



Analysis of the 3D reconstruction methodologies used within the framework of the 3D-ICONS project

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WP4 tasks

Objective

execute the digitisation in a smooth and secure way,
according to the digitisation plan defined in WP2

General Tasks

- ❑ 4.1 Digitisation (post-processing) execution (MAP)
- ❑ 4.2 Metadata creation (CISA)
- ❑ 4.3 Digitisation (post-processing) monitoring and control (CISA)

What is (3D) post processing ?

2D Digitisation

sampling, filtering

Final output



● 2D post-processing

What is (3D) post processing ?



● 2D post-processing



● 3D post-processing

Post processing execution

Classification of post processing techniques et methodologies

Geometric reconstruction



TECHNIQUES

- ❑ Automatic meshing from a dense 3D point cloud
- ❑ Interactive or semi-automatic reconstruction based on relevant profiles
- ❑ Interactive or semi-automatic reconstruction based on primitives adjustment
- ❑ Interactive reconstruction based on technical iconography (plans, cross-sections and elevations)
- ❑ Interactive reconstruction based on artistic iconography (sketches, paintings, etc.)

SOURCE 3D MODEL FORMAT

- ❑ ply, Obj, 3DsMAX, Maya, ...

FINAL 3D MODEL FORMAT (for 3D real-time rendering)

- ❑ Collada , Obj, Ply, ...





Post processing execution

Classification of post processing techniques et methodologies

Model structuring



❑ METHODOLOGY

- ❑ Unstructured (point clouds, simple mesh, ...)
- ❑ Decomposed in elementary entities
- ❑ Decomposed in elementary entities hierarchically organized (e.g. architectural layouts)
- ❑ Decomposed in entities organized in classes (e.g. materials, temporal states, etc.)

❑ DATASET STRUCTURE

- ❑ 3D GEOMETRY
  - ❑ Single 3D file structured (1 LOD)
  - ❑ Multiple independent 3D files (1 LOD)
  - ❑ Multiple independent 3D files (multiple LODs)
- ❑ TEXTURES
  - ❑ Embedded into the 3D geometry file
  - ❑ External 2D images

Post processing execution

Classification of post processing techniques et methodologies

Visual enrichment

❑ TECHNIQUES

- ❑ Texture extraction and projection starting from photographs finely oriented on the 3D model (e.g. image-based modeling, photogrammetry)
- ❑ Texturing by photographic samples of the real materials of the artifact
- ❑ Texturing by generic shaders.

❑ SOURCE 2D IMAGES FORMAT

- ❑ TIFF, BMP, TGA, ...

❑ FINAL 2D IMAGES FORMAT (for 3D real-time rendering)

- ❑ JPG, PNG, ...



Post processing execution

Classification of post processing techniques et methodologies

Hypothetical reconstruction



❑ HYPOTHETICAL RECONSTRUCTION

❑ METHODOLOGIES

- ❑ Basing on the 3D acquisition of existing (or existed) parts;
- ❑ Basing on previous 2D surveys of existing (or existed) parts;
- ❑ Basing on non-metric iconographic sources of the studied artifact;
- ❑ Basing on iconographic sources (metric and / or non-metric) related to similar artifacts;

❑ SCIENTIFIC (Historic) ADVISING

- ❑ Scientific Committee
- ❑ Bibliographic references

Post processing execution

Classification of post processing techniques et methodologies

Complementary 2D media (images, videos, VR scenes,...)



❑ TYPE OF MEDIA

- ❑ Static image (e.g. renderings)
- ❑ Animated images (e.g. videotours)
- ❑ Interactive Image (e.g. panoramic imaging)

❑ FORMAT

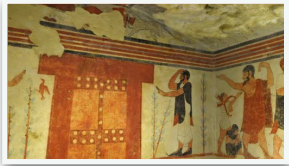
- ❑ Image :
  - ❑ source file : TIFF, TGA,...
  - ❑ final output : JPG, PNG, ...
- ❑ Video :
  - ❑ source file : MOV, AVI, ...
  - ❑ final output : MPEG4, etc...
- ❑ Panorama :
  - ❑ source file : TIF, JPG, ...
  - ❑ final output : QuickTime MOV, Flash, ...



Post processing execution

Classification of post processing techniques et methodologies

Analysis of 4 case studies



☒ Cerveteri and Tarquinia Tombs (FBK)



☒ Centre Pompidou in Paris (CNRS)



☒ Roman archaeological finds (POLIMI)



☒ Treasury of Marseille in Delphi (CNRS)

Case study 1



A - GEOMETRIC RECONSTRUCTION	
	Automatic meshing from a dense 3D point cloud
A2	Interactive or semi-automatic reconstruction based on relevant profiles
A3	Interactive or semi-automatic reconstruction based on primitives adjustment
A4	Interactive reconstruction based on technical iconography (plans, cross-sections and
A5	Interactive reconstruction based on artistic iconography (sketches, paintings, etc.)
B - MODEL STRUCTURING	
	Unstructured (point clouds, simple mesh, ...)
B2	Decomposed in elementary entities
B3	Decomposed in elementary entities hierarchically organized
B4	Decomposed in entities organized in classes (e.g. materials, temporal states, etc.)
C - DATASET STRUCTURE (Geometry)	
	Single 3D file structured (1 LOD)
C2	Multiple independent 3D files (1 LOD)
C3	Multiple independent 3D files (multiple LODs)
D - DATASET STRUCTURE (Textures)	
D1	Embedded into the 3D geometry file
	External 2D images
E - VISUAL ENRICHMENT	
	Texture extraction and projection starting from photographs finely oriented on the 3D
E2	Texturing by photographic samples of the real materials of the artifact
E3	Texturing by generic shaders.
F - HYPOTHETICAL RECONSTRUCTION	
F1	Basing on the 3D acquisition of existing (or existed) parts;
F2	Basing on previous 2D surveys of existing (or existed) parts;
F3	Basing on non-metric iconographic sources of the studied artifact;
F4	Basing on iconographic sources (metric and / or non-metric) related to similar artifacts;
G - SCIENTIFIC (Historic) ADVISING	
G1	Scientific Committee
G2	Bibliographic references

Cerveteri and Tarquinia Tombs (FBK)

Case study 2



Centre Pompidou in Paris (CNRS)

A - GEOMETRIC RECONSTRUCTION	
A1	Automatic meshing from a dense 3D point cloud
●	Interactive or semi-automatic reconstruction based on relevant profiles
A3	Interactive or semi-automatic reconstruction based on primitives adjustment
●	Interactive reconstruction based on technical iconography (plans, cross-sections and
A5	Interactive reconstruction based on artistic iconography (sketches, paintings, etc.)
B - MODEL STRUCTURING	
B1	Unstructured (point clouds, simple mesh, ...)
B2	Decomposed in elementary entities
B3	Decomposed in elementary entities hierarchically organized
●	Decomposed in entities organized in classes (e.g. materials, temporal states, etc.)
C - DATASET STRUCTURE (Geometry)	
C1	Single 3D file structured (1 LOD)
C2	Multiple independent 3D files (1 LOD)
●	Multiple independent 3D files (multiple LODs)
D - DATASET STRUCTURE (Textures)	
●	Embedded into the 3D geometry file
●	External 2D images
E - VISUAL ENRICHMENT	
E1	Texture extraction and projection starting from photographs finely oriented on the 3D
●	Texturing by photographic samples of the real materials of the artifact
●	Texturing by generic shaders.
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F1	Basing on the 3D acquisition of existing (or existed) parts;
F2	Basing on previous 2D surveys of existing (or existed) parts;
F3	Basing on non-metric iconographic sources of the studied artifact;
F4	Basing on iconographic sources (metric and / or non-metric) related to similar artifacts;
G - SCIENTIFIC (Historic) ADVISING	
G1	Scientific Committee
G2	Bibliographic references

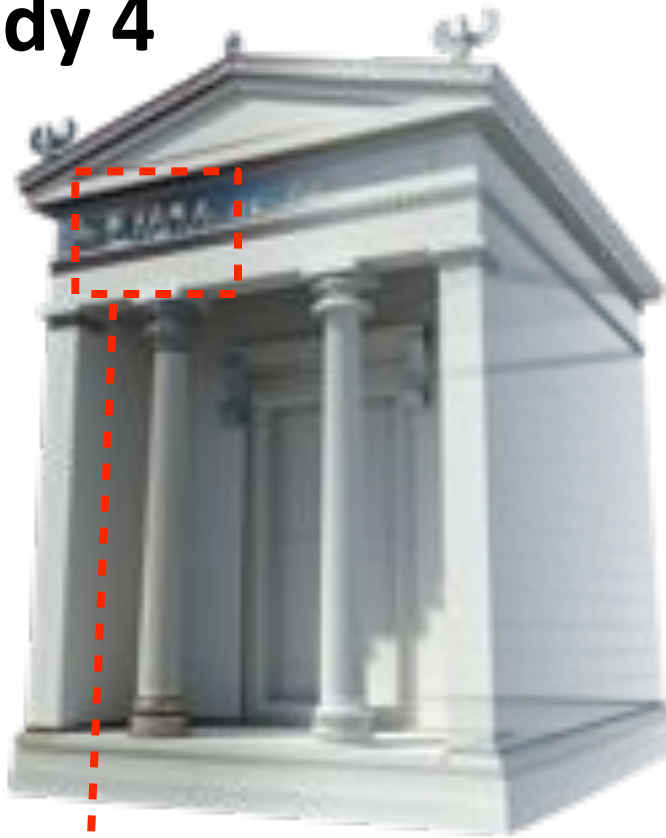
Case study 3



A - GEOMETRIC RECONSTRUCTION	
●	Automatic meshing from a dense 3D point cloud
A2	Interactive or semi-automatic reconstruction based on relevant profiles
A3	Interactive or semi-automatic reconstruction based on primitives adjustment
A4	Interactive reconstruction based on technical iconography (plans, cross-sections and
A5	Interactive reconstruction based on artistic iconography (sketches, paintings, etc.)
B - MODEL STRUCTURING	
●	Unstructured (point clouds, simple mesh, ...)
B2	Decomposed in elementary entities
B3	Decomposed in elementary entities hierarchically organized
B4	Decomposed in entities organized in classes (e.g. materials, temporal states, etc.)
C - DATASET STRUCTURE (Geometry)	
●	Single 3D file structured (1 LOD)
C2	Multiple independent 3D files (1 LOD)
C3	Multiple independent 3D files (multiple LODs)
D - DATASET STRUCTURE (Textures)	
D1	Embedded into the 3D geometry file
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F3	Basing on non-metric iconographic sources of the studied artifact;
F4	Basing on iconographic sources (metric and / or non-metric) related to similar artifacts;
G - SCIENTIFIC (Historic) ADVISING	
●	Scientific Committee
G2	Bibliographic references

Roman archaeological finds (POLIMI)

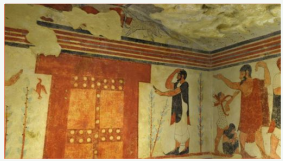
Case study 4



Treasury of Marseille in Delphi (CNRS)

A - GEOMETRIC RECONSTRUCTION	
☒	Automatic meshing from a dense 3D point cloud
☒	Interactive or semi-automatic reconstruction based on relevant profiles
A3	Interactive or semi-automatic reconstruction based on primitives adjustment
A4	Interactive reconstruction based on technical iconography (plans, cross-sections and
A5	Interactive reconstruction based on artistic iconography (sketches, paintings, etc.)
B - MODEL STRUCTURING	
B1	Unstructured (point clouds, simple mesh, ...)
☒	Decomposed in elementary entities
B3	Decomposed in elementary entities hierarchically organized
B4	Decomposed in entities organized in classes (e.g. materials, temporal states, etc.)
C - DATASET STRUCTURE (Geometry)	
☒	Single 3D file structured (1 LOD)
C2	Multiple independent 3D files (1 LOD)
C3	Multiple independent 3D files (multiple LODs)
D - DATASET STRUCTURE (Textures)	
☒	Embedded into the 3D geometry file
☒	External 2D images
E - VISUAL ENRICHMENT	
☒	Texture extraction and projection starting from photographs finely oriented on the 3D
E2	Texturing by photographic samples of the real materials of the artifact
☒	Texturing by generic shaders.
F - HYPOTHETICAL RECONSTRUCTION	
☒	Basing on the 3D acquisition of existing (or existed) parts;
F2	Basing on previous 2D surveys of existing (or existed) parts;
☒	Basing on non-metric iconographic sources of the studied artifact;
☒	Basing on iconographic sources (metric and / or non-metric) related to similar artifacts;
G - SCIENTIFIC (Historic) ADVISING	
☒	Scientific Committee
G2	Bibliographic references

Typical post processing pipelines



□ TYPE 1

- Dense point cloud + regular mesh + vertex coloring
- automatic processing + optimization
- unstructured
- final model managed in : Meshlab, RapidForm, ...



□ TYPE 2

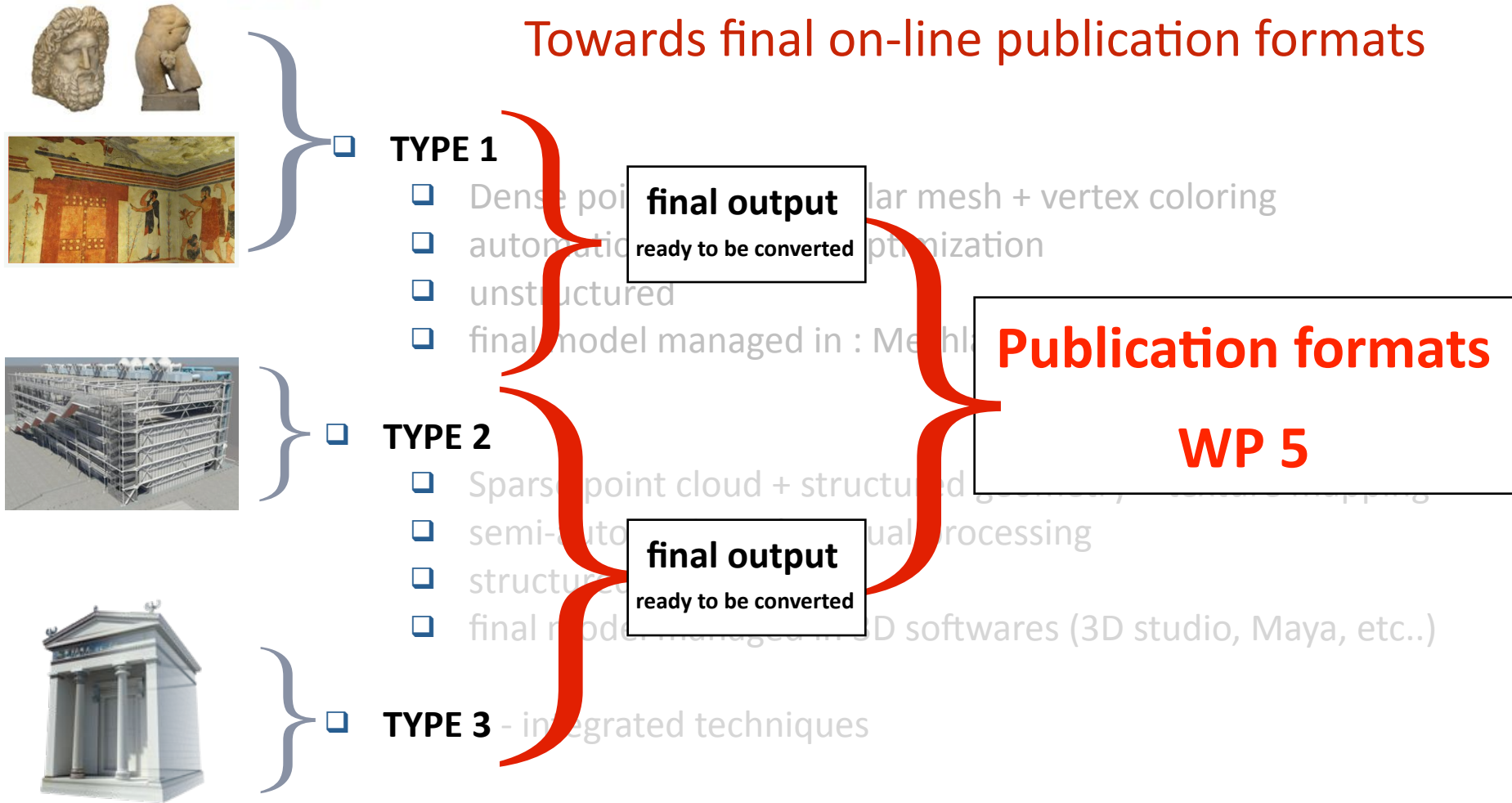
- Sparse point cloud + structured geometry + texture mapping
- semi-automatic and manual processing
- structured
- final model managed in 3D softwares (3D studio, Maya, etc..)



□ TYPE 3 - integrated techniques

Typical post processing pipelines

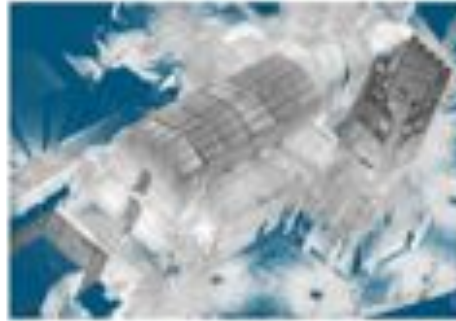
Towards final on-line publication formats



How many final outputs ?

The case of Saint Michel de Cuxa's cloister

DIGITISATION



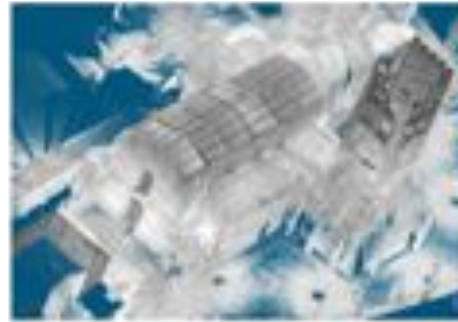
FINAL OUTPUT



How many final outputs ?

The case of Saint Michel de Cuxa's cloister

DIGITISATION

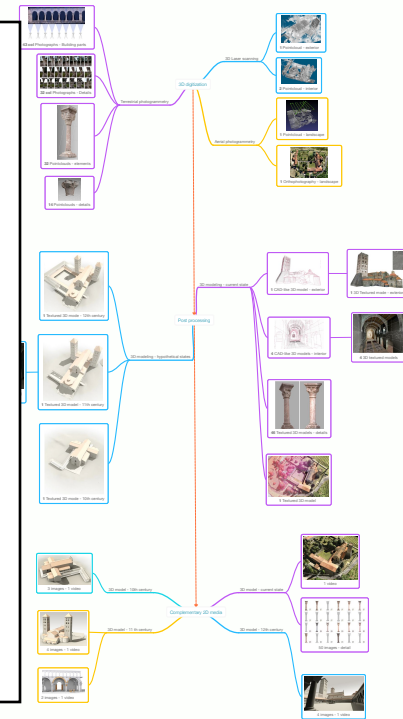


POST PROCESSING



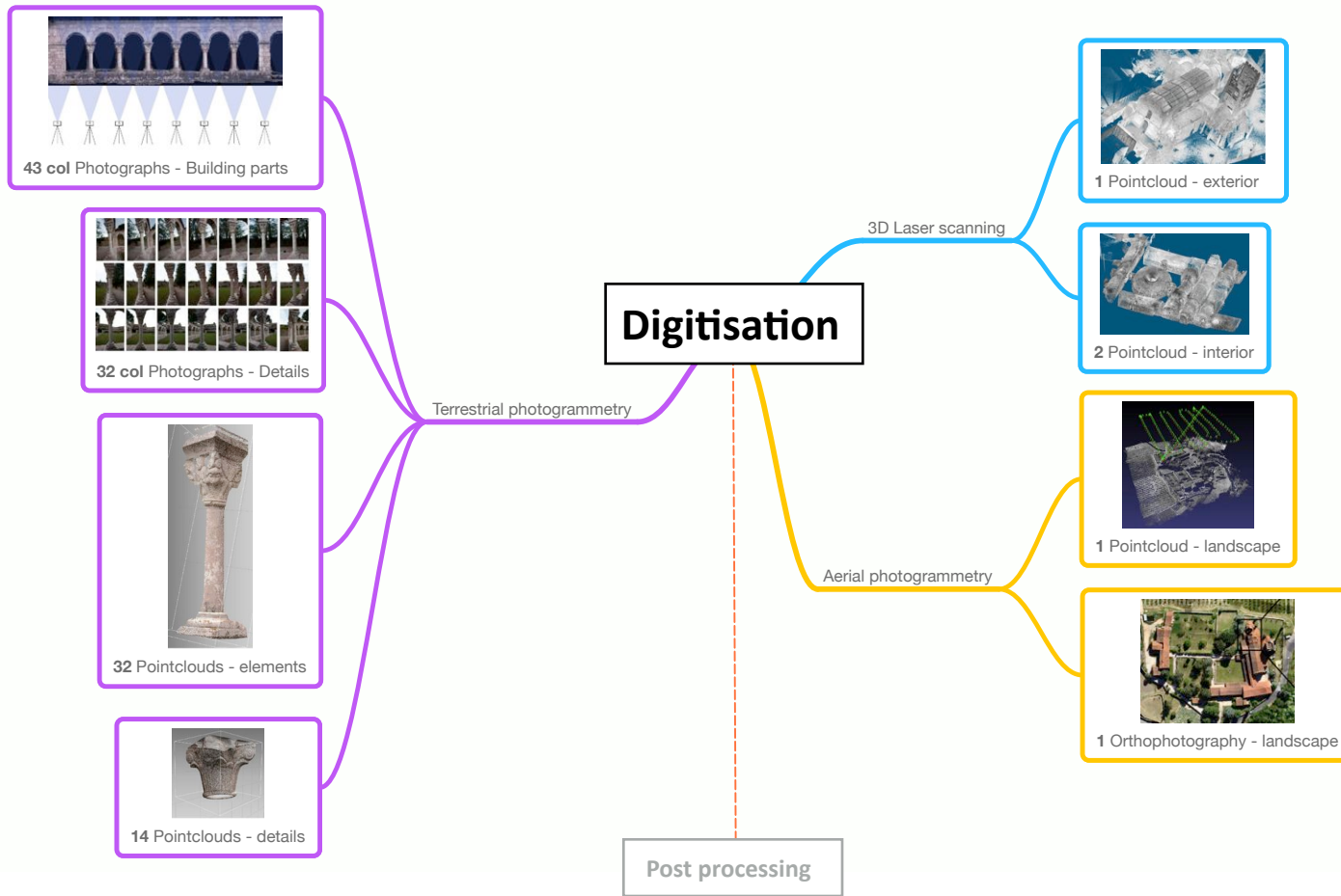
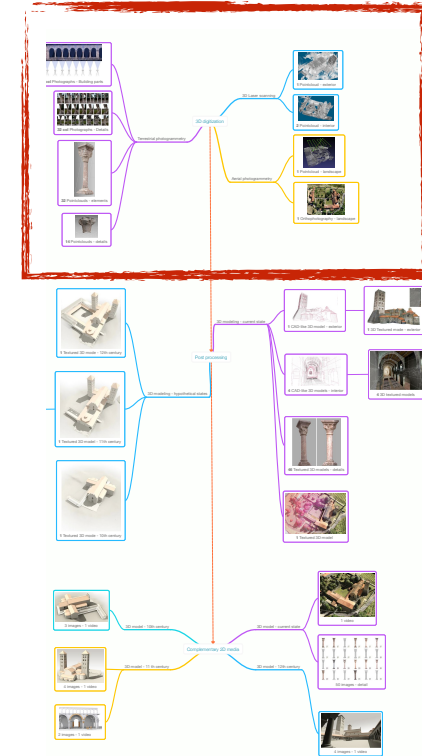
FINAL OUTPUT

MULTIPLE DIGITAL ASSETS

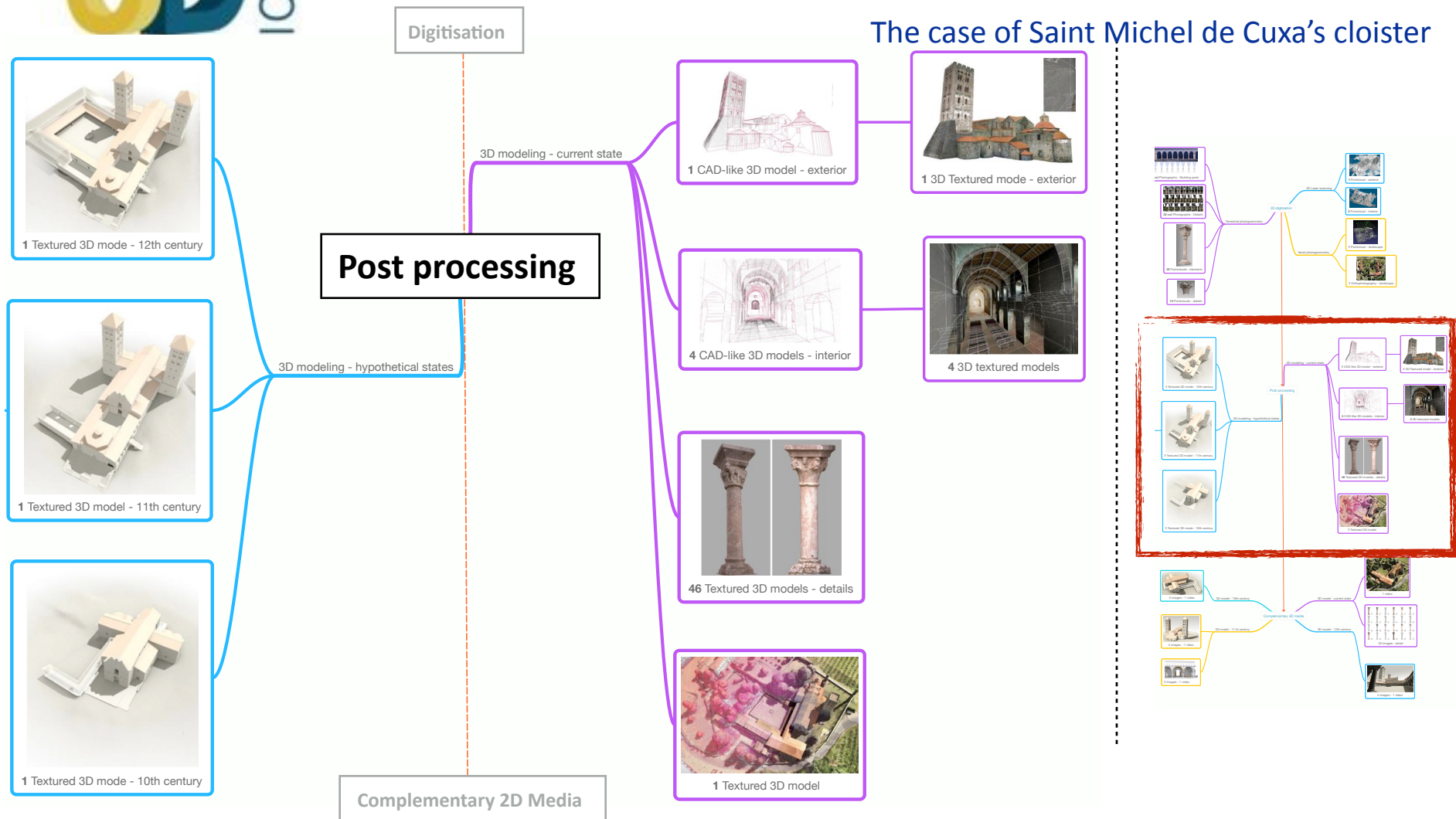


How many final outputs ?

The case of Saint Michel de Cuxa's cloister

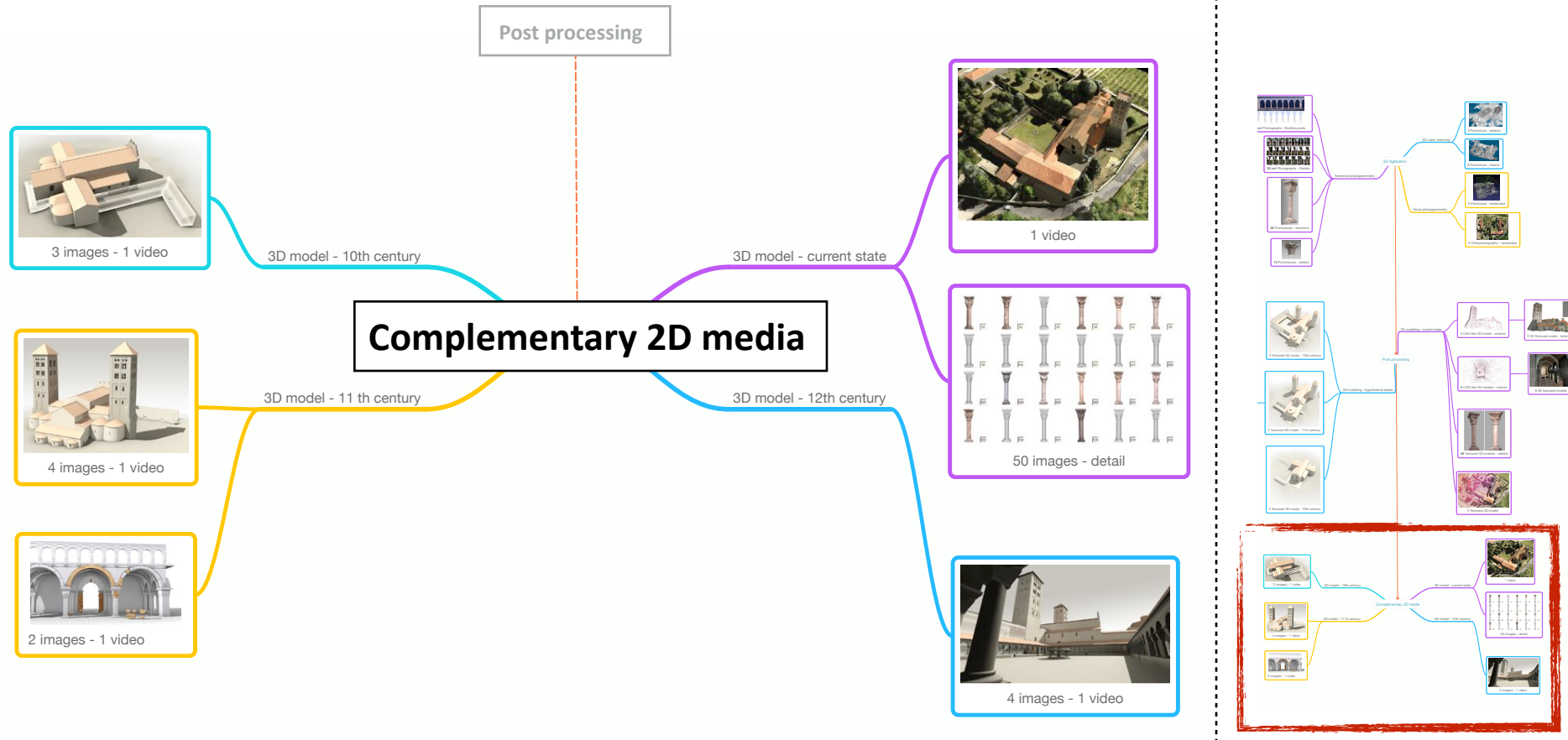


How many final outputs ?



How many final outputs ?

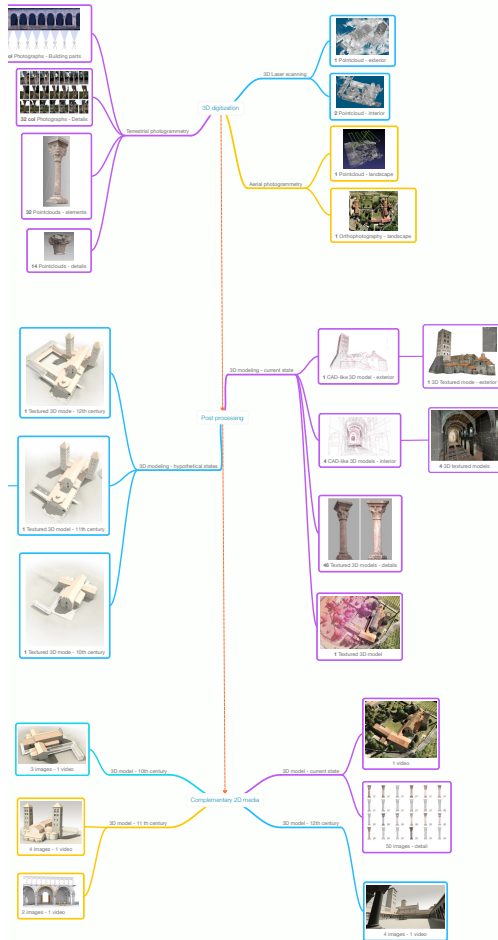
The case of Saint Michel de Cuxa's cloister





How many final outputs ?

The case of Saint Michel de Cuxa's cloister



- ❑ **3D Digitisation**
    - ❑ Images : **75** collections (+ **450** images)
+ **1** orthophotography
    - ❑ 3D models : **50** pointclouds
  - ❑ **Post processing**
    - ❑ Current state :
      - ❑ **5** cad-like 3D models
      - ❑ **52** textured 3D models
    - ❑ Hypothetical states :
      - ❑ **4** textured 3D models
  - ❑ **Complementary 2D media (derived from 3D models)**
    - ❑ **63** Images (rendering)
    - ❑ **5** Video animations
-
- ❑ **Total**
    - ❑ **111** 3D Models
      - ❑ **50** pointclouds
      - ❑ **5** cad-like 3D models
      - ❑ **56** textured 3D models
    - ❑ **514** images
      - ❑ **75** images collections (+ 450 images)
      - ❑ **64** images (derived from the 3D model)



WorkPackage 4 - Post processing

Metadata creation

Linking the 3D processing pipeline to the metadata creation

Versailles

Petit Trianon

Chambre de la Reine



Sécrétaire W1-38-1



Metadata creation

Linking the 3D processing pipeline to the metadata creation

Versailles

Petit Trianon

Chambre de la Reine



Sécrétaire W1-38-1



PHYSICAL
OBJECT

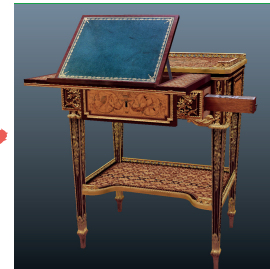
DIGITAL
ASSET



Digital asset

3D Textured PointCloud
HD version

DIGITAL
ASSET



Digital asset

3D Textured Model
HD and LD version

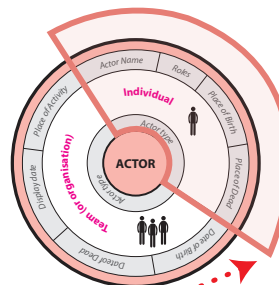
DIGITAL
ASSET



Digital asset

Video animation

A1



ACTOR

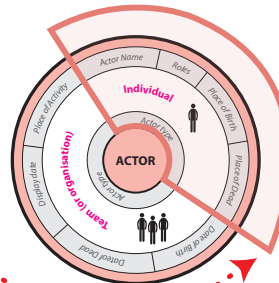
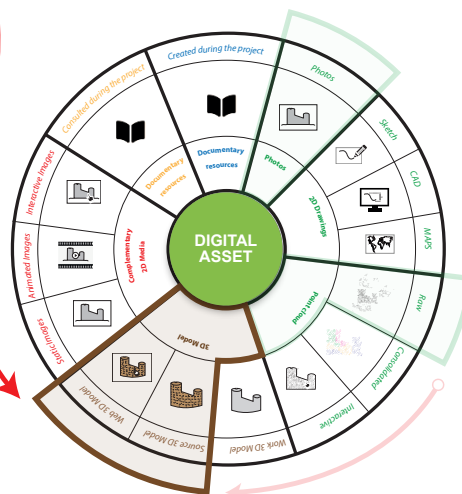
ORGANIZATION

DIGITAL ASSET - 3D POINT CLOUD



Appellation Name**	Data_10.vvd
Description**	Nuage de point issu du relevé laser de la table mécanique W1-38-1
Link (thumbnail)**	
Object **	
Is Shown at**	
Copyright Credit Line**	UMR 3495 CNRS/MCC MAP
European Rights **	The Public Domain Mark (PDM)
Access Rights (enum)	
Reproduction Rights	
Licence	
Type*	Nuage de points
Format* Details	.vvd
Publisher	
Place (publication)	
Actor	Noémie RENAUDIN

A1

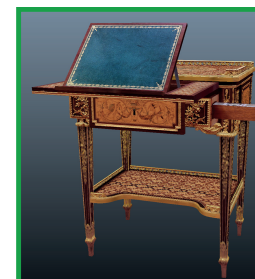


- ## ACTIVITY

ACTOR

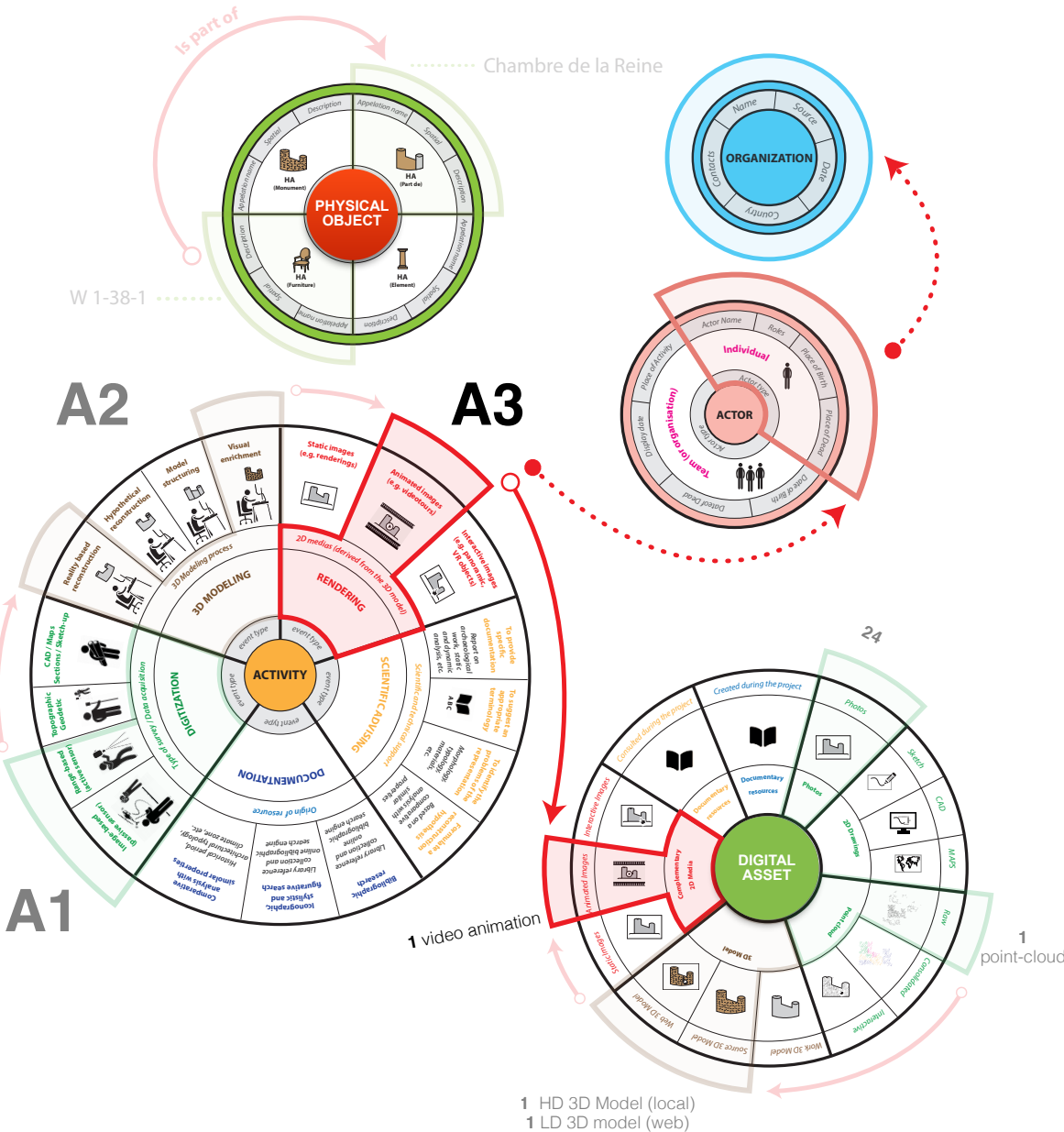
ORGANIZATION

DIGITAL ASSET - TEXTURED 3D MODEL



Appellation Name**	W1-38-1.mb
Description**	Fichier Maya de reconstruction 3D de la table mécanique W1-38-1
Link (thumbnail)**	
Object **	
Is Shown at**	
Copyright Credit Line**	UMR 3495 CNRS/MCC MAP
European Rights **	The Public Domain Mark (PDM)
Access Rights (enum)	
Reproduction Rights	
Licence	
Type*	3D
Format* Details	.mb
Publisher	
Place (publication)	
Actor	Luca FORESI

Complementary 2D media (video)



ACTIVITY

	Appellation Name**	Création de médias 2D associés à la table mécanique W1-38-1
	Event Type*	Rendering
	Actor	Rendu Vidéo de la manipulation de la table mécanique W1-38-1
	Has assisted	Luca FORESI, Noémie RENAUDIN
	Is derived of	
	Had Specific Purpose	
	Start Date	
	End Date	
	Methods	Animated Images
	Material	
	Software	Autodesk Maya 2008

ACTOR

Actor Name **	Luca FORESI	Noémie RENAUDIN
Actor Type	Individual	Individual
Roles	Géomètre	Assistante Ingenieur
Place of Birth		
Place of Death		
Place of Activity		
Date of Birth		
Date of Death		
Display Dates		

ORGANIZATION

Organization Name **	UMR 3495 CNRS/MCC MAP
Source *	UMR 3495 CNRS/MCC MAP
Date *	13/02/2014
Country *	FRANCE
Contacts Name *	Livio DE LUCA
Contacts Role	Ingénieur de Recherche au CNRS, HDR
Contacts Organization	UMR 3495 CNRS/MCC MAP
Contacts Address Building Name	Campus CNRS Joseph Aiguier, Bât Z'
Contacts Address Number In Road	31
Contacts Address Road Name	Chemin Joseph Aiguier
Contacts Address Town Or City	Marseille Cedex 20
Contacts Address Postcode or Zipcode	13402
Contacts Address Locality	
Contacts Address Admin Area	
Contacts Address Country	FRANCE
Contacts Phone	+33 (0)491164347
Contacts Fax	+33 (0)491164343
Contacts Email	livio.deluca@map.archi.fr
Contacts Description	

DIGITAL ASSET - VIDEO ANIMATION

	Appellation Name**	secrétaire-7.mov
	Description**	Vidéo de la manipulation de la table mécanique W1-38-1
	Link (thumbnail)**	
	Object **	
	Is Shown at**	
	Copyright Credit Line**	UMR 3495 CNRS/MCC MAP
	Europeana Rights **	The Public Domain Mark (PDM)
	Access Rights (enum)	
	Reproduction Rights	
	Licence	
	Type*	Vidéo
	Format* Details	.mov
	Publisher	
	Place (publication)	
	Actor	Noémie RENAUDIN



livio.deluca@map.archi.fr

www.3Dicons-project.eu

