓fluvial hydraulics
- ✓hydrological & hydraulic modelling
- ✓scour phenomenon
- ✓risk & reliability analysis

- ✓UAV for remote sensing operations
- ✓development of specific UAV payloads
- ✓point cloud processing
- ✓Image processing

Luis Miguel Gonzalez
(Post-doc Researcher)

- ✓reliability & risk
- ✓inspection, diagnosis & testing of existing structures
- ✓safety analysis

Hélder S. Sousa
(Post-doc Researcher)

Joaquim Tinoco
(Post-doc Researcher)

- ✓slopes stability
- ✓geotechnical engineering
- ✓big data & soft computing
- ✓soil improvement

José Campos Matos
(Group Coordinator)

- ✓structural analysis
- ✓asset management
- ✓BIM

Mário Coelho
(Post-doc Researcher)

Yina Muñoz
(Post-doc Researcher)

- ✓degradation models
- ✓thermal shock
- ✓management system

- ✓materials characterization
- ✓natural-based solutions
- ✓GIS
- ✓circular economy

Elisabete Teixeira
(Post-doc Researcher)

Students

Research and innovation in management systems, reliability and risk analysis with **more than 25 PhD students and 10 Master students.**

PhD Students









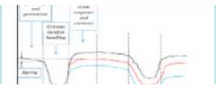

Objectives & Skills

Main objective: better managing the built environment in the face of not only **natural aging,** but also the **existence of extreme events** of natural and human origin. In this sense, **the following sub-objectives** are identified:

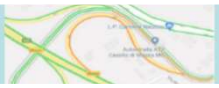
To carry out the technology for surveys at different scales of existing infrastructures

Support institutions to better manage information from their assets

Development of recommendations and protocols, to be incorporated in future regulations



Establish and define strategies for a better implementation of an inspection and maintenance plan



Implementation of measurements at different levels and scales, from satellite to on-site measurements

Study the extreme events most likely to occur, in a single or combined way, as well as outline scenarios of associated climate change

Main Competences

The working group presents its competences within the following areas:

- ✓ Structural evaluation of existing structures (robustness and redundancy);
- ✓ Development of forecasting models for existing structures;
- ✓ "Big Data" analysis and data fusion (inference);
- ✓ Asset management, namely infrastructures;
- ✓ Optimization and decision-making (resilience models);
- ✓ Risk analysis and resilience for extreme events (incl. Climate changes);
- ✓ BIM and BrIM for FM;
- ✓ GIS and UAV / drones;
- ✓ Design and implementation of nature-based solutions;
- ✓ Life-cycle assessment and life-cycle cost;
- ✓ Circular economy;
- ✓ Design and production of sustainable materials.

Facilities

LEST - Structures and Geotechnics Laboratory of the Civil Engineering Department of the University of Minho, Azurém Campus

FUJITSU Server PRIMERGY RX2540 M5 Rack based server 19" (2U):

- ❑ 2 Intel Xeon Gold 6234 8C 3.30 GHz Processors
- ❑ 512 GB DDR4-2933 R ECC Internal Memory
- ❑ NVIDIA Quadro RTX4000 Graphic Card
- ❑ 2 SSD 480 GB + 5 HD 2.4TB RAID 480GB
- ❑ 1 UPS 1.5kVA / 1.2kW R/T (2U)

Tools & Software

The working group have experience with the following tools and software:

- ✓ MatLab;
- ✓ DIANA;
- ✓ SAP2000;
- ✓ Robot;
- ✓ OpenSees;
- ✓ Python;
- ✓ R / Rstudio
- ✓ JAVA;
- ✓ CAD/SURF 3D;
- ✓ REVIT;
- ✓ Tekla;
- ✓ OpenBIM;
- ✓ ArcGis/Qgis
- ✓ FReET

R&D Projects

SustIMS
SUSTAINABLE INFRASTRUCTURE MANAGEMENT

TEAM

+ 2 Doctoral students
+ 2 Master students

INFO

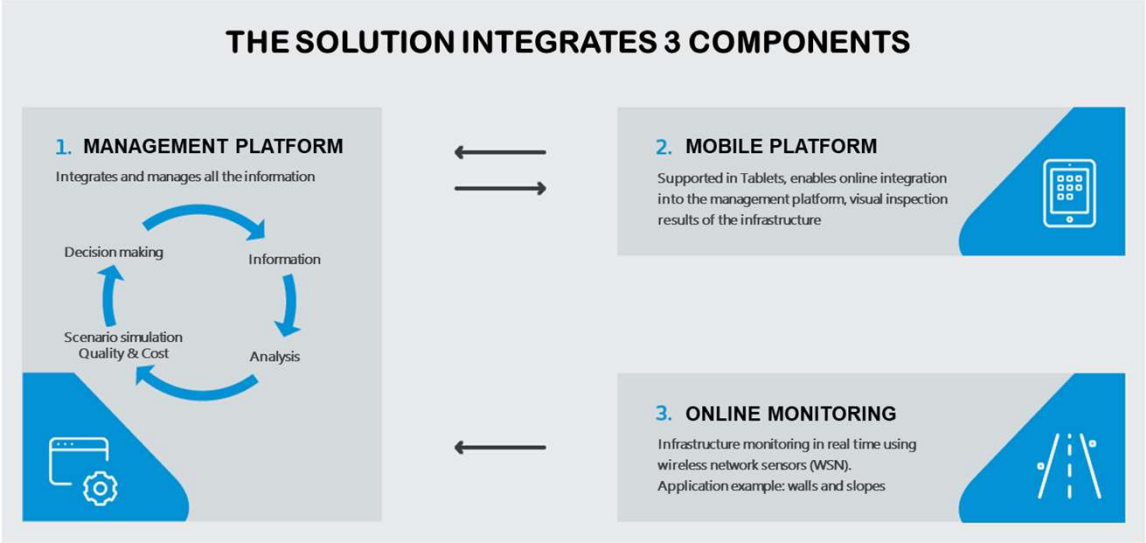
Financing entity: ANI - QREN
Project Leader: ASCENDI
Partners: 3
Start date: 01/01/2013
End date: 30/06/2015
Overall budget: 1.026.000€
UMinho budget: 393.000€

DISSEMINATION

Website:
https://www.eng.uminho.pt/pt/investigareinovar/projetoscomempresas/Paginas/projetosustims.aspx

Journal papers: 1
Conference papers: 12
Book chapters: 2
Academic thesis/dissertations: 4
Apps: 1

SUSTIMS – Sustainable Infrastructure Management System



Objectives: SUSTIMS' main aim was to create a technological solution to support an integrated road infrastructure management system and to comply with quality levels for pavements, bridges, retaining walls and slopes and telematics. To that, optimized maintenance and conservation system was intended.

R&D Projects

SustIMS
SUSTAINABLE INFRASTRUCTURE MANAGEMENT

TEAM

+ 2 Doctoral students
+ 2 Master students

INFO

Financing entity: ANI - QREN
Project Leader: ASCENDI
Partners: 3
Start date: 01/01/2013
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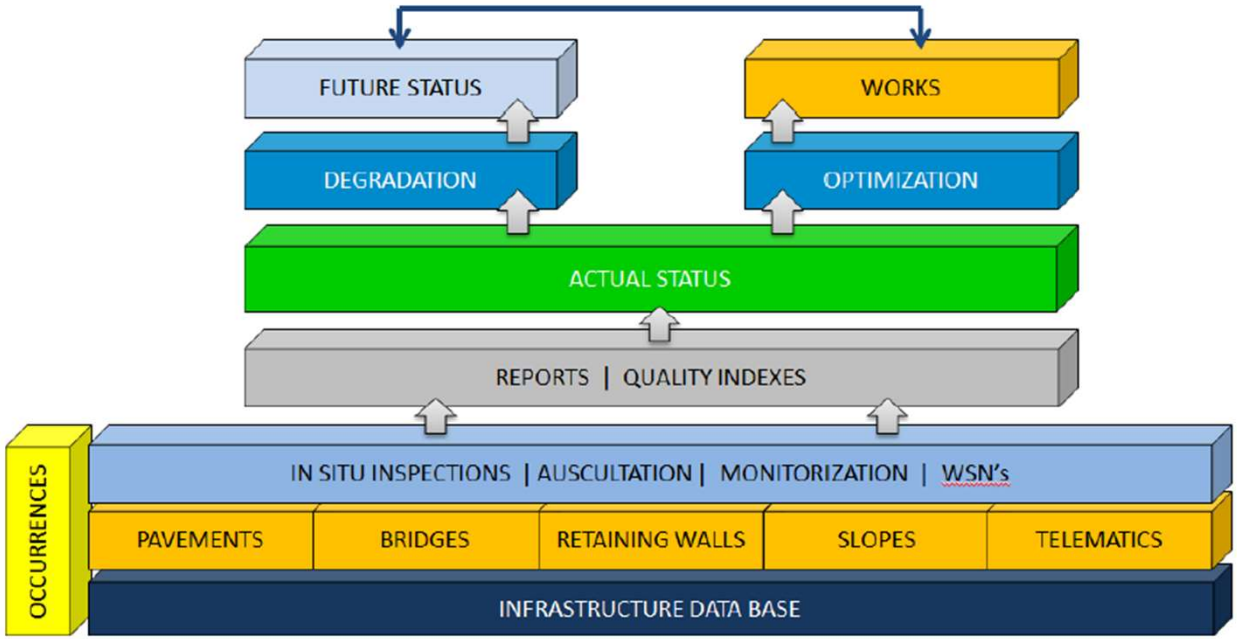
DISSEMINATION

Website: https://www.eng.uminho.pt/pt/investigareinovar/projetoscomempresas/Paginas/projetosustims.aspx

Journal papers: 1
Conference papers: 12
Book chapters: 2
Academic thesis/dissertations: 4
Apps: 1

SUSTIMS – Sustainable Infrastructure Management System

Case studies and applications



R&D Projects

TU1406 COST ACTION

TEAM

+ 57 participating countries

INFO

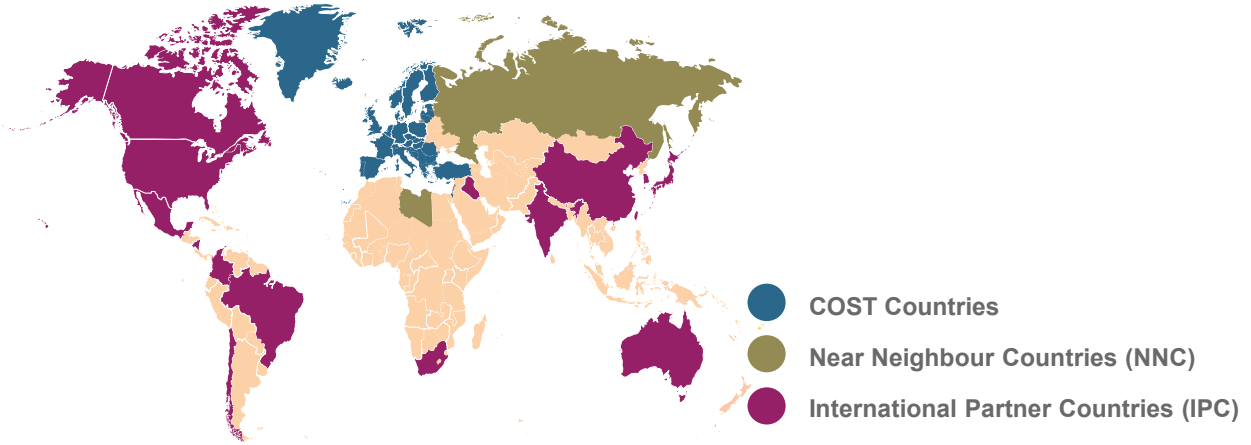
Financing entity: EU
Project Leader: UMinho
Partners: 38 COST Countries
Start date: 16/04/2015
End date: 15/04/2019
Overall budget: 855.000€
UMinho budget: 855.000€

DISSEMINATION

Website: www.tu1406.eu

Journal and conference papers: 128
Technical reports: 6

COST ACTION TU1406 – Quality specifications for roadway bridges, standardization at a European level (*BridgeSpec*)



Objectives: The main objective is to develop a guideline for the establishment of QC plans in roadway bridges, by integrating the most recent knowledge on performance assessment procedures with the adoption of specific goals.

R&D Projects

TU1406 COST ACTION

TEAM

+ 57 participating countries

INFO

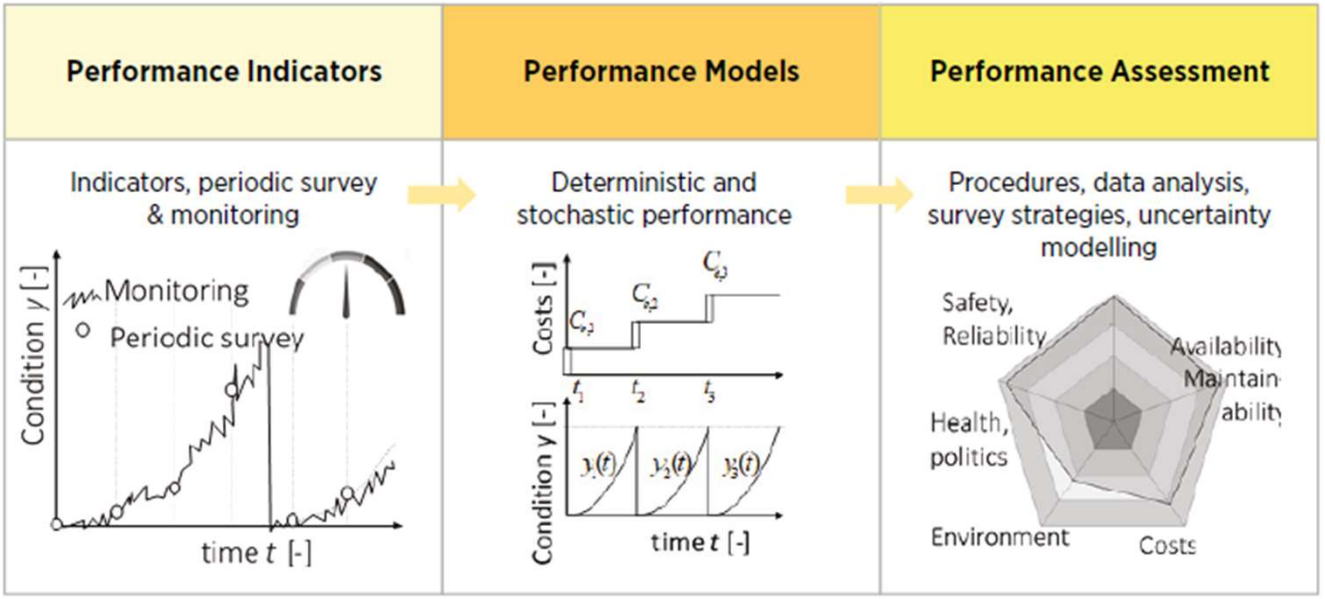
Financing entity: EU
Project Leader: UMinho
Partners: 38 COST Countries
Start date: 16/04/2015
End date: 15/04/2019
Overall budget: 855.000€
UMinho budget: 855.000€

DISSEMINATION

Website: www.tu1406.eu

Journal and conference papers: 128
Technical reports: 6

COST ACTION TU1406 – Quality specifications for roadway bridges, standardization at a European level (*BridgeSpec*)



Road bridge management concept

R&D Projects

TEAM

+ 7 PhD students

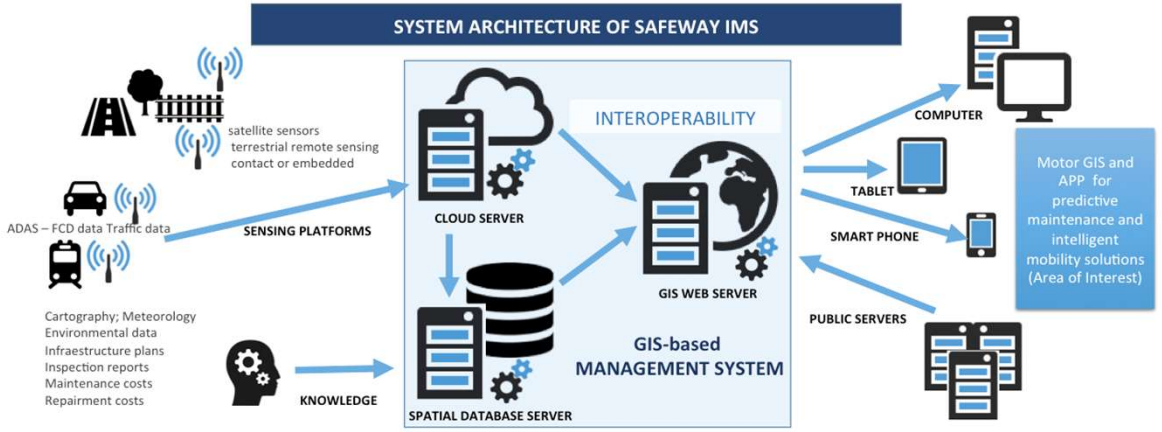
INFO

Financing entity: H2020
Project Leader: UVigo
Partners: 15
Start date: 01/09/2018
End date: 28/02/2022
Overall budget: 4.860.000€
UMinho budget: 370.000€

DISSEMINATION

Website: https://www.safeway-project.eu/en
Twitter: @SAFEWAY_EU
Researchgate: https://www.researchgate.net/project/GIS-based-infrastructure-management-system-for-optimized-response-to-extreme-events-on-terrestrial-transport-networks-SAFEWAY
Journal papers: 1
Conference papers: 10
Reports: 2

SAFEWAY – GIS-Based infrastructure management system for optimized response to extreme events of terrestrial networks



Objectives: SAFEWAY's main aim is to design, validate and implement holistic methods, strategies, tools and technical interventions to significantly increase the resilience of inland transport infrastructure by reducing risk vulnerability and strengthening network systems to extreme events.

R&D Projects

TEAM


+ 7 PhD students

INFO

Financing entity: H2020
Project Leader: UVigo
Partners: 15
Start date: 01/09/2018
End date: 28/02/2022
Overall budget: 4.860.000€
UMinho budget: 370.000€

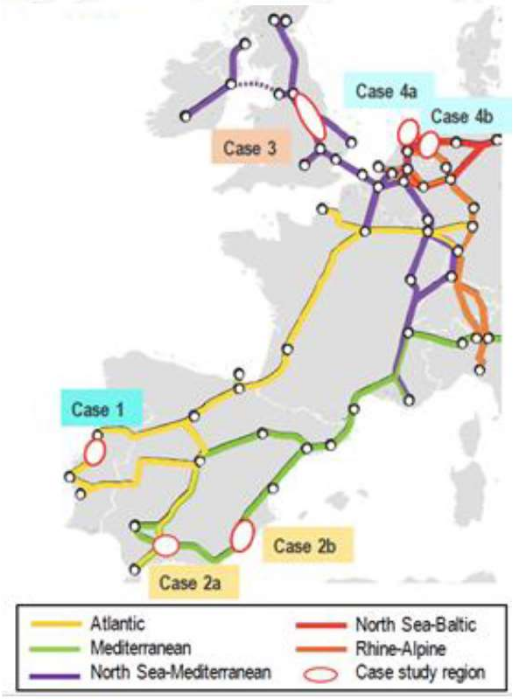
DISSEMINATION

Website: https://www.safeway-project.eu/en
Twitter: @SAFEWAY_EU
Researchgate: https://www.researchgate.net/project/GIS-based-infrastructure-management-system-for-optimized-response-to-extreme-events-on-terrestrial-transport-networks-SAFEWAY
Journal papers: 1
Conference papers: 10
Reports: 2

SAFEWAY – GIS-Based infrastructure management system for optimized response to extreme events of terrestrial networks

Case studies and applications

Four demonstrative pilots are envisioned, that will consist of the mapping of vulnerable areas in the European core network to test the SAFEWAY concept under different potential extreme events: flooding and land displacement in UK, The Netherlands and Spain; wildfires in Portugal, seismic and terrorism impact in Spain. These pilots include both single mode of terrestrial transport, as well as multimodal.



R&D Projects

SIRMA

TEAM

+ 1 PhD student

INFO

Financing entity: Interreg Atlantic
Project Leader: UMinho
Partners: 10
Start date: 01/04/2019
End date: 30/09/2022
Overall budget: 2.023.994,52 €
UMinho budget: 311.438,64 €

DISSEMINATION

Website: https://www.sirma-project.eu/
Twitter: @SIRMAPROJECT

Journal papers: 7
Conference papers: 13
Reports: 6

SIRMA - Strengthening Infrastructure Risk Management in the Atlantic Area

Objectives: SIRMA aims to develop, validate and implement a robust framework for the efficient management and mitigation of natural hazards in terrestrial transportation modes at the Atlantic Area, which consider both road and railway infrastructure networks (multi-modal).

R&D Projects

SIRMA

TEAM

+ 1 PhD student

INFO

Financing entity: Interreg Atlantic
Project Leader: UMinho
Partners: 10
Start date: 01/04/2019
End date: 30/09/2022
Overall budget: 2.023.994,52 €
UMinho budget: 311.438,64 €

DISSEMINATION

Website: https://www.sirma-project.eu/
Twitter: @SIRMAPROJECT

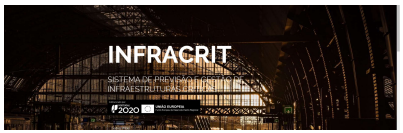
Journal papers: 7
Conference papers: 13
Reports: 6

SIRMA - Strengthening Infrastructure Risk Management in the Atlantic Area

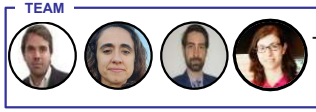
Case studies and applications

The SIRMA infrastructure partners have identified two test beds to be looked at for this project.
One test bed is located on a coastal area in Portugal frequently facing tidal issues.
The other test bed is in Ireland, where some bridges could have some scour and flooding risks associated with it.

R&D Projects



TEAM



+ 1 PhD student

INFO

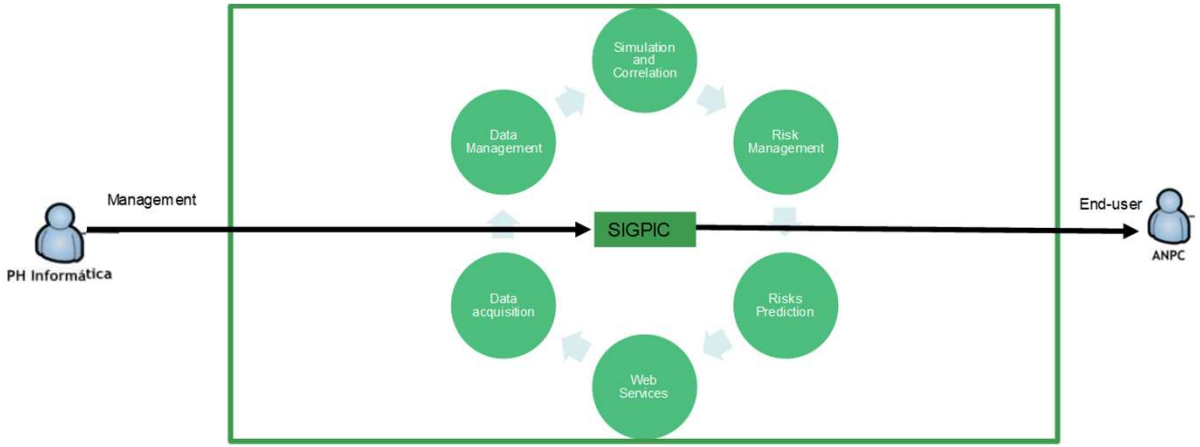
Financing entity: FCT-ANI
Project Leader: PH-Informática
Partners: 3
Start date: 01/09/2019
End date: 30/09/2022
Overall budget: 724.956€
UMinho budget: 239.414,47€

DISSEMINATION

Website: www.infracrit.pt

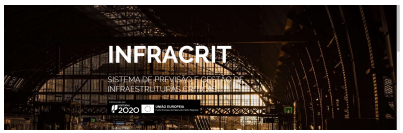
Journal papers: 1
Conference papers: 3
Reports: 2

INFRACRIT – Development of a predict and management systems for Critical Infrastructures

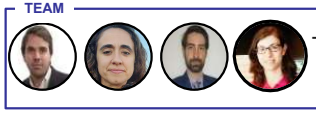


Objectives: Creation of a Risk Assessment framework focused on the Urban Critical Infrastructures (UCIs) vulnerability and their interdependences against multiple natural hazards. Risk Assessment framework will be incorporated in a GIS platform, that will be used as a support decision making for first-responders and UCIs managers.

R&D Projects



TEAM



+ 1 PhD student

INFO

Financing entity: FCT-ANI
Project Leader: PH-Informática
Partners: 3
Start date: 01/09/2019
End date: 30/09/2022
Overall budget: 724.956€
UMinho budget: 239.414,47€

DISSEMINATION

Website: www.infracrit.pt

Journal papers: 1
Conference papers: 3
Reports: 2

INFRACRIT – Development of a predict and management systems for Critical Infrastructures

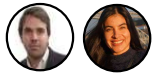
Case studies and applications

Two demonstrative pilots are envisioned, that will consist of the development of risk assessment and mapping of two Portuguese vulnerable regions: fire in Guimarães, and flooding in Vila Nova de Gaia. These pilots are historical centers, and it will be analyzed all critical infrastructures (telecommunication, energy, hospital, terrestrial transport). With the data gathering in this pilot case studies, it is possible to included real-data and validate the GIS platform that will be created in this project.

R&D Projects

GIIP

TEAM



+ 2 PhD student

INFO

Financing entity: Portugal2020
Project Leader: 3MAPS
Partners: 4
Start date: 01/06/2020
End date: 01/06/2023
Overall budget: 785.429,02€
UMinho budget: 200.259,09€

DISSEMINATION

Website: -

Journal papers:
Conference papers:
Reports:

GIIP – Intelligent Management of Port Infrastructures

Objective: Develop a modular decision support system for the integrated asset management, based on new functional and structural degradation models for different asset types and taking into account operational, economic and environmental criteria.

Level 1 - development of a global architecture for a management system of port infrastructures, which will address some advanced sensoring frameworks.

Level 2 - development of performance predictive models of port assets, which allow to assess in a short, medium and long term, their condition and related risk.

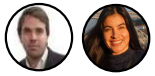
Level 3 - development of a modular platform that allows prioritizing intervention and inspection needs, in an integrated and optimal way, taking into account the cost benefit relation.

Port of Leixões

R&D Projects

GIIP

TEAM



+ 2 PhD student

INFO

Financing entity: Portugal2020
Project Leader: 3MAPS
Partners: 4
Start date: 01/06/2020
End date: 01/06/2023
Overall budget: 785.429,02€
UMinho budget: 200.259,09€

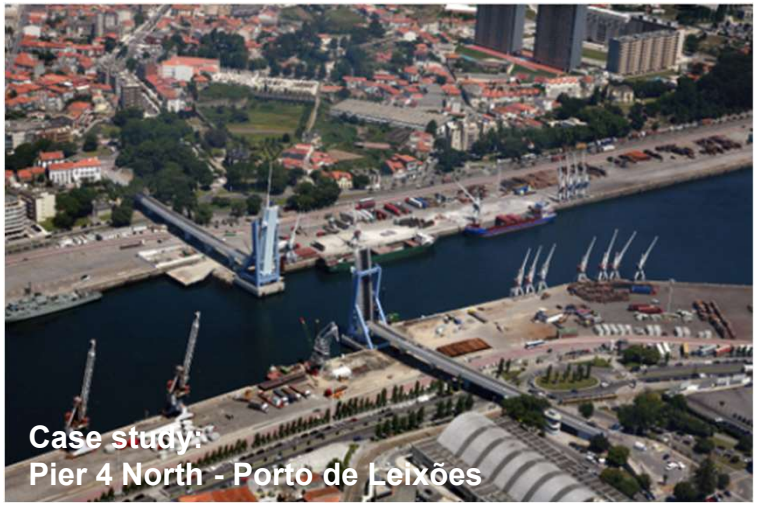
DISSEMINATION

Website:

Journal papers:
Conference papers:
Reports:

GIIP – Intelligent Management of Port Infrastructures

Case studies and applications



The tests to achieve the objectives of the project are being developed in pier 4, and where the installation of sensors is currently being carried out that will allow the monitoring of the structures and from where the data will be obtained to carry out the projection of its future behavior.

R&D Projects

FERROVIA 4.0

TEAM

+ 2 PhD students

INFO

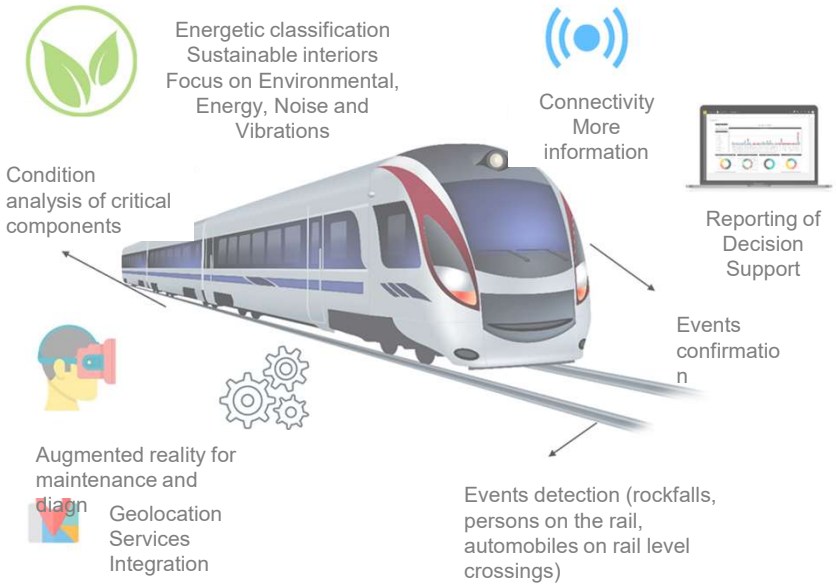
Financing entity: FCT-ANI
Project Leader: EFACEC
Partners: 22
Start date: 01/07/2020
End date: 30/06/2023
Overall budget: 8.455.654€
UMinho budget: 194.242€

DISSEMINATION

Website: http://ferrovia40.pt/?lang=en

Journal papers:
Conference papers:
Reports:

FERROVIA 4.0 – A smart, sustainable and new generation of rail system



Objectives: The project aims to increase the attractiveness and capacity of the railway system in which the members of the Portuguese Railway Platform are mobilized. The project's theme is the implementation of measures 4.0 on the railway, from its life cycle and sustainability, to maintenance and safety.

R&D Projects

IN2TRACK2

TEAM

+ 2 PhD students

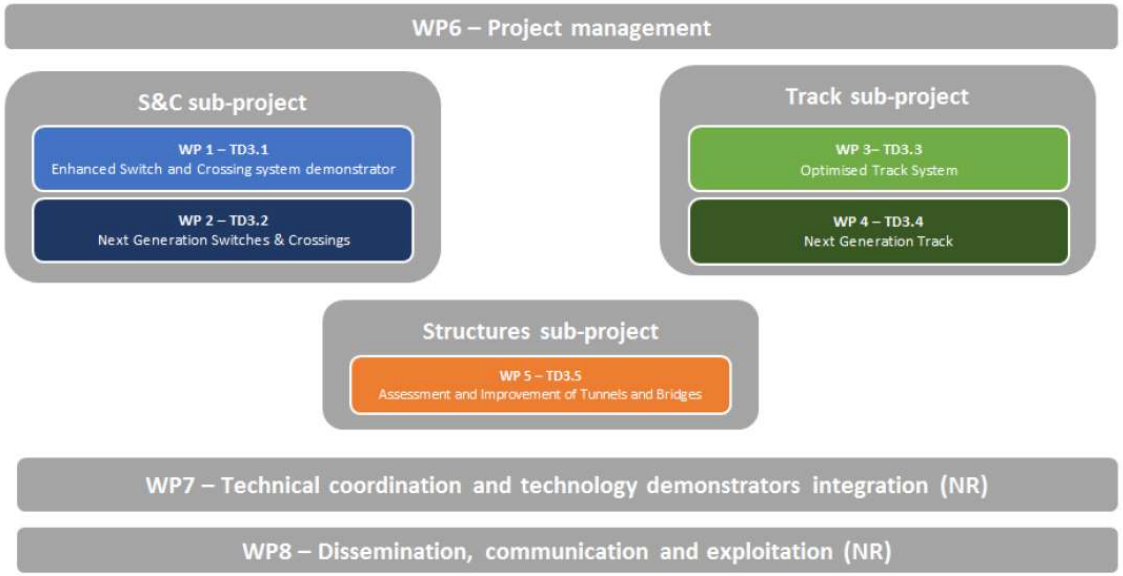
INFO

Financing entity: S2R – H2020
Project Leader: Network Rail
Partners: 28
Start date: 01/11/2018
End date: 30/04/2021
Overall budget: 29.676.015€

DISSEMINATION

Website: https://projects.shift2rail.org/s2r_ip3_n.aspx?p=IN2TRACK2

IN2TRACK2 – Research into enhanced track and switch and crossing system 2



Objectives: The project is divided into 5 different areas of knowledge tackled in different working packages, namely: WP1 - Enhanced Switch and Crossing system demonstrator; WP2 - Next Generation Switches & Crossings; WP3 - Optimised Track System; WP4 - Next Generation Track; WP5 - Assessment and Improvement of Tunnels and Bridges

R&D Projects

In2Track3

TEAM

+ 2 PhD students

INFO

Financing entity: H2020
Project Leader: TRAFIKVERKET
Partners: 27
Start date: 01/12/2020
End date: 30/11/2023
Overall budget: 26.046.685€
UMinho budget: 253.308€

DISSEMINATION

Website: https://projects.shift2rail.org/s2r_ip3_n.aspx?p=IN2TRACK3

Journal papers:
Conference papers: 1
Reports:

In2Track3 – Research into optimized and future railway infrastructure

Objectives: The overall IN2TRACK3 objective is to develop technology and technology demonstrators for the track, switches and crossings (S&C), bridge and tunnel assets. IN2TRACK3 presents the objectives and impacts of five Technology Demonstrators (TDs) of the Shift2Rail Innovation Programme 3 (IP3) and details the methodology/process that will be implemented to deliver those five TDs. The objectives are divided into enhancements to existing track, switches and crossings; next generation track, switches and crossings; and enhanced performance of tunnel and bridges.

R&D Projects

TEAM

+ 1 PhD student

INFO

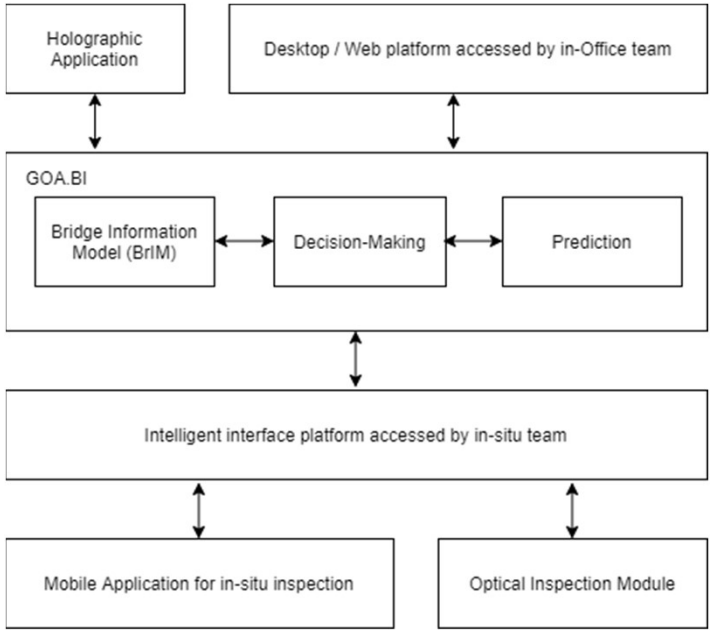
Financing entity: FCT-ANI
Project Leader: Betar
Partners: 3
Start date: 01/01/2021
End date: 30/06/2023
Overall budget: 1.144.733,71€
UMinho budget: 296.521,89€

DISSEMINATION

Website: under development

Journal papers: 0
Conference papers: 5
Reports: 2

GOA.BI – GOA Bridge Management System – Bridge Intelligence



Objectives: Development of a new generation BMS with digital features such as BIM-based database, mobile and automated inspection tools, mixed reality tools to support the maintenance process, involving the analysis and visualization of the information existing in the BMS.

R&D Projects

InfraROB - Maintaining integrity, performance and safety of the road infrastructure through autonomous robotized solutions and modularization

TEAM

INFO

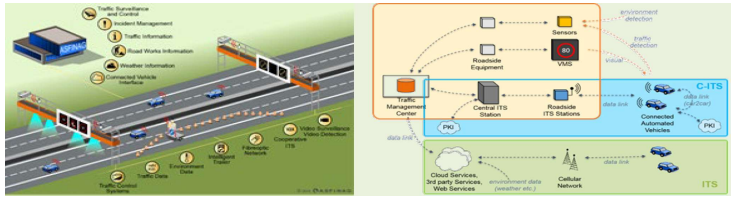
Financing entity: H2020
Project Leader: UVigo
Partners: 14
Start date: 01/09/2021
End date: 28/02/2025
Overall budget: 5 005 648,75€
UMinho budget: 298 671,25€

DISSEMINATION

Website:
https://cordis.europa.eu/project/id/955337

Objectives: *Keeping road users and workers safe through collaborative robotics and modularization*

- Develop autonomous robotised systems and machinery to carry out line marking, repaving, and the repair of cracks and potholes;
- Develop collaborative robotised safety systems for construction workers and road users;
- Integrate pavement management system and traffic management system solutions for a holistic, unified management of road infrastructure and live traffic.



R&D Projects

Cognitive CMMS

TEAM

+ 1 PhD student

INFO

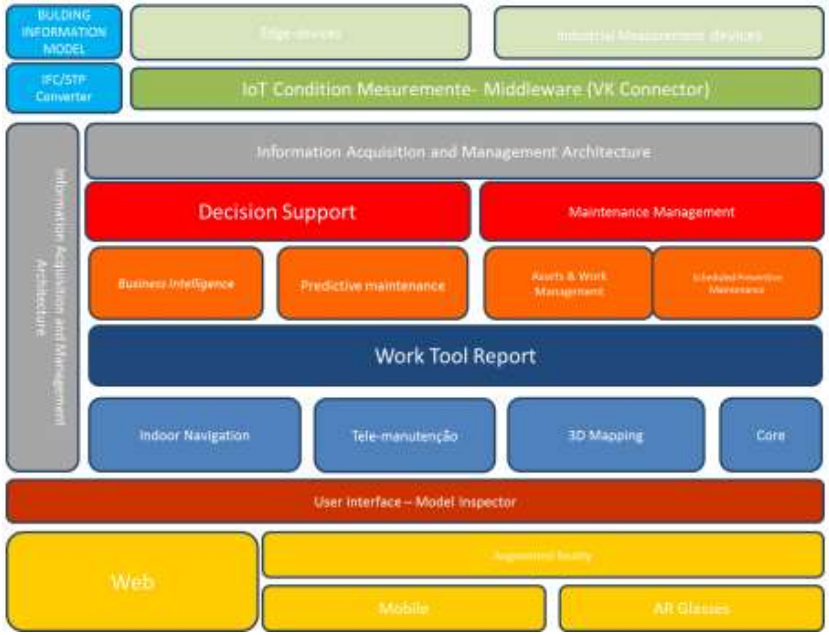
Financing entity: FCT-ANI
Project Leader: Valuekeep
Partners: 5
Start date: ?
End date: ?
Overall budget: ?€
UMinho budget: ?€

DISSEMINATION

Website: under development

Journal papers: 0
Conference papers: 0
Reports: 0

Cognitive CMMS - Cognitive Computerized Maintenance Management System



Objectives: Develop a solution that acts in a transversal way in maintenance management (including maintenance actions). A platform that allows an integrated view (BIM 6D) on the management (Analytical Models, Stochastic Models, Neural Networks and Machine Learning) of faults or anomalies that will allow to optimize resources and maintenance operations (via modern optimization techniques), in a context of predictive maintenance.

National Partners

The group has established a set of external partnerships, **national** and international, with public and private institutions, aiming to fill some of the areas not covered.

PH INFORMÁTICA E MICRO SISTEMAS SA.

CÂMARA MUNICIPAL VIANA DO CASTELO

Infraestruturas de Portugal

ascendi

Betar CONSULTORES

PORTO DE LEIXÕES APDL

3Maps

LABORATÓRIO NACIONAL DE ENGENHARIA CIVIL

Centro de Computação Gráfica
Investigação & Desenvolvimento Tecnológico
Research & Technological Development

U.PORTO

1 2 9 0 UNIVERSIDADE D COIMBRA

NOVA UNIVERSIDADE NOVA DE LISBOA

International Partners

The group has established a set of external partnerships, national and **international**, with public and private institutions, aiming to fill some of the areas not covered.

International Associations

Distinctions / Awards

- ✓ **Senior Scientist Award** at the first conference of EUROSTRUCT – European Association for the Quality Control of Bridges and Structures which took place from August 29th to September 1st, 2021, in Padua, Italy.
- ✓ IconSWM-CE Award – 2020 for **Excellent Presentation**, presented to **E.R. Teixeira**, for the presentation of paper entitled, "Reduction of construction and demolition wastes with its reuse in different construction scenarios" in 10th International Conference on Sustainable Waste Management towards Circular Economy.
- ✓ Outstanding Paper Award in the Scientific Paper category (OPAC): "Shear Performance Mechanism Description Using Digital Image Correlation", **IABSE Awards** (co-author: Matos, J. C.). 2019.
- ✓ **GRAA Award -** "Asset Preservation & Maintenance Management," Projecto SustIMS – Sustainable Infrastructure Management System, em 2017 (coordinator by University of Minho: Jose C. Matos). 2017
- ✓ **Best paper** of the Civil Engineering Student Research Competition in Ireland 2016 (CERI2016) "Integrating multivariate techniques in bridge management systems for life-cycle prediction", Hanley, C., Matos, J. C., Kelliher, D., Pakrashi, V.2016.

PhD Theses

- ✓ Sander Sein, *Development of an Optimised Condition Assessment Plan for Common Reinforced Concrete Bridges in Estonia,* Universidade de Tallinn, Estónia, 26 de novembro de 2021. Orientadores: Juhan Idnum, **José C. Matos**, Marti Kiisa.

- ✓ João Nuno Duarte Fernandes, Risk-based railway infrastructure management systems. Universidade do Minho, 20 de maio de 2021. Orientação: **José C. Matos**, Daniel Oliveira, António Abel Henriques (FEUP).

- ✓ Claudia Alexandra Rocha Ferrreira, Use of Petri Nets to Manage Civil Engineering Infrastructures. Faculdade de Ciencias e Tecnologia da Universidade Nova de Lisboa (FCT/UNL), 17 de dezembro de 2018. Orientação: Luis C. Neves (FCT/UNL); **José C. Matos**.

- ✓ Bruno Samuel Ferreira Gonçalves, *The use of Advanced Technologies on Life-cycle Assessment of Infrastructures*. Universidade do Minho, 28 de novembro de 2018. Orientação: Paulo B. Lourenço, **José C. Matos.**

- ✓ Ivan Zambon, Condition prediction models for the performance assessment and management of existing concrete bridges. University for Natural Resources and Life Sciences (BOKU), Vienna, Austria, 28 June 2018. Orientação: Alfred Strauss (BOKU), **José C. Matos**, Rade Hajdin (Belgrade University), Dan M. Frangopol (Lehigh University).

Publications

- ✓ Sein, S.; Matos, J.; Idnurm, J.; Kiisa, M.; Coelho, M. (2021). RC bridge management optimisation considering condition assessment uncertainties. Proceedings of the Estonian Academy of Sciences, 2021, 70, 2, 172-189. 10.3176/proc.2021.2.07.
- ✓ Urbina, O. J.; Teixeira, E. R. & Matos, J. C. (2021, May). Identification of risk management models and parameters for critical infrastructures. In 18th International Probabilistic Workshop: IPW 2020 (Vol. 153, p. 391). Springer Nature.
- ✓ Tinoco, J.; Parente, M.; Gomes Correia, A.; Cortez, P. & Toll, D. (2021). Predictive and perspective analytics in transportation geotechnics: Three case studies. Transportation Engineering, 100074.
- ✓ Tinoco, J.; Correia, A. A. S. & Venda Oliveira, P. J. (2021). Soil-cement mixtures reinforced with fibers: A data-driven approach for mechanical properties prediction. Applied Sciences, 11(17), 8099.
- ✓ Bento, A. M.; Gomes, A.; Viseu, M. T.; Couto, L.; Pêgo, J. P. (2020). Risk-based methodology for scour analysis at bridge foundations. Engineering Structures, 223, 111115.
- ✓ Matos, J.C.; Fernandes, S.; Sousa, H.S.; Coelho, M.; Teixeira, E.; Moscoso, Y. & Tinoco, J. (2020). From quality control to decision-making on the management of bridges and structures: What's next?. Journal of Materials and Engineering Structures «JMES», 7(4), 551-559.
- ✓ Ariza M.P.S.; Zambon I.; Sousa H.S.; Matos J.C. & Strauss A. (2020). Comparison of forecasting models to predict concrete bridge decks performance. Structural Concrete, 21, pp. 1240-1253 (doi.org/10.1002/suco.201900434)
- ✓ Tinoco, J.; Gomes Correia, A. & Cortez, P. (2018). Data-driven model for stability condition prediction of soil embankments based on visual data features. American Society of Civil Engineers.

Conferences Organized

- ✓ IABSE 2019 Guimarães Symposium: Towards a Resilient Built Environment, Risk and Asset Management (IABSE2019). Guimarães, Portugal, 27-29 March 2019

- ✓ 18th International Probabilistic Workshop (IPW2020). Guimarães (online), Portugal, 12-14 May 2020

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