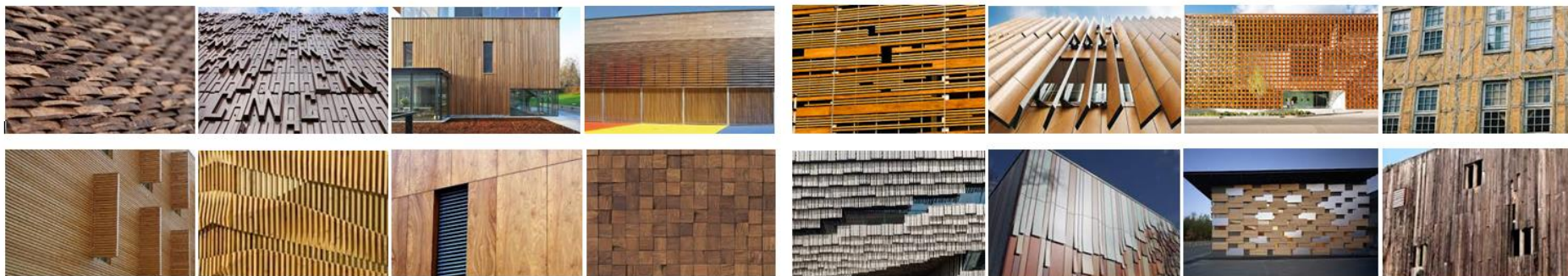


BIO4ever project concept to promote the bio-based materials in modern construction sector



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Outline

- Challenges of construction market
- Trends in bio-based materials
- BIO4ever project concept
- Materials and its properties to be evaluated
- Service life performance tests
- Integration of models with software tools for architects



Construction market

Is one of the major employment sectors across the EU (496 billion € of value added).

The sector provides 20 million direct jobs and contributes to about 10 % of the EU's GDP

Represents a large proportion of the consumption of the earth's non-renewable resources in terms of:

- materials used for construction
- energy consumption for operation of buildings



Challenges that construction sector is facing currently



- **Stimulating demand:**
efficiency improvements in existing buildings and renovations



- **Training:**
improving specialized training and making the sector more research attractive



- **Innovation:**
more active uptake of new technologies₅

Bio-materials in construction sector

- In Italy 1 on 12 buildings is made of wood and growing tendency is observed nowadays
- Bio-based materials are often used for retrofitting of existing structures, upward construction or vertical gardens
- Buildings that use bio-materials are not just sustainable, strong and durable; they are also beautiful

Development priorities

- **Structural components**

(need for developed wood products - Engineered Wood Products, high strength wood, moisture resistant sills, light-weight beams/joists/studs of bio-composites, sandwich panels for exterior walls)



- **Insulation**

(need for compactable bats of cellulose insulation, environmentally friendly fire impregnation, high-performance insulation that provides thinner walls, insulation, optimized for soundproofing)



- **Barrier Materials**

(need for bio-based wind and vapor barrier for moisture-proof exterior walls, waterproofing for wet areas, **façade** and roofing materials **with improved durability/serviceability**)



A key issue in building construction: durability and performance



Bio4ever goals



Promote innovative bio-materials with minimal environmental impact

Establish original construction strategies by reducing gaps between expectations of designers, developers and consumers



Integrate science and experiences for understanding functional and aesthetical performance of bio-materials during service life

Improve sustainability of bio-materials by controlling its transformation at the end of use



Create new business opportunities for the construction industry by using validated material solutions and design tools



Research focus

- design and management of buildings and constructed assets
- proper choice of materials
- efficient energy use
- the physical, functional and aesthetical performances of building materials
- interaction with the urban and economic development and management

Aesthetical aspects of service life, specific consumer demands and preferences, as well as the functionality of building assemblies are the central focus of research 10

Experimental samples origin



20 companies/research units from 13 countries

Experimental samples types

- Different wood species
- Modified wood: thermally, chemically
- Composites pannels
- Silicone and silicate based coatings
- Nano coatings
- Melamine treated wood
- Copper treated wood
- Bamboo cladding
- Reconstituted slate made with bio-resin
- Painted wood
- Waxed wood
- Shou-sugi-ban

**Totally around 100 different bio-materials
to be evaluated**

Surface properties

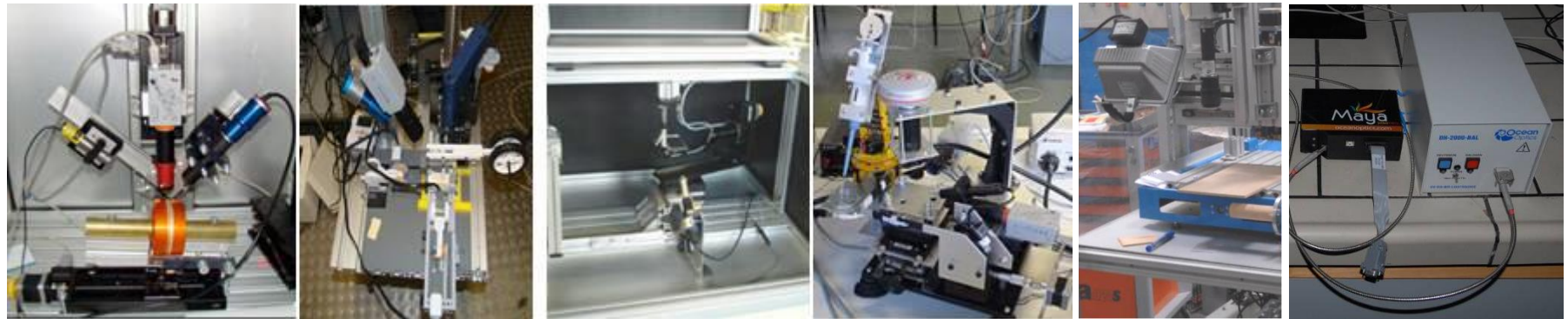
leveling
roughness
pattern
outlook
resistance to abrasion
wetability
touch experience
resistance to dirt
brightness
facture
durability
soft feel
gloss
waviness
color
hardness
matting effect
adhesion
softness
contamination
temperature
surface free energy
chemical activity
resistance to scratch
aseptic
water repellency

How to assess properties “objectively”?



Multi-scale & multi-sensors characterization

An integrated set of prototype and ordinary instruments for determination of bio-materials properties at different scales (from nano to macro) at the **Lab. of Surface Characterization**



color CIE Lab + VIS + NIR + MIR + HI + gloss + XRF + microscopy + roughness + X-ray + wettability + surface pattern/texture + image analysis + aesthetics & customer preferences

Service life performance: living lab

- natural weathering of bio-materials on the structure designed by Renzo Piano and installed at CNR-IVALSA (San Michele All'Adige, ITALY);
- samples will be exposed for different weathering doses/periods and characterized in the laboratory
- 2 replicates/biomaterial/cycle

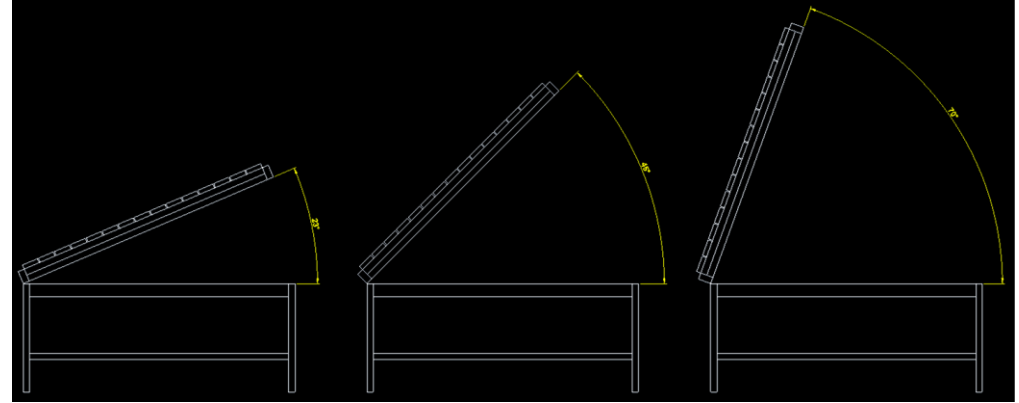
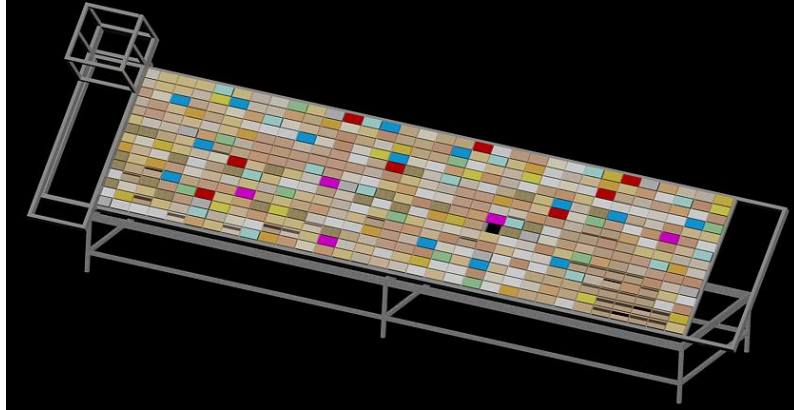


30 months in total according to the schedule

test start	3 months	6 months	9 months	12 months	18 months	24 months	30 months
april 2016	july 2016	october 2016	january 2017	april 2016	july 2017	january 2018	july 2018
	1	8					
	2		9				
	3			10			
	4				11		
	5					12	
	6						13
	7						

Service life performance: natural weathering

- robotized stand, (South exposure, variable inclination 23° , 45° and 70°)
- samples will be automatically characterized weekly with a multi sensor scanner installed on the stand in-field
- 3 replicates/bio-material



30 months continuously

April 2016

July 2018

Service life performance: artificial weathering

- SUN-test, QUV
- 3 replicates/bio-material/test

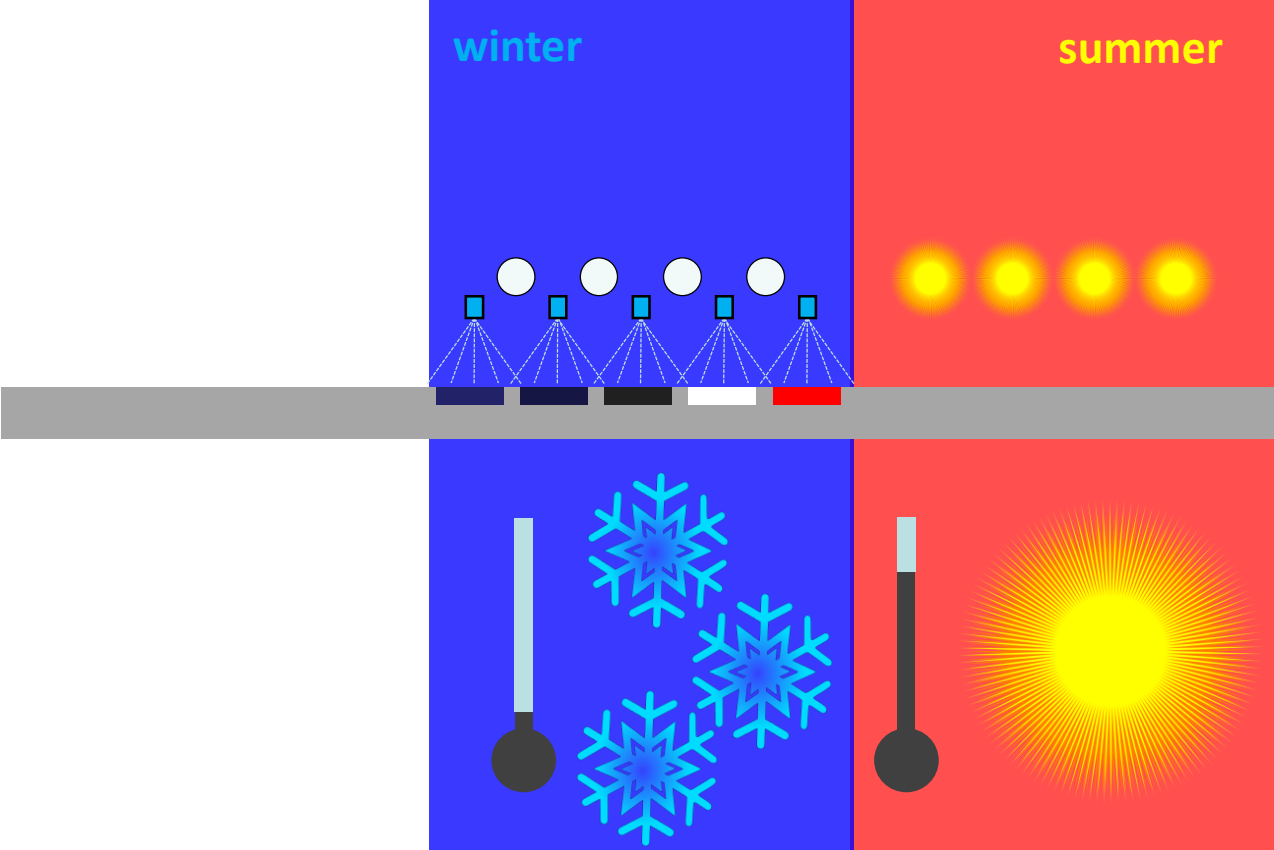


according to standard UNI EN 927-6

April 2016

July 2018

Service life performance: custom weathering machine



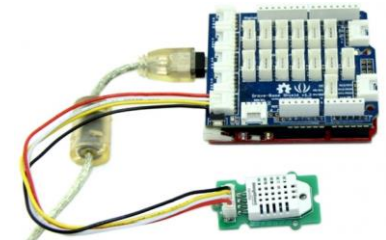
Service life performance: model house

- Natural weathering of bio-materials on the model structure in order to investigate influence of architectonic details on degradation rate



digital camera

weather station



Arduino moisture & temperature

30 months continuously



April 2016

July 2018

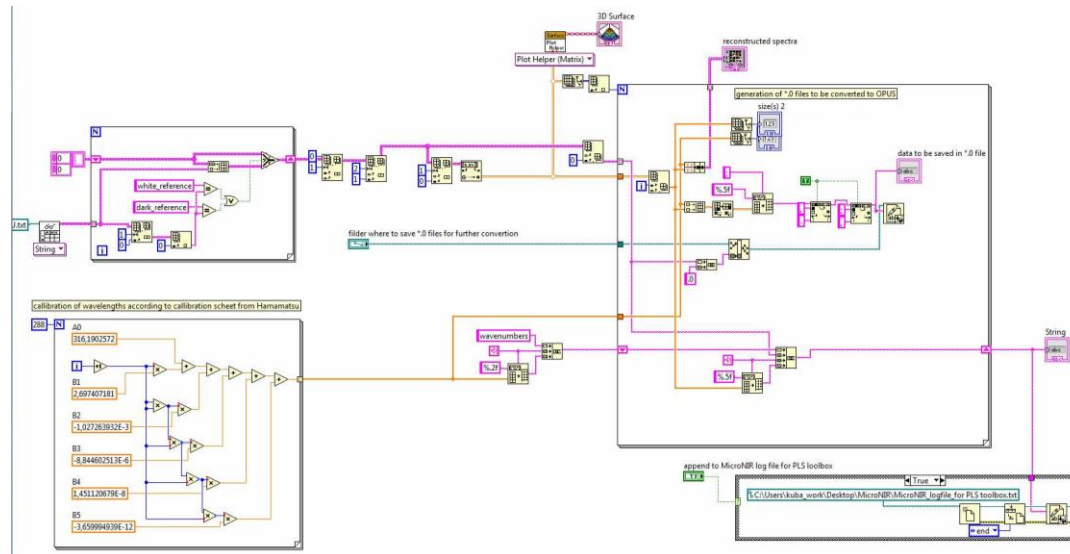
Optimal end of life transformation



- Recycling, reuse & resources recovery
- Validation of the state of-the-art methods (pelletizing, combustion, gasification, digestion, land filling, animal bedding, fermentation, platform molecules production)
- Intensive experimental trials with root fungi, bacteria and insects
- LCA, LCC

Multi-scale modeling and simulation of material deterioration

- Selection of the most suitable data pre- and post- processing
- “Data Fusion” for the integration of experimental data



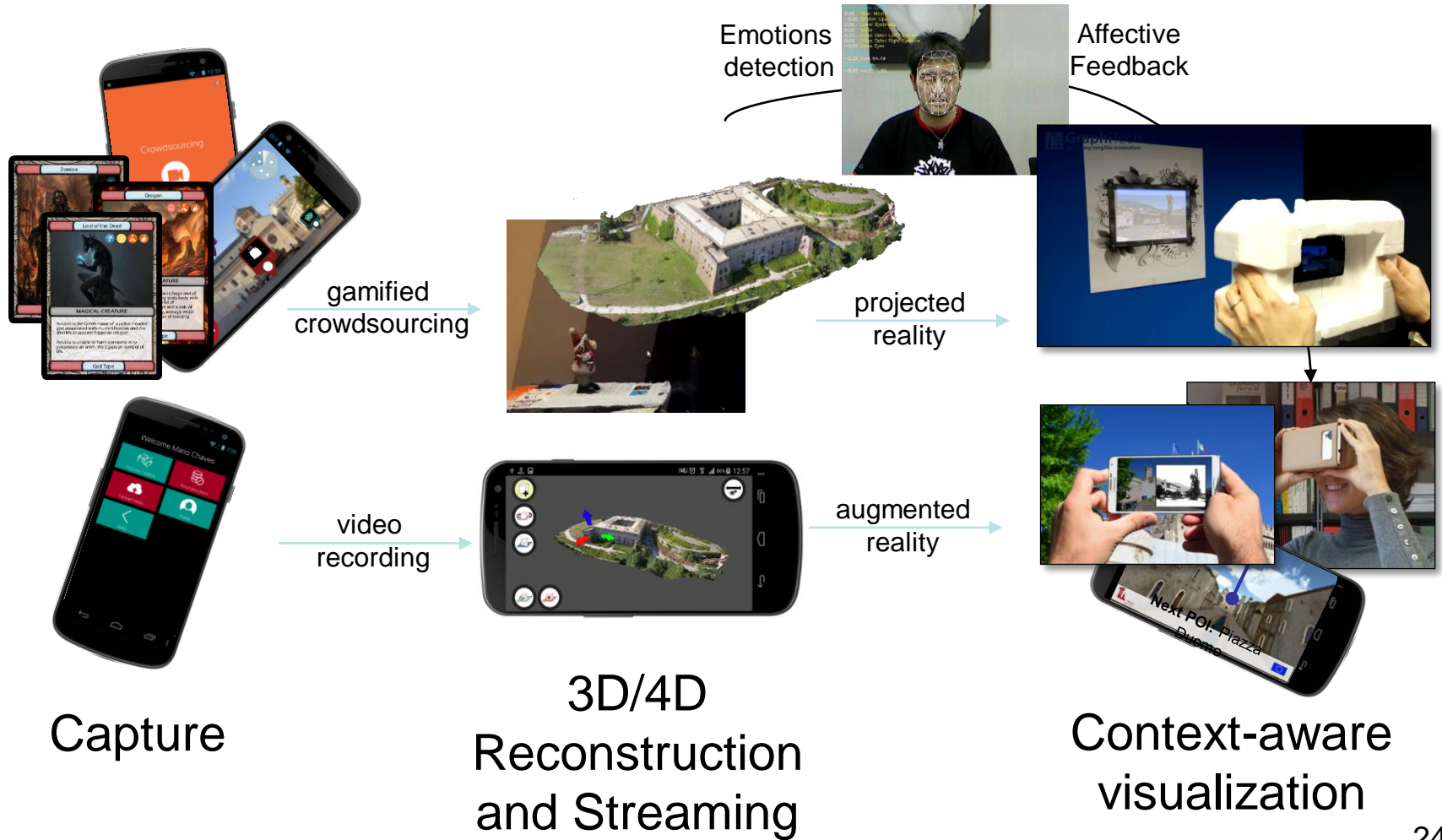
- Multivariate classification of bio-materials quality/functionality - special focus on aesthetical aspect
- Design of dose-response model for material deterioration at different scales

Integration of models with software tools for architects

The aim of c-Space is to create new technologies aiming at supporting creativity processes

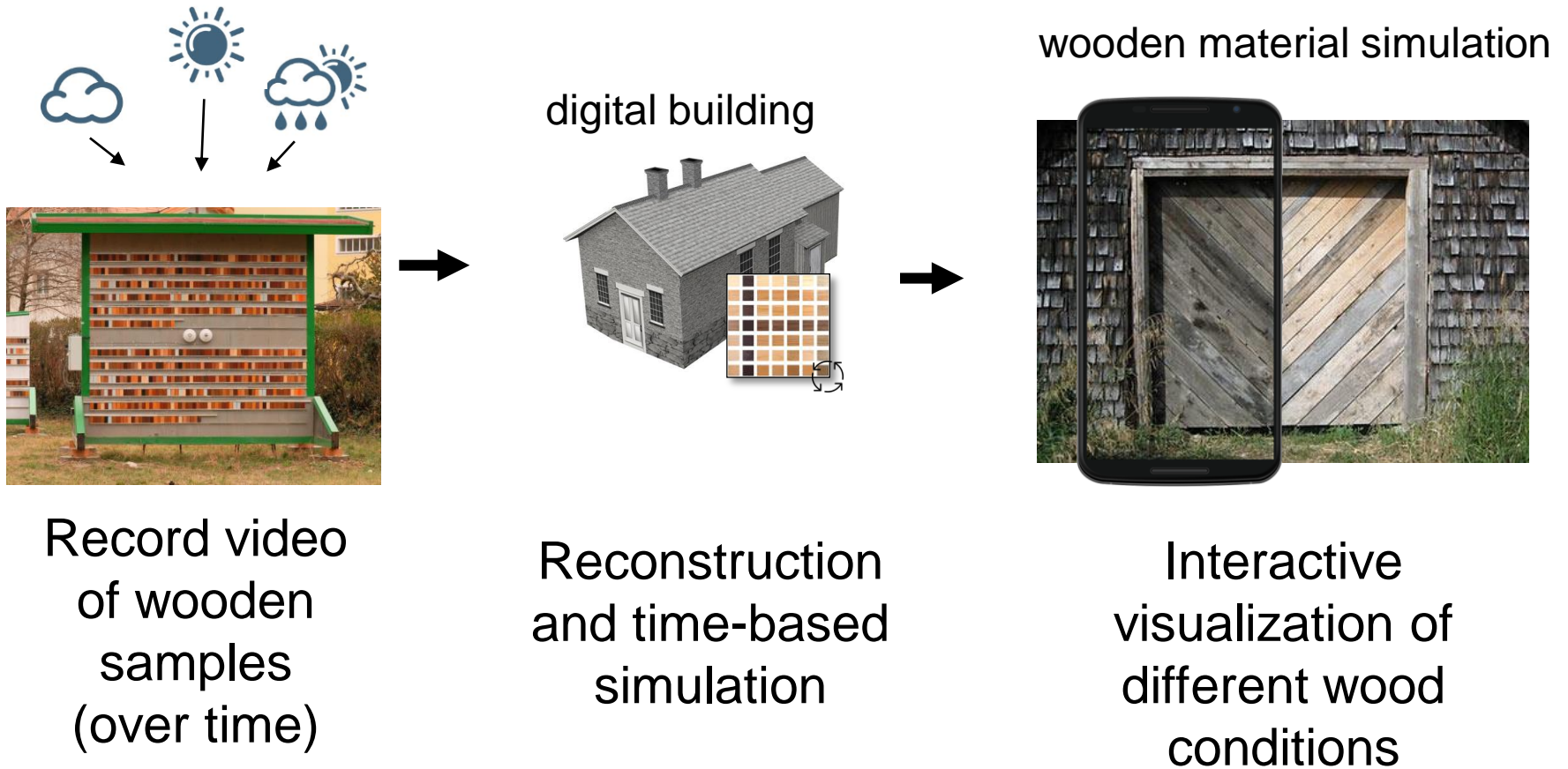
- 4D digital reconstruction from mobile images and videos
- Development of additional mechanisms to support large sense sensing
- Adaptive and affective content access
- Projection-based augmented reality

C-SPACE framework



C-SPACE and BIO4ever

Enhancing the way we perceive bio-materials



Project partners



Univerza v Ljubljani



BioComposites Centre
Innovation in biomaterials for industry



POLITECNICO
DI TORINO
Dipartimento di
Architettura e Design



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BIO4ever



