Research strategies towards technological development and integration

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Member of TekneHab Laboratory, Construction Platform, Emilia-Romagna High Technology Network

Technical Coordinator of “INCEPTION - Inclusive Cultural Heritage in Europe through 3D semantic modelling”, ongoing H2020 project

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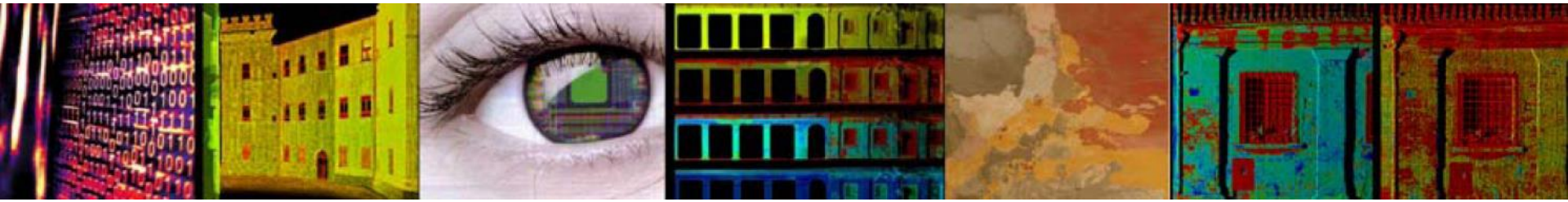
Research strategies towards technological development and integration

Short outline of TekneHub research strategies in the field of interdisciplinary projects and integrated technologies and processes (BIM, diagnostic procedures, heritage documentation and conservation, built environment management, energy efficiency)

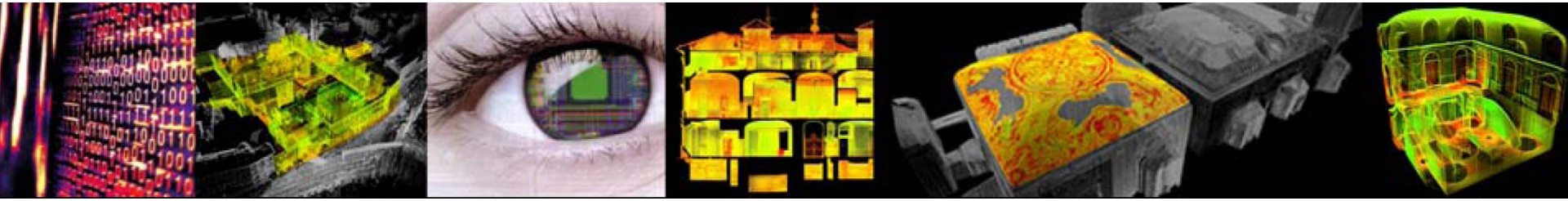
Operational strategies | research avenues, governance, training, education

Some projects in short



DIAPReM Research Centre

Since 1997 the Department Centre for the Development of Integrated Automatic Procedures for Restoration of Monuments (DIAPReM) has been developing operative procedures for the **3D geometric modelling and virtual representation** of architectural complexes of a monumental scale as an analytic tool to aid in an **interdisciplinary approach** to the study of such complexes. DIAPReM is especially engaged in sectors relating to the preservation and restoration of archaeological sites and architectural works.



The Centre is especially involved in 3D data acquisition at different scales and accuracy. To do this it uses a variety of instruments and techniques so as to develop experimental procedures and methods for best surveying. 3D laser scanner surveying allows accurate dimensional-geometrical checks for developing **3D models of architectural features and for carrying out structural and environmental assessments and analyses**.

TekneHub is one of the four Laboratories of the Technopole of Ferrara, within the Construction Platform of the **High Technology Network of the Emilia-Romagna region**, the first regional plan in Italy focused on fostering **Innovation**, **Industrial Research** and **Technology Transfer**.
TekneHub refers to the University of Ferrara with the main aim of supporting SMEs to develop new products, methods and services or to adapt their own ones, to the specific needs of the cultural heritage.

TekneHub works in the main field of **advanced techniques for refurbishment and restoration**, innovative technologies for diagnostic and conservation (Architecture, art, landscape, etc.), conservation, management and valorization of the heritage, ICT procedures to assess and preserve cultural heritage and built environment .

TekneHub

RETE ALTA TECNOLOGIA EMILIA-ROMAGNA HIGH TECHNOLOGY NETWORK
PIATTAFORMA COSTRUZIONI

archaeology | architecture | conservation | cultural heritage | diagnostic | exhibition design | management | materials | museography | palaeontology | refurbishment | restoration | technologies | valorization

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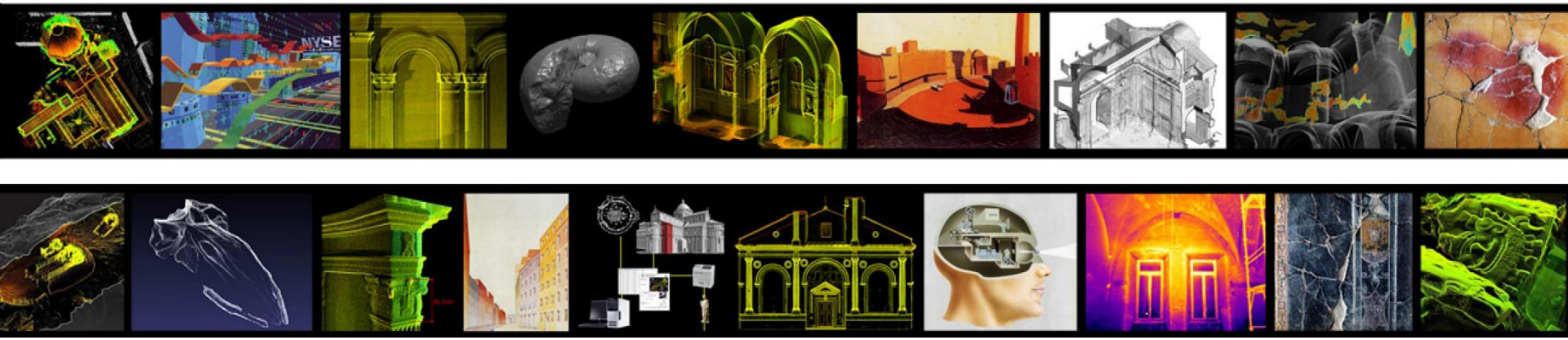
TekneHub develops its R&D strategies through five main research fields

- Methods and technologies for architectural restoration
- Equipment, materials and techniques for museography and exhibition design
- Diagnostic and preservation
- Technologies for the recovery and preservation of the palaeontology and archaeological heritage
- Management and enhancement of the cultural heritage



CLUST-ER BUILD
EDILIZIA E COSTRUZIONI

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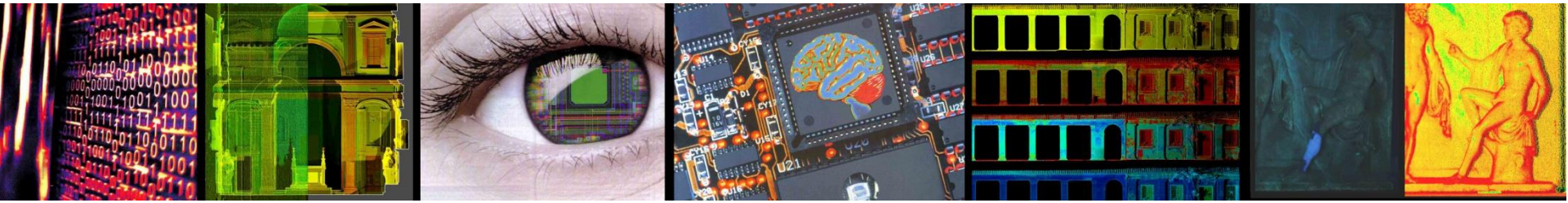
The **Build and Constructions Clust-ER** is an association of public and private bodies: companies, research centres and training institutions that share skills, ideas and resources to support the competitiveness of the sector. The Emilia-Romagna Region has found in the Clust-ERs the subjects capable of multiplying innovation opportunities through a collaborative approach, as they focus their activity in R&D strategic sectors.

Together with the Technopoles and the High Technology Network laboratories, they are one of the **key players in the regional innovation ecosystem** coordinated by ASTER, the Emilia-Romagna consortium for innovation and technology transfer.



The Clust-ER is divided into thematic working groups focused on the priorities of the **Smart Specialization Strategy (S3)** and representative of the most relevant value chains for the regional economy in terms of employment and competitive positioning in the international context.
For each value chain, a programmatic manifesto was drawn up defining the overall strategic vision and the main objectives.

Three Value chains under the Clust-ER Build:

- Innova-CHM - Innovation in Construction and Cultural Heritage Management
- G2B - Green2Build | Energy efficiency and sustainability
- SICUCI - Safety of buildings and infrastructure

Strategic targets

- redevelopment of existing buildings;
- integration of heritage redevelopment with **reduction of seismic vulnerability within the energy-environmental regeneration** of buildings and cities;
- optimized integration of technologies, components, applications and skills;
- indoor and outdoor comfort;
- **sustainable use of resources, reuse of raw materials, use of sustainable and efficient materials, components and technologies**;
- aware use of energy resources, toward zero energy balance (ZEB) and zero environmental impact (ZIB);
- a life cycle approach implemented through tools such as the LCA (Life Cycle Assessment) and the LCC (Life Cycle Costing).

Projects on energy harvesting, predictive maintenance and BIM for interventions on existing buildings (eBIM) have been found under POR-FESR Emilia-Romagna 2014-2019.

The eBIM project starts from research results already validated with reference to specific categories of existing heritage and to specific data management protocols

INCEPTION | Inclusive Cultural Heritage in Europe through 3D semantic modelling

Know-how on BIM modelling and data management (platform)

HORIZON 2020 WORK PROGRAMME 2014 -2015

Europe in a changing world -inclusive, innovative and reflective Societies

REFLECTIVE-7-2014

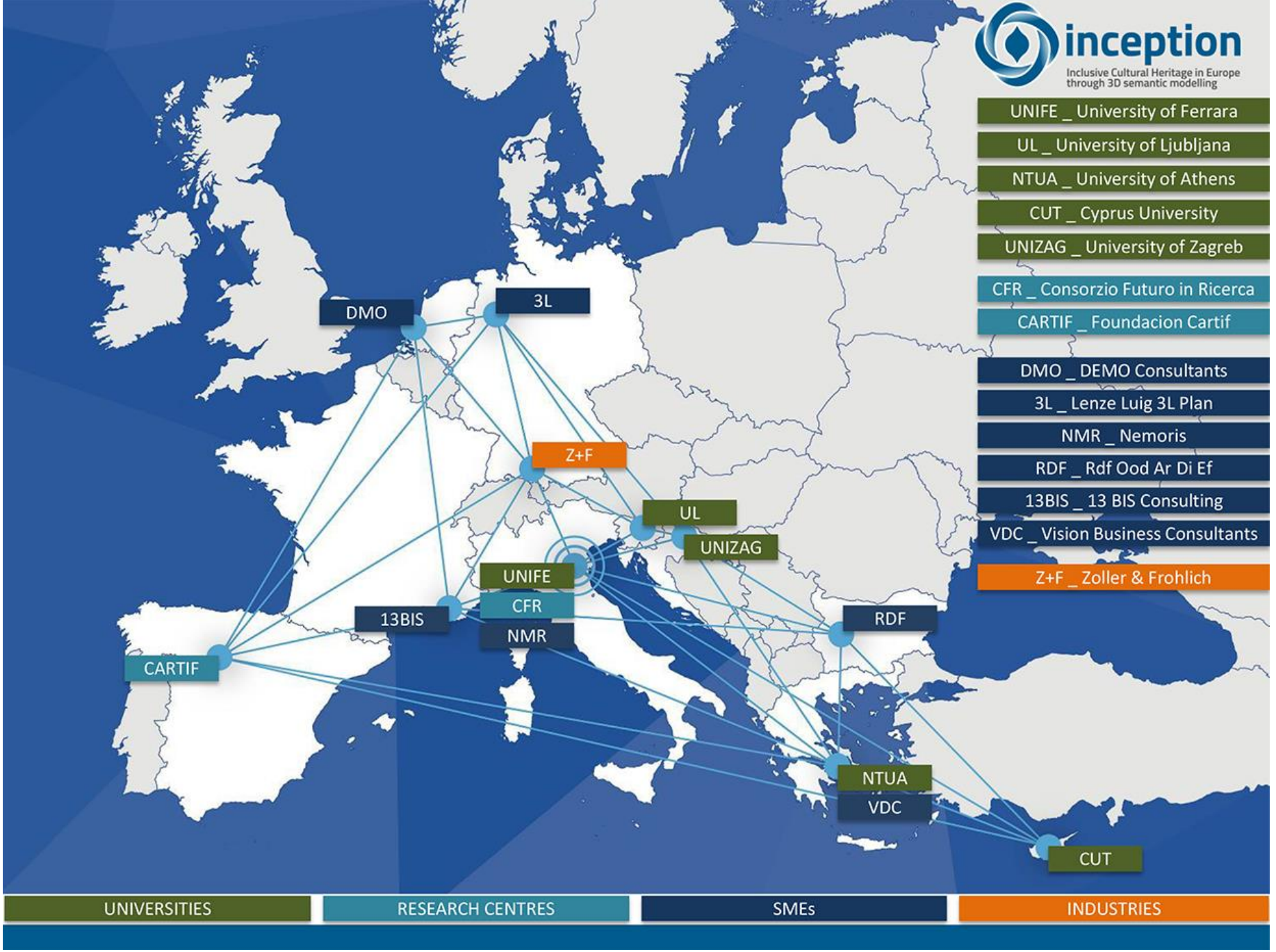
Advanced 3D modelling for accessing and understanding European cultural assets

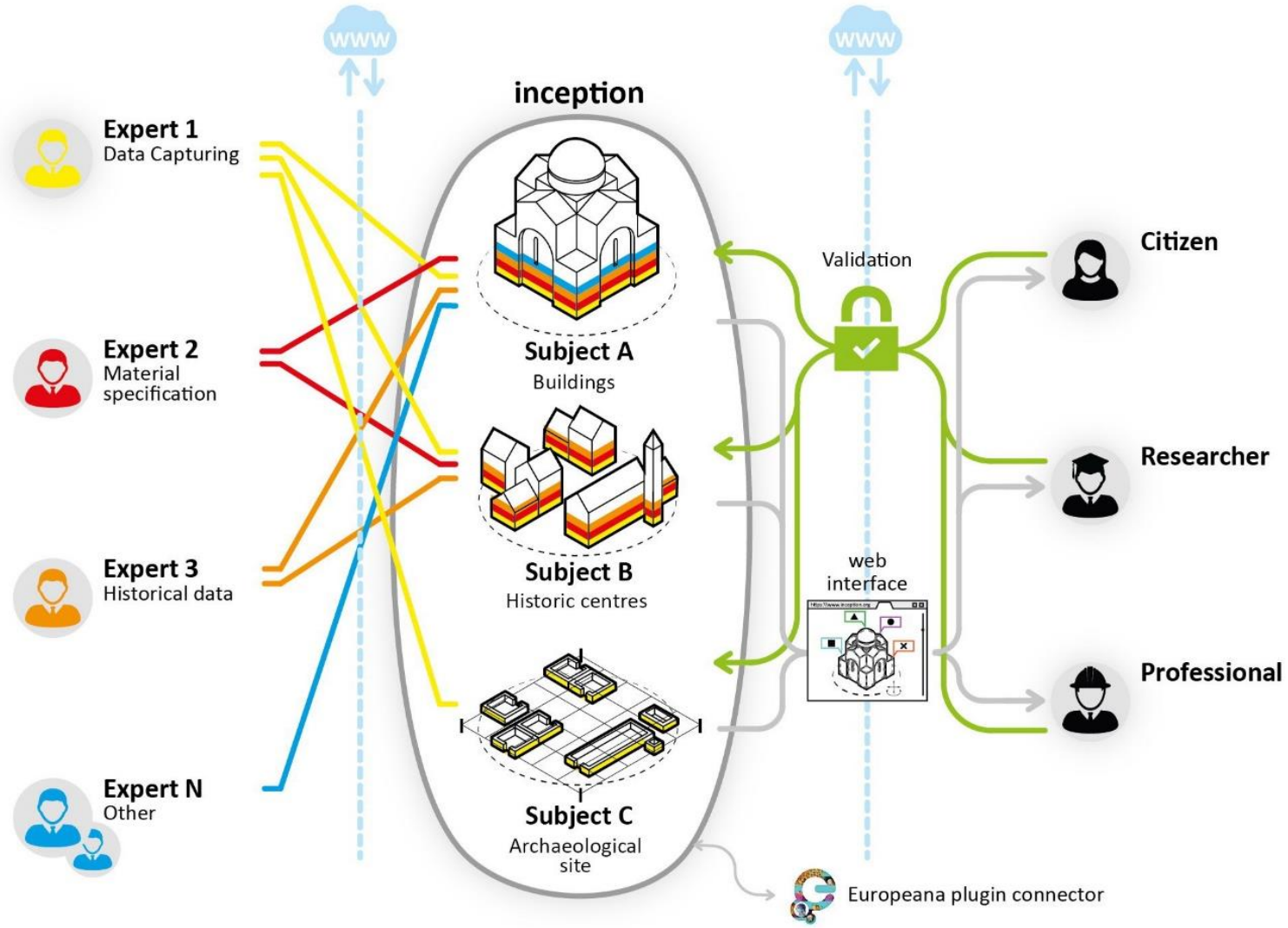
a. Research on cost-effective technologies for advanced 3D modelling to enhance the understanding of cultural heritage | Research and innovation actions

b. Devise standard formats for the semantic-aware 3D modelling of Europe's cultural heritage for researchers and practitioners | Coordination and support actions

14 partners, 10 European countries

June 2015 | May 2019


inception
Inclusive Cultural Heritage in Europe through 3D semantic modelling
UNIFE _ University of Ferrara
UL _ University of Ljubljana
NTUA _ University of Athens
CUT _ Cyprus University
UNIZAG _ University of Zagreb
CFR _ Consorzio Futuro in Ricerca
CARTIF _ Foundacion Cartif
DMO _ DEMO Consultants
3L _ Lenze Luig 3L Plan
NMR _ Nemoris
RDF _ Rdf Ood Ar Di Ef
13BIS _ 13 BIS Consulting
VDC _ Vision Business Consultants
Z+F _ Zoller & Frohlich
DMO
3L
Z+F
UL
UNIZAG
UNIFE
CFR
NMR
13BIS
RDF
CARTIF
NTUA
VDC
CUT
UNIVERSITIES
RESEARCH CENTRES
SMEs
INDUSTRIES


www
www
inception
Expert 1
Data Capturing
Expert 2
Material specification
Expert 3
Historical data
Expert N
Other
Subject A
Buildings
Subject B
Historic centres
Subject C
Archaeological site
Validation
web interface
Citizen
Researcher
Professional
Europeana plugin connector

Main aim | To realise innovation in 3D modelling of cultural heritage through an inclusive approach for time-dynamic 3D reconstruction of built and social environments.

Project objective 1 | To create an inclusive understanding of European cultural identity and diversity by stimulating and facilitating collaborations across disciplines, technologies and sectors.

Project objective 2 | To develop cost-effective procedures and enhancements for on-site 3D survey and reconstruction of cultural heritage buildings, sites and social environments.

Project objective 3 | To develop an open-standard Semantic Web platform for accessing, processing and sharing interoperable digital models resulting from 3D survey and data capturing.

inception
This project is funded by the Horizon 2020 Framework Programme of the European Union

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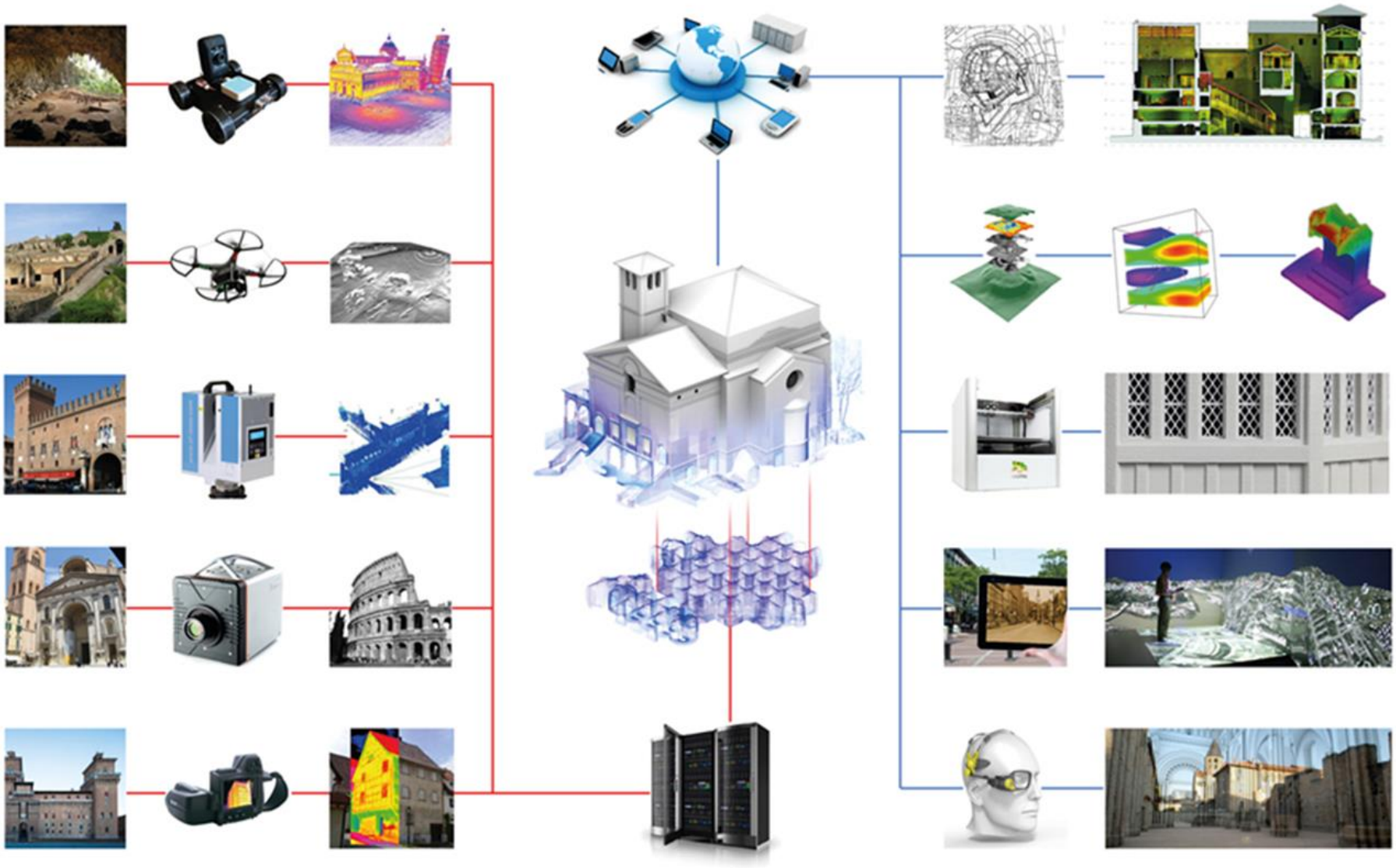
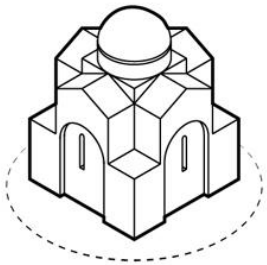


ACTION 1 | Common framework for catalogue methodology



Cultural Heritage Building

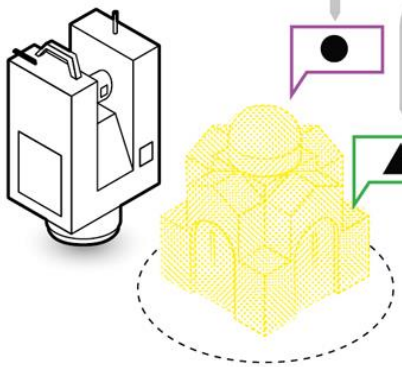
Citizen

Technician

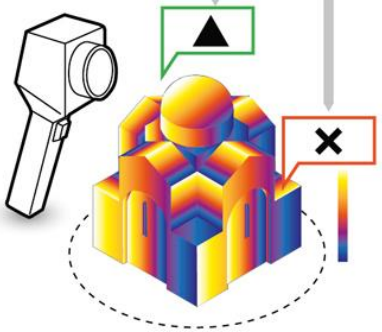
Schoolars

Literature

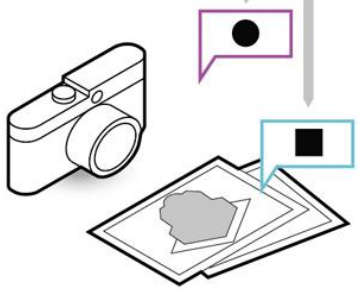
ACTION 2 | Integrated data capturing



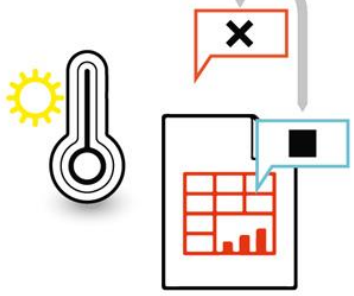
3D point cloud



2D thermal image

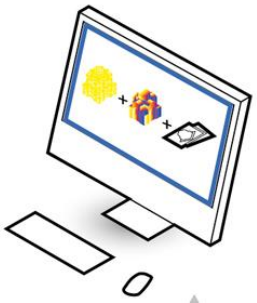


2D photo

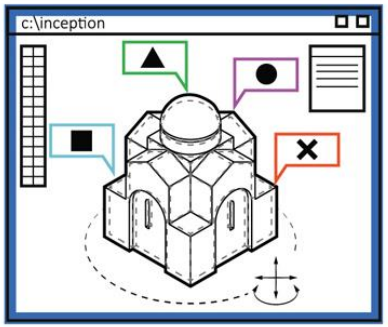


Remote sensing

ACTION 3 | Semantic Modelling for Cultural Heritage Buldings



H-BIM software



Cross-discipline interoperability

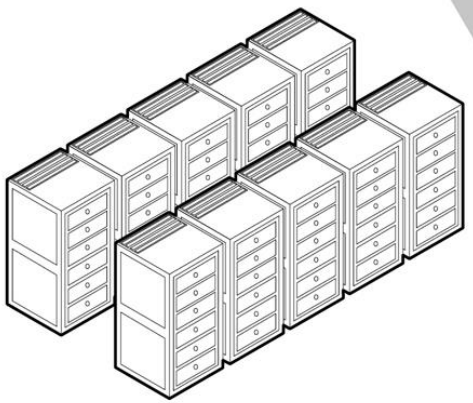
BIM model integration from expert A

BIM model implementation from expert B

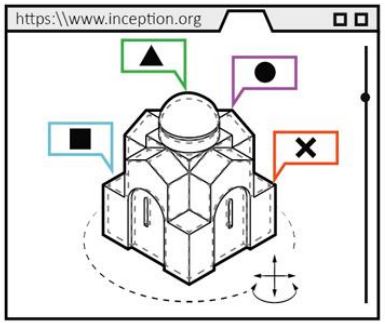
BIM model updating from expert B

and so on...

ACTION 4 | Development of the INCEPTION Platform

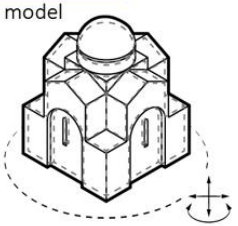


Online web interface

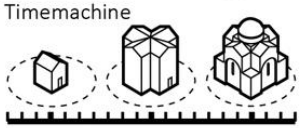


ACTION 5 | Deployment and Valorisation

3D model



Timemachine

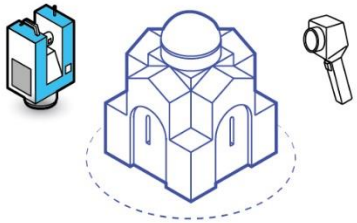


Augmented reality

DOCUMENTATION PROJECT

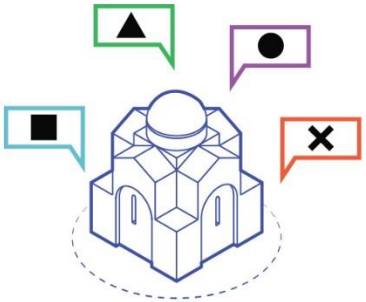
- TIME CONSUMING
- LIMITED BUDGET

3D DATA CAPTURING



- ACCURACY
- COMPLEXITY

DATA INTEGRATION AND PRESERVATION



- METADATA
- SEMANTICS
- MULTIMEDIA
- ARCHIVING

Main challenges in 3D documentation of complex Heritage architectures

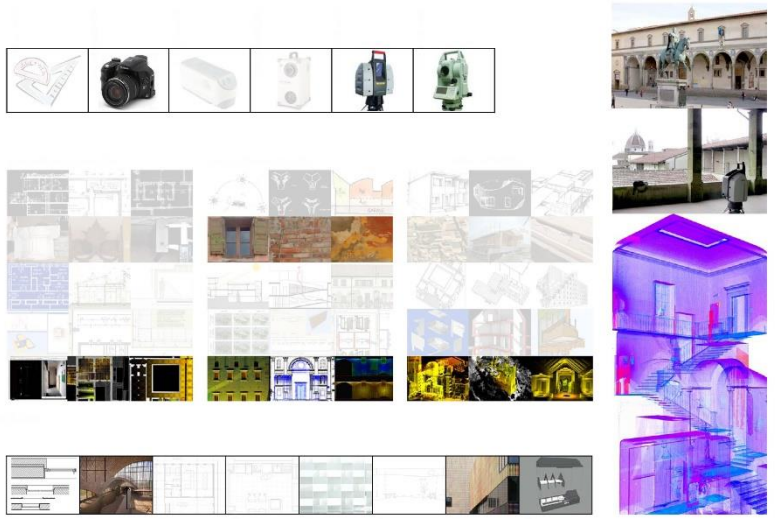
3.3.1 Survey project

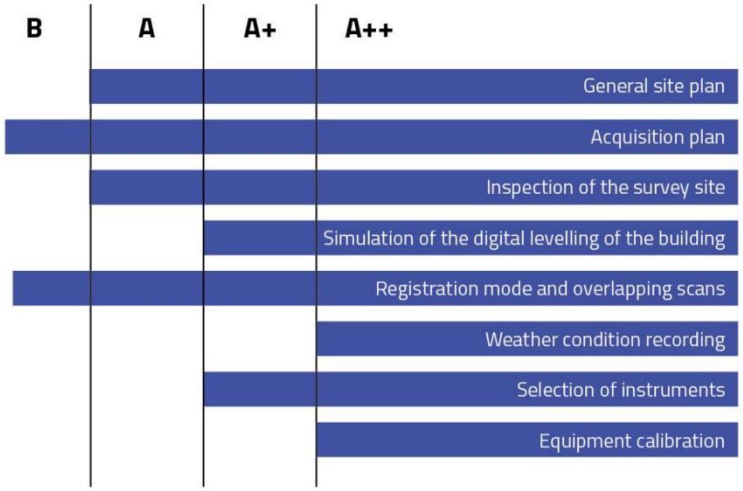
The survey project defines a workflow for every operation performed during the survey of a building to understand procedures and instruments suitable for specific condition according to expected results.

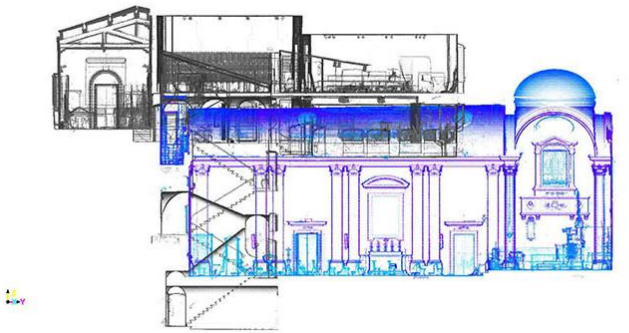
The definition of a project for the survey campaign became one of the most important action in order to create a H-BIM semantic model.

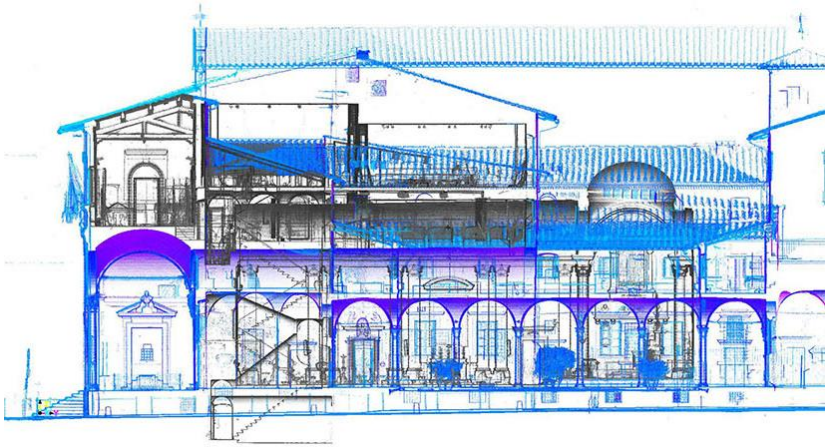
The activity indicators for the scan plan are:

- General site plan;
- Acquisition plan;
- Inspection of the survey site;
- Simulation of the digital levelling of the building;
- Registration mode and overlapping scans;
- Weather condition recording;
- Selection of instruments;
- Equipment calibration.









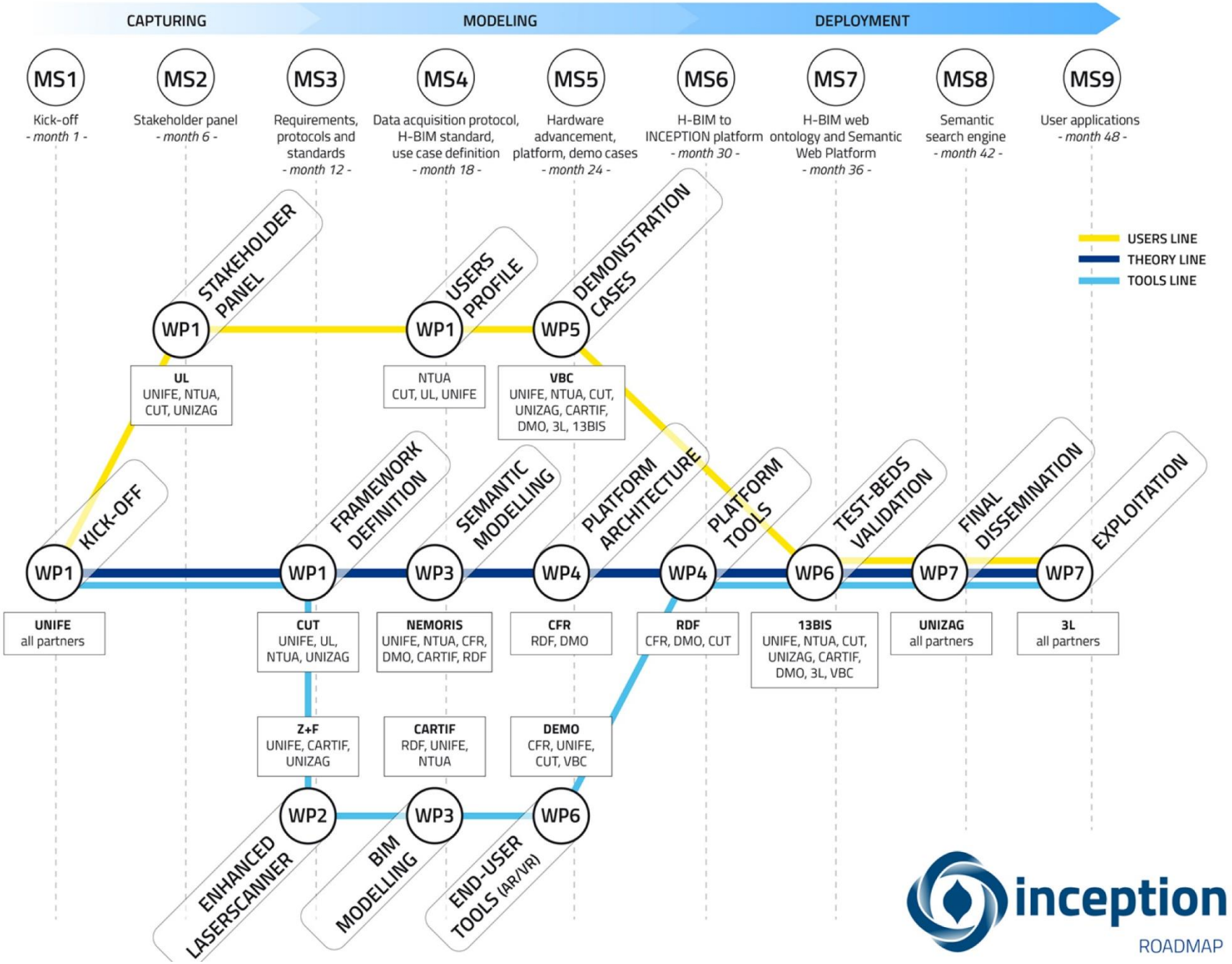
3.3.1a General site plan

General or preliminary site plan should be performed at scales from 1:500 to 1:1,000. It's a general layout, that need to be provided in order to arrange logistic issues as well as the access to the site.

This indicator is compulsory for A, A+ and A++ evaluation categories.

3.3.1b Acquisition plan

A detailed acquisition plan should describe the methodology, tasks, equipment and procedures used to obtain the spatial data. It could be also defined as the procedures to achieve the specified objectives in terms of quality


CAPTURING
MODELING
DEPLOYMENT
MS1
Kick-off
- month 1 -
MS2
Stakeholder panel
- month 6 -
MS3
Requirements, protocols and standards
- month 12 -
MS4
Data acquisition protocol, H-BIM standard, use case definition
- month 18 -
MS5
Hardware advancement, platform, demo cases
- month 24 -
MS6
H-BIM to INCEPTION platform
- month 30 -
MS7
H-BIM web ontology and Semantic Web Platform
- month 36 -
MS8
Semantic search engine
- month 42 -
MS9
User applications
- month 48 -
USERS LINE
THEORY LINE
TOOLS LINE
STAKEHOLDER PANEL
USERS PROFILE
DEMONSTRATION CASES
KICK-OFF
FRAMEWORK DEFINITION
SEMANTIC MODELLING
PLATFORM ARCHITECTURE
PLATFORM TOOLS
TEST-BEDS VALIDATION
FINAL DISSEMINATION
EXPLOITATION
ENHANCED LASERSCANNER
BIM MODELLING
END-USER TOOLS (AR/VR)
WP1
WP1
WP1
WP5
WP1
WP3
WP4
WP4
WP6
WP7
WP7
WP2
WP3
WP6
UL
UNIFE, NTUA, CUT, UNIZAG
NTUA
CUT, UL, UNIFE
VBC
UNIFE, NTUA, CUT, UNIZAG, CARTIF, DMO, 3L, 13BIS
UNIFE
all partners
CUT
UNIFE, UL, NTUA, UNIZAG
NEMORIS
UNIFE, NTUA, CFR, DMO, CARTIF, RDF
CFR
RDF, DMO
RDF
CFR, DMO, CUT
13BIS
UNIFE, NTUA, CUT, UNIZAG, CARTIF, DMO, 3L, VBC
UNIZAG
all partners
3L
all partners
Z+F
UNIFE, CARTIF, UNIZAG
CARTIF
RDF, UNIFE, NTUA
DEMO
CFR, UNIFE, CUT, VBC
inception
ROADMAP

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Thank you for your attention

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