The oldest traditional Trawler of Cyprus on its way to the Data Cloud and Memory-Twin

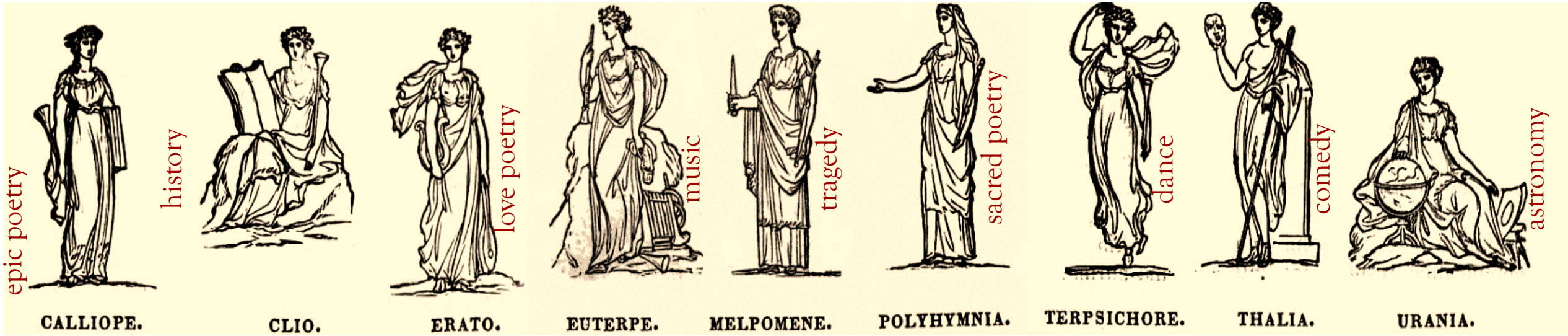
Marinos Ioannides,
Panayiotis Panayiotou

THANK YOU

CONGRATULATIONS

OUR NAME

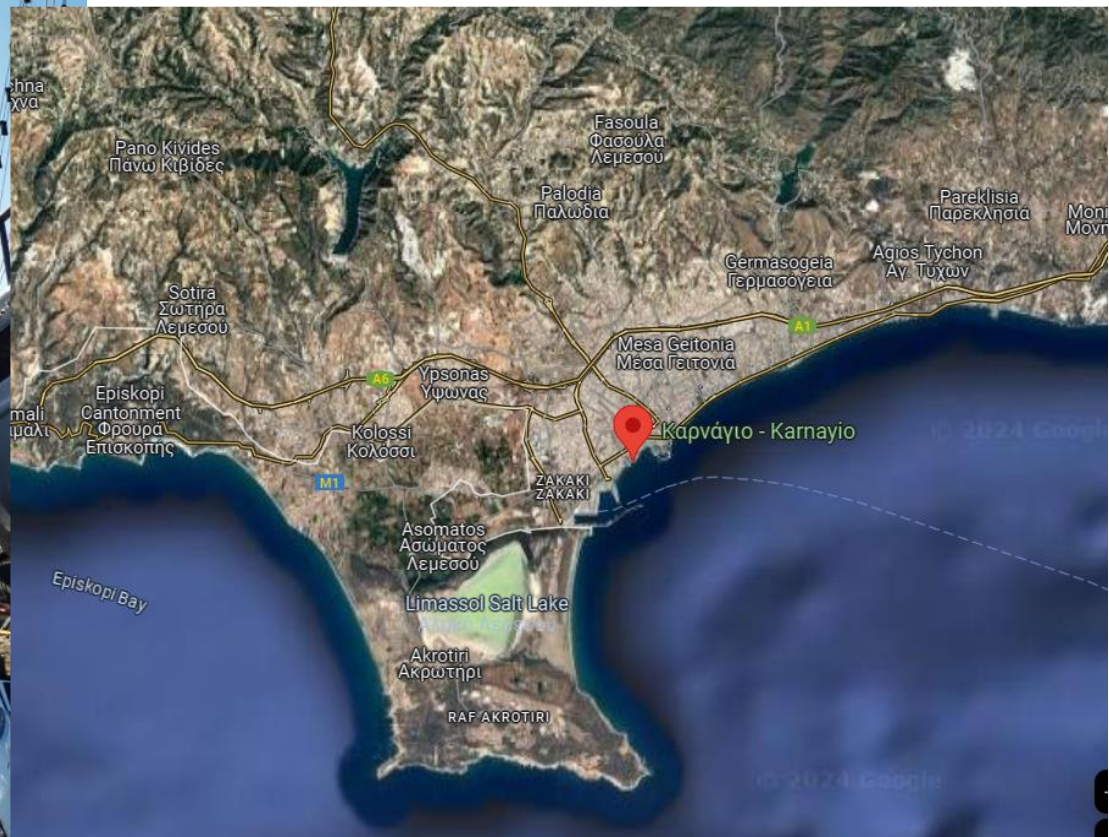
ΜΝΗΜΟΣΥΝΗ



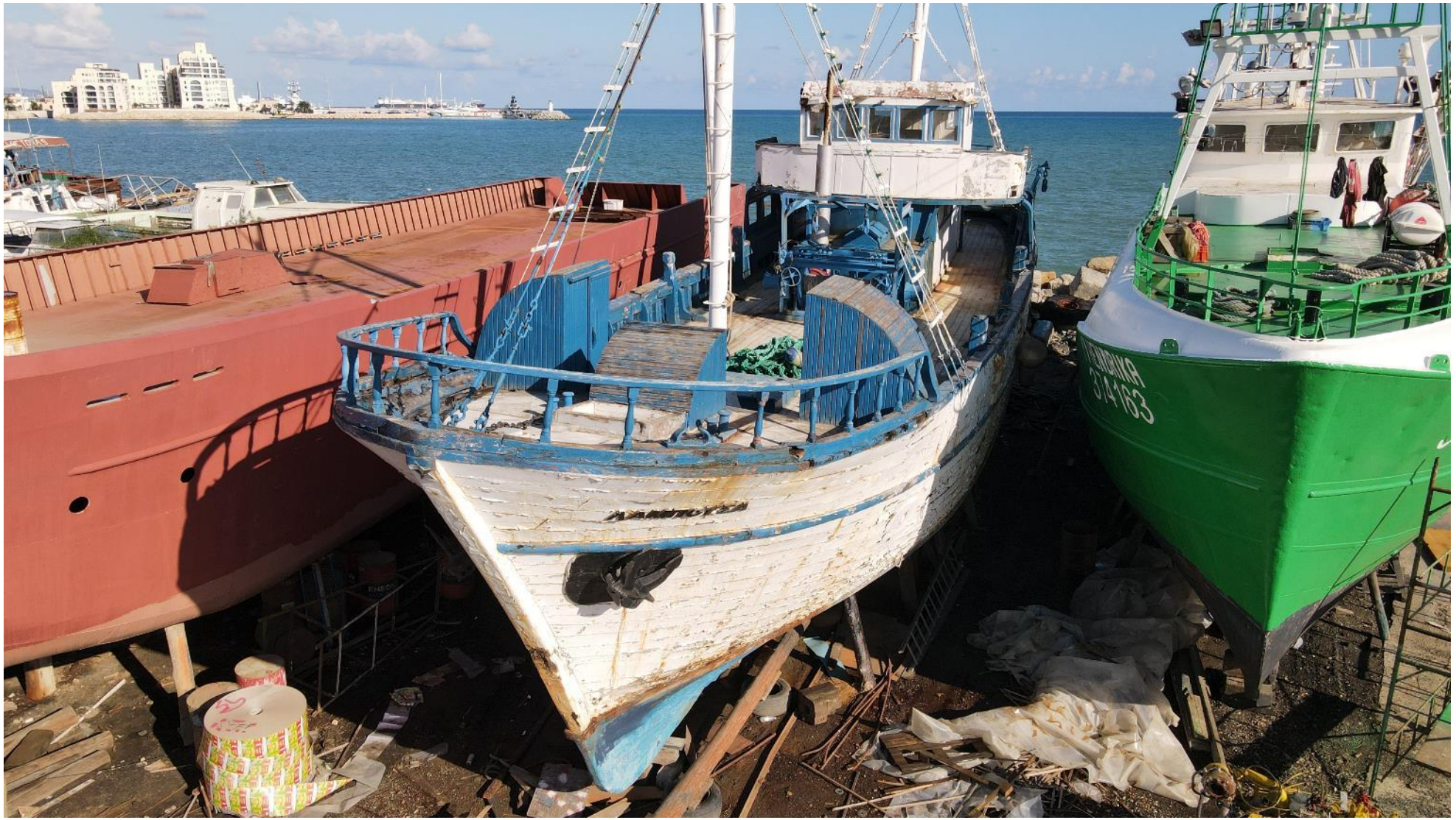
MAY 2022

FOLLOWING AN INVITATION OF THE MAYOR OF LIMASSOL MUNICIPALITY

KARNAYIO SHIPYARD, Limassol

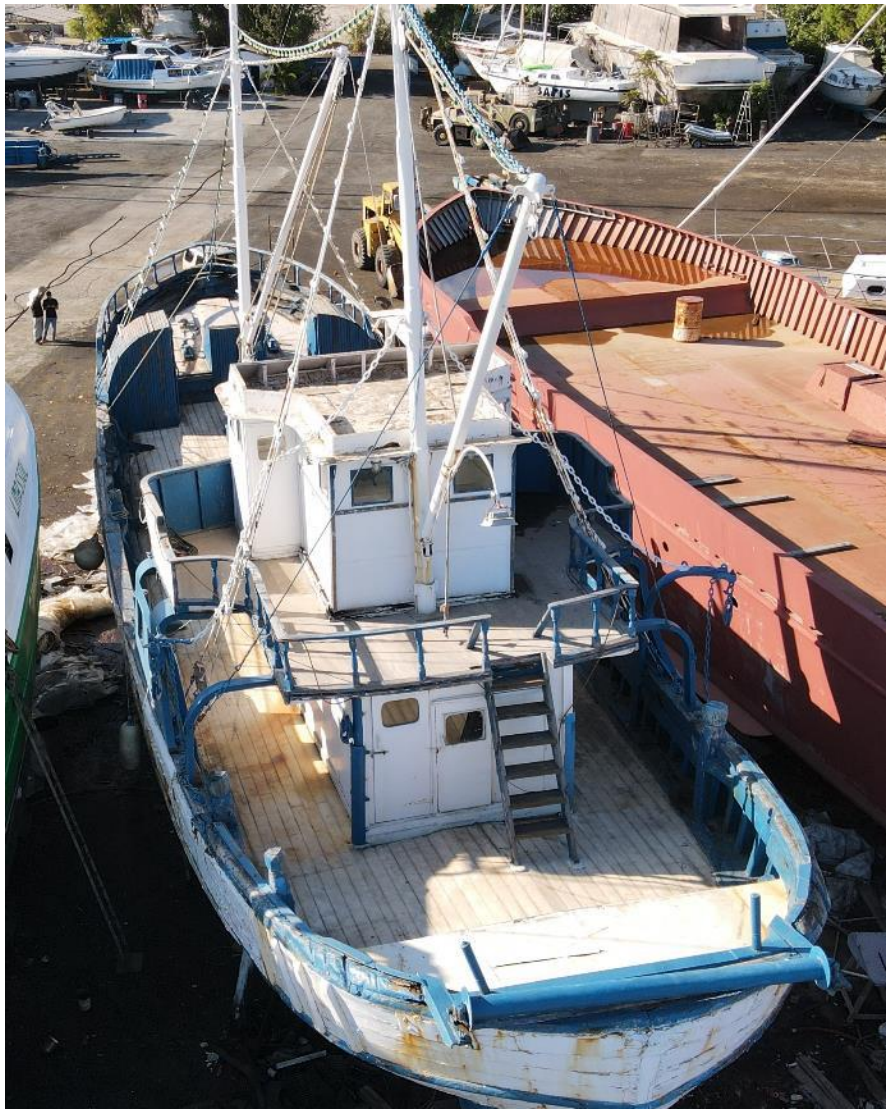


DECAY CONDITION - JANUARY 2023



DECAY CONDITION - JANUARY 2023

DECAY CONDITION - JANUARY 2023



RECONSTRUCTION WORKS - MARCH 2023

Existing Stern Structure in decayed condition

RECONSTRUCTION WORKS - MARCH 2023

Existing Bow Structure in decayed condition

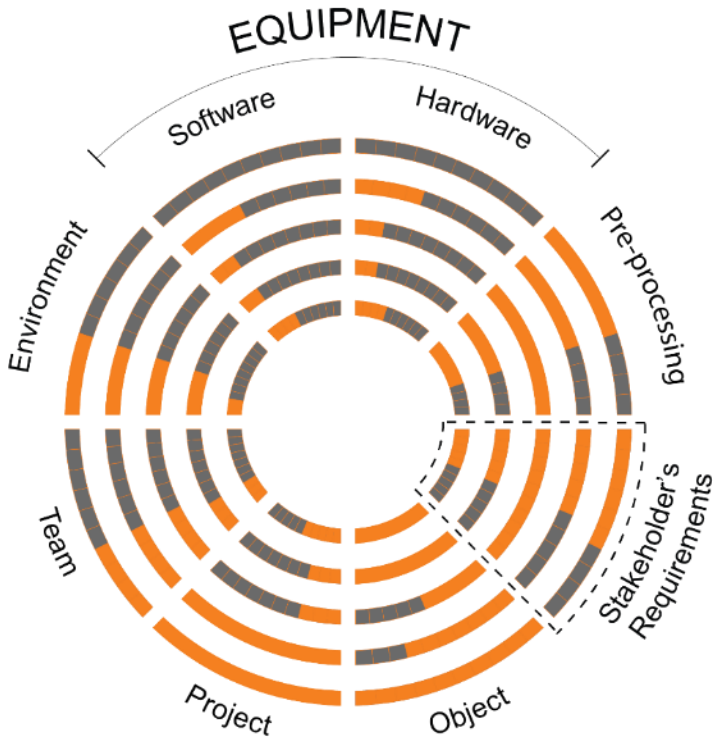
FINALISED RECONSTRUCTION AT KARNAYIO SHIPYARD - MAY 2024

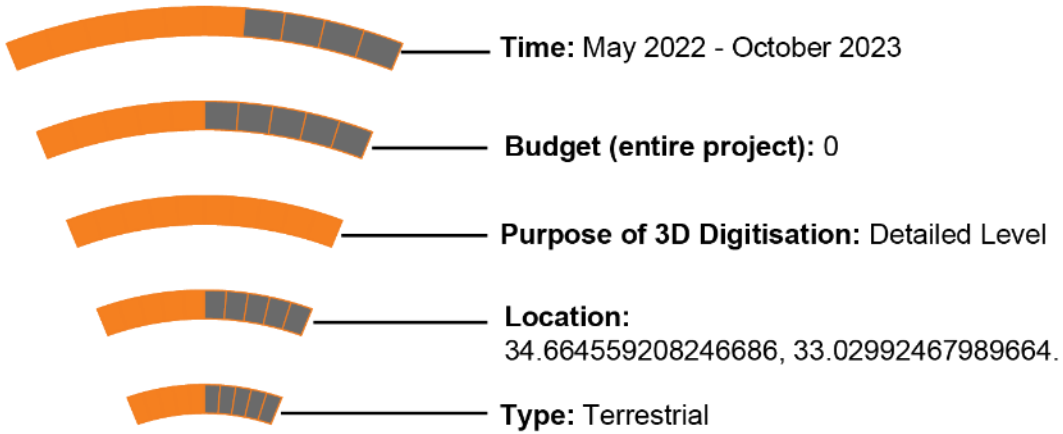
FINALISED RECONSTRUCTION AT KARNAYIO SHIPYARD - MAY 2024

EUREKA3D
European Union's REKonstructed content in 3D

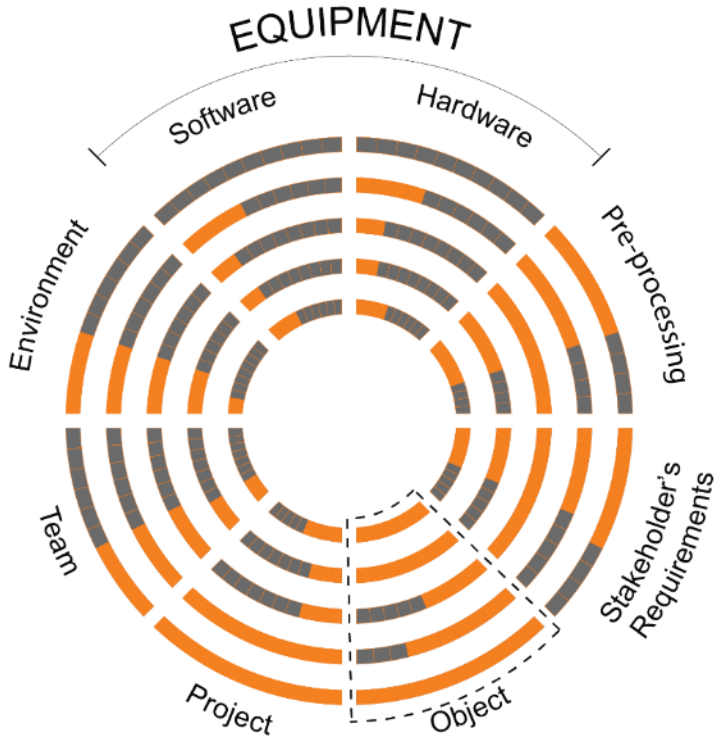
PARADATA

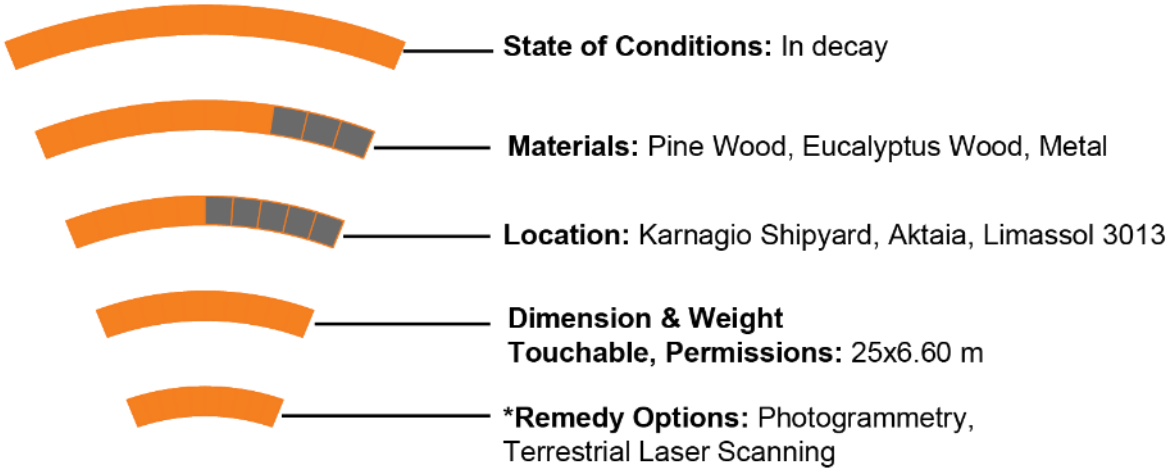
STAKEHOLDER'S REQUIREMENTS





OBJECT





State of Conditions: In decay

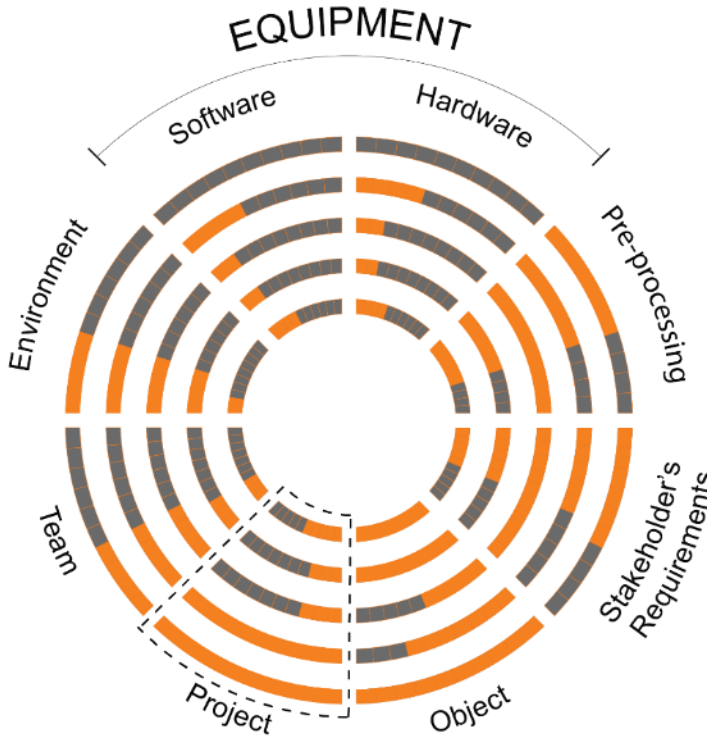
Materials: Pine Wood, Eucalyptus Wood, Metal

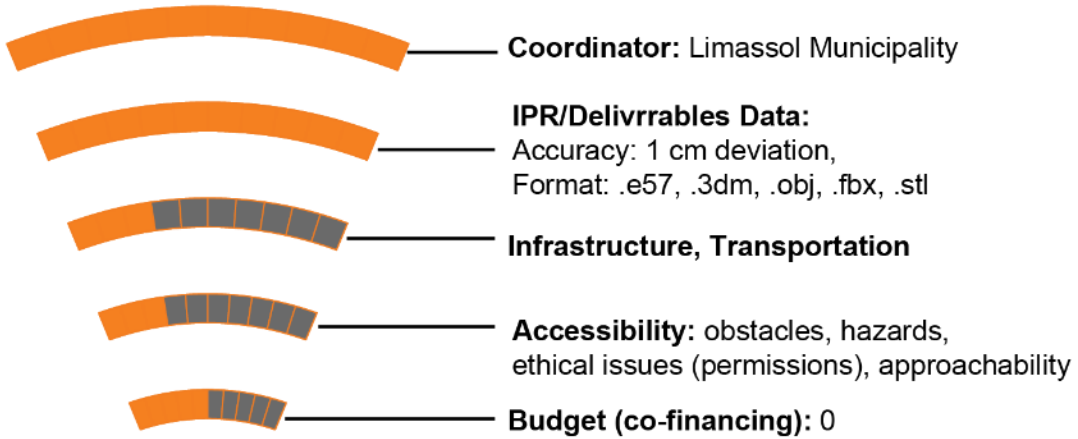
Location: Karnagio Shipyard, Aktaia, Limassol 3013

Dimension & Weight
Touchable, Permissions: 25x6.60 m

***Remedy Options:** Photogrammetry, Terrestrial Laser Scanning

PROJECT





Coordinator: Limassol Municipality

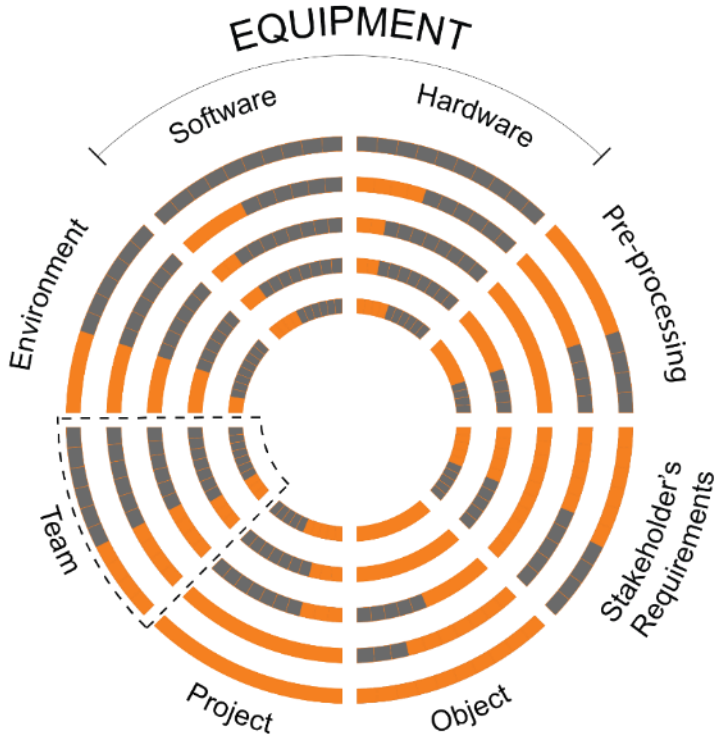
IPR/Delivrrables Data:
Accuracy: 1 cm deviation,
Format: .e57, .3dm, .obj, .fbx, .stl

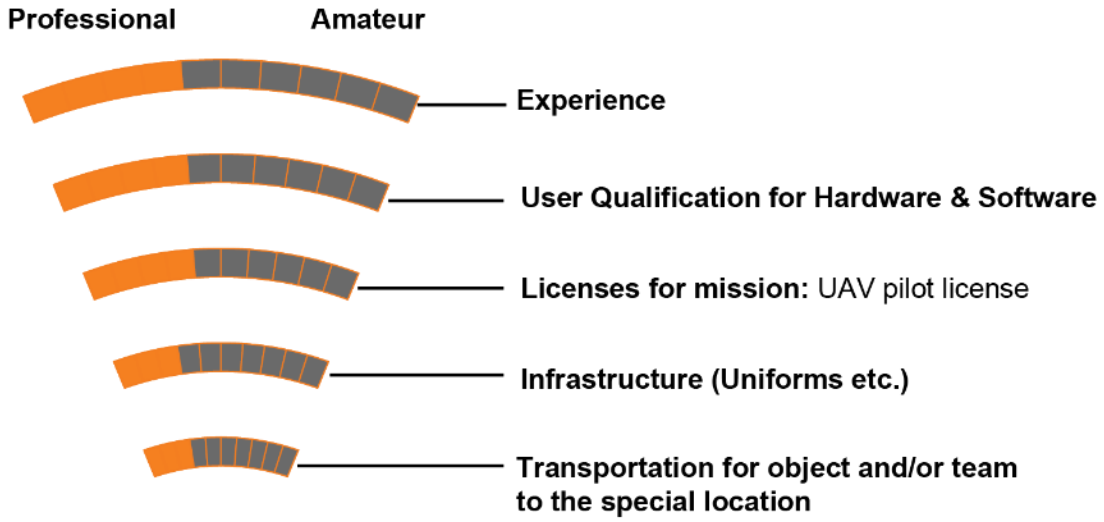
Infrastructure, Transportation

Accessibility: obstacles, hazards,
ethical issues (permissions), approachability

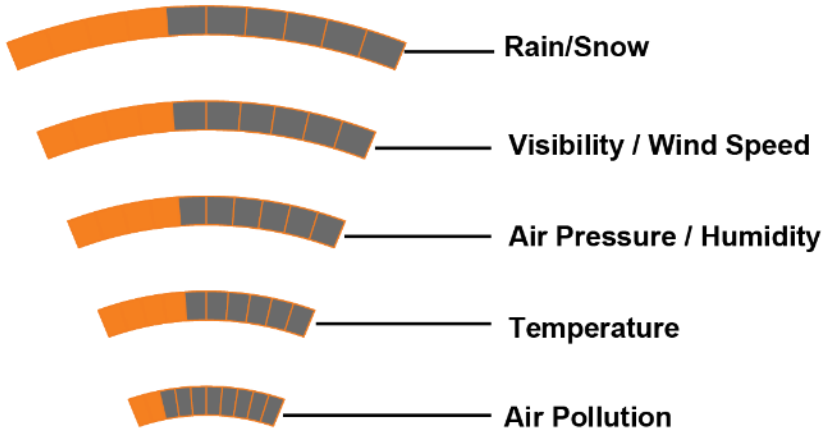
Budget (co-financing): 0

TEAM

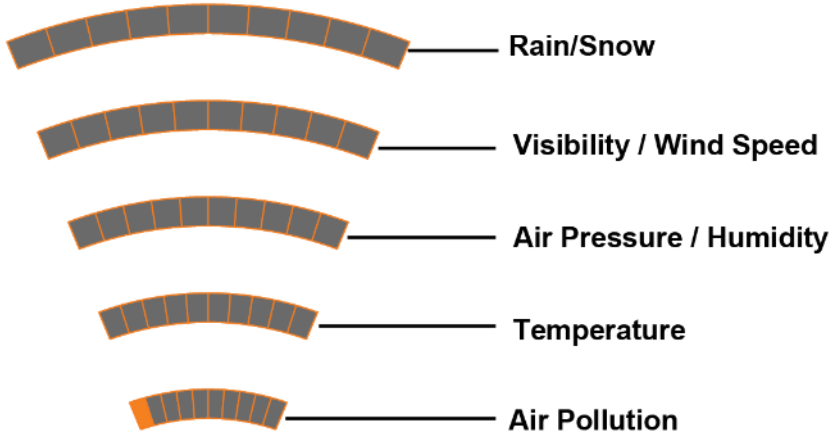

EQUIPMENT
Software
Hardware
Pre-processing
Stakeholder's Requirements
Object
Project
Team
Environment


Professional
Amateur
Experience
User Qualification for Hardware & Software
Licenses for mission: UAV pilot license
Infrastructure (Uniforms etc.)
Transportation for object and/or team to the special location

ENVIRONMENT – UAV PHOTOGRAMMETRIC AND TLS SURVEY



Dates of data acquisition using UAV Photogrammetry: 9-13/1/23



Date of data acquisition using Terrestrial Laser Scanning: 26/10/23

ENVIRONMENTAL CONDITIONS - UAV

9-13 January 2023			
Meteorological Station: Cyprus, Limassol, New Port			
Day	Max. Temperature (°C)	Min. Temperature (°C)	Rain (mm)
9	17.6	8.1	0.0
10	18.1	7.0	0.0
11	18.3	10.6	17.8
12	16.5	10.4	39.7
13	15.5	7.1	3.8

Limassol Traffic Station					
Pollutant	**Date: 9/1/23** Time: 8:00	**Date: 10/1/23** Time: 8:00	**Date: 11/1/23** Time: 8:00	**Date: 12/1/23** Time: 8:00	**Date: 13/1/23** Time: 8:00
PM10	39.9	70	49.4	19.3	19.3
PM2.5	18.3	25.7	17.9	7.4	7.4
O3	4.4	3	13.1	46.1	46.1
NO2	80.7	85.9	81.6	40.2	40.2
SO2	4.5	7.6	3.9	1	1

Meterological Stations in Cyprus:
https://www.moa.gov.cy/moa/dm/dm.nsf/automaticdata_en/automaticdata_en?OpenDocument

Air Pollution in Cyprus:
https://www.airquality.dli.mlsi.gov.cy/

Pollution Level (µg/m³)				
Pollutant	Low (1)	Moderate (2)	High (3)	Very High (4)
PM_{10}	0 - 50	50 - 100	100 - 200	> 200
$PM_{2.5}$	0 - 25	25 - 50	50 - 100	> 100
O_3	0 - 100	100 - 140	140 - 180	> 180
NO_2	0 - 100	100 - 150	150 - 200	> 200
SO_2	0 - 150	150 - 250	250 - 350	> 350
CO	0 - 7000	7000 - 15000	15000 - 20000	> 20000
C_6H_6	0 - 5	5 - 10	10 - 15	> 15

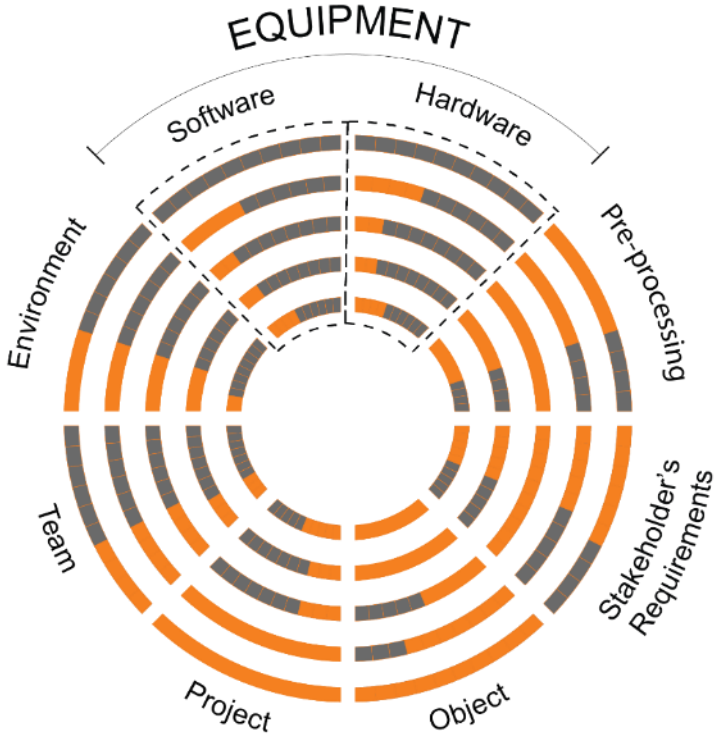
ENVIRONMENTAL CONDITIONS - TLS

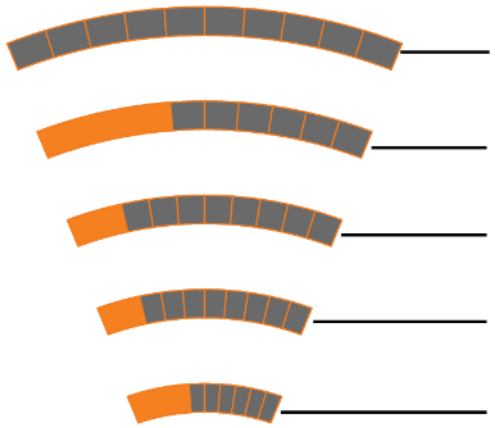
Rain and Temperature		
26 October 2023		
Meteorological Station: Cyprus, Limassol, New Port		
Max. Temperature (°C)	Min. Temperature (°C)	Rain (mm)
28.7	17.8	0.0

Pollution Level (µg/m³)				
Pollutant	Low (1)	Moderate (2)	High (3)	Very High (4)
PM_{10}	0 - 50	50 - 100	100 - 200	> 200
$PM_{2.5}$	0 - 25	25 - 50	50 - 100	> 100
O_3	0 - 100	100 - 140	140 - 180	> 180
NO_2	0 - 100	100 - 150	150 - 200	> 200
SO_2	0 - 150	150 - 250	250 - 350	> 350
CO	0 - 7000	7000 - 15000	15000 - 20000	> 20000
C_6H_6	0 - 5	5 - 10	10 - 15	> 15

Air Pollution	
26 October 2023	
Limassol Traffic Station	
Pollutant	**Date: 9/1/23** Time: 8:00
PM10	39.9
PM2.5	18.3
O3	4.4
NO2	80.7
SO2	4.5

SOFTWARE & HARDWARE





Licence for Hardware to be Used
(i.e. frequencies,interferences with other systems)

Precision of multisensor system under
different environment conditions

Usability-Comunication/Transfer of Data /
Batterry / Available Storage

Efficiency-Speed of Data Acquisition in relation
to Software & Hardware-Accuracy (Byte Resolution)

Sensor

PHOTOGRAMMETRY HARDWARE

Aerial and Terrestrial Photogrammetry
DJI Mini 3 pro
and
Sony A7 IV Mirrorless Camera

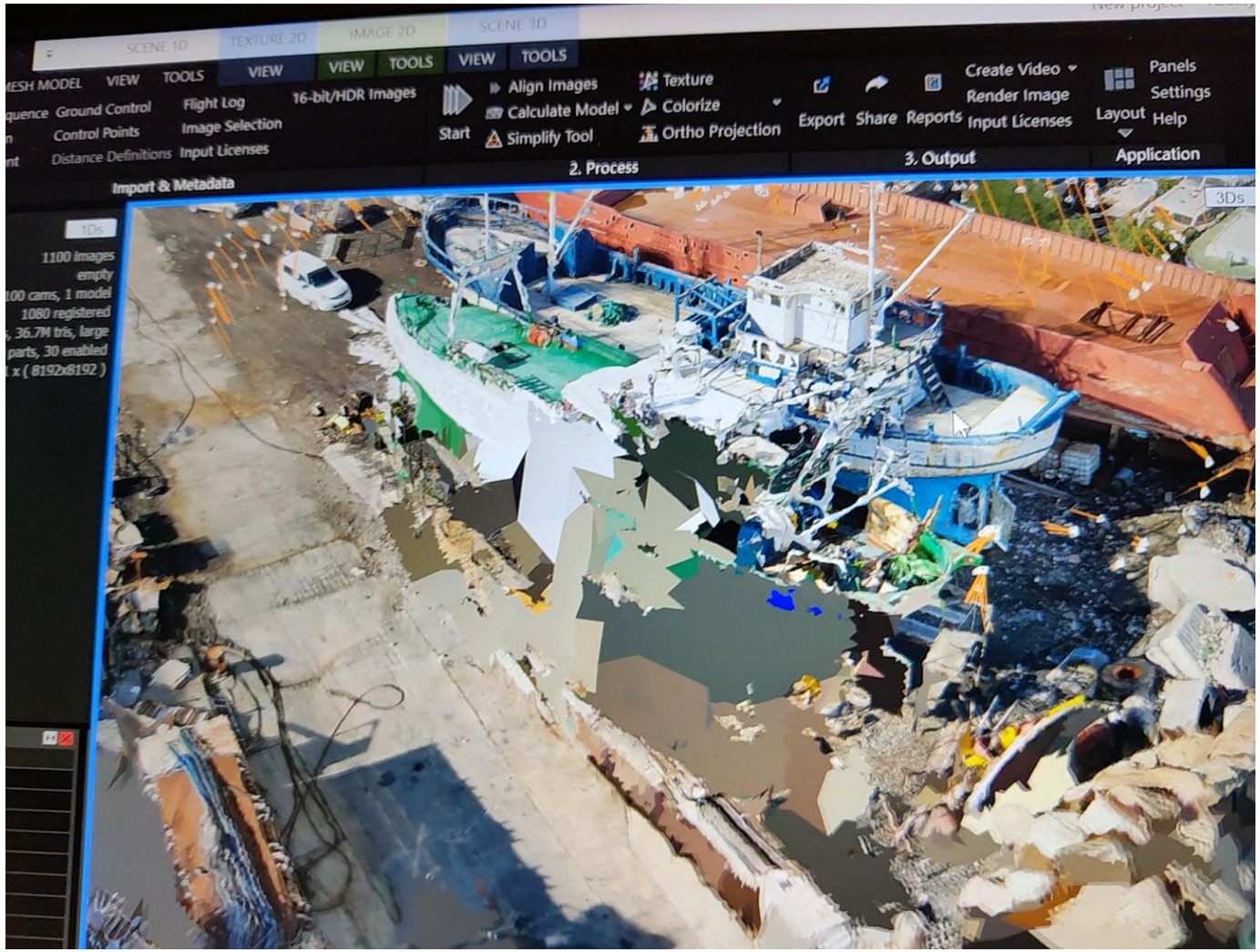
DJI Mini 3 pro	
Weight	<249 g
Obstacle Sensing	Yes
GNSS	GPS + Galileo + BeiDou
Internal Storage	-
Operating Environment	-10° to 40° C
Video Transmission	8 Km
Video Format	MP4/MOV (H.264/H.265)
Photo Format	JPEG/DNG (RAW)
Sensor	1/1.3-inch CMOS
Effective Pixels	48 MP
Camera Type	4K: 3840×2160@24/25/30/48/50/60fps
Flight Time	34 mins (with Intelligent Flight Battery) and 47 mins (with Intelligent Flight Battery Plus
ISO Rnge	Video: 100-6400 (Auto), 100-6400 (Manual) Photo: 100-6400 (Auto), 100-6400 (Manual)
Shutter Speed	Electronic Shutter: 2-1/8000 s

Sony A7 IV Mirrorless Camera	
Mirrorless/DSLR	Mirrorless
Sensor Type	CMOS
Sensor Manufacturer	Sony
Effective Megapixels (millions)	33 megapixels
Total Pixels	34.1
Pixel Size	5.12µm
Max Resolution	7008 x 4672
Sensor Format	33 MP full-frame (35.9 x 24.0mm) BSI Exmor R CMOS sensor
Sensor Size	35.6 x 23.8 mm
Lens Mount	Sony E
ISO Sensitivity	Stills: ISO 100-51,200 (expandable to ISO 50 to ISO 204,800) Video: ISO ISO 100-51,200 (expandable to ISO 100-102,400)
Image Processor	BIONZ XR
Shutter Speed	Still images: 1/8000 to 30 s, Bulb, Movies (NTSC mode): 1/8000 to 1/4 (1/3 steps), up to 1/60 in AUTO mode (up to 1/30 in Auto slow shutter mode), Movies (PAL mode): 1/8000 to 1/4 (1/3 steps), up to 1/50 in AUTO mode (up to 1/25 in Auto slow shutter mode)
Exposure Compensation	±5 (at 1/3 EV, 1/2 EV steps)
Focal Length Multiplier	1×
Storage Media	One CFexpress Type A/UHS-II SD, One UHS-II SD
Autofocus System	Hybrid AF with 759 phase detection points and 425 contrast detection points, Still images: Human (Right/Left Eye Select) / Animal (Right/Left Eye Select) / Bird, Movie: Human (Right/Left Eye Select), sensitive down to -4EV
Focus Points	759
Wireless Features	Wi-Fi (2.4 and 5 GHz, IEEE 802.11a/b/g/n/ac), Bluetooth 4.1
GPS	Can be synchronized with connected mobile device
Operating Environment	32–104°F / 0–40°C

PHOTOGRAMMETRY PROCESSING SOFTWARE

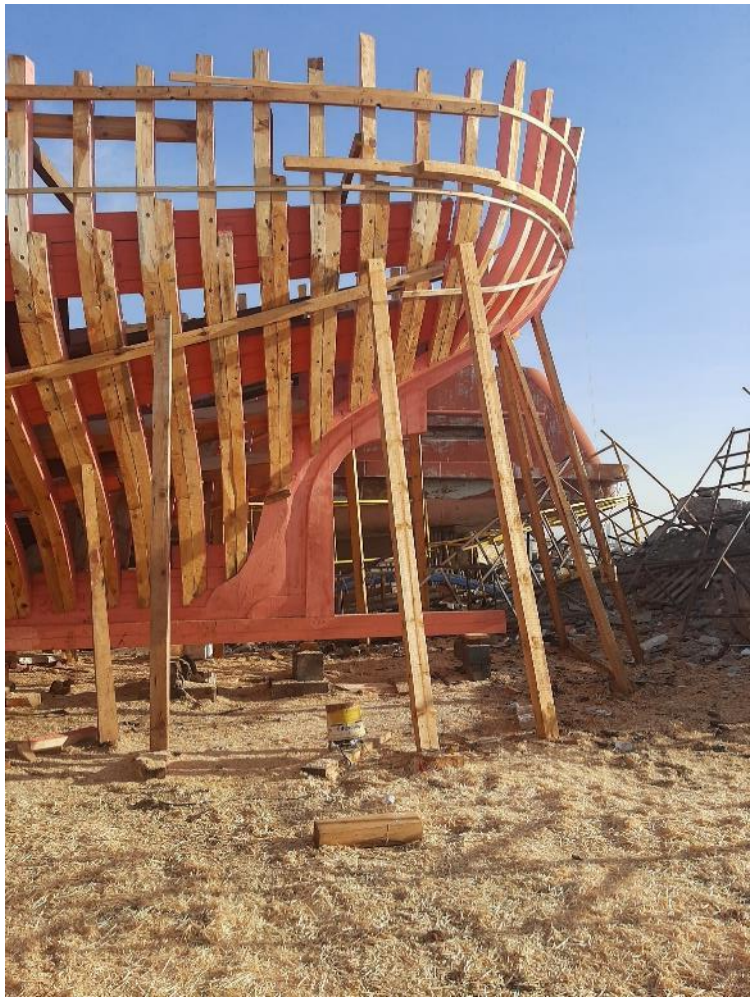
Reality Capture
1.2.2 Tarasque

Raw data
1100 Images
Image Format: JPG
Resolution of each image:
4000 X 2250 px



RECONSTRUCTION WORKS – OCTOBER 2023

RECONSTRUCTION WORKS – OCTOBER 2023



Reconstructed Stern (Side Elevation)

Reconstructed Stern (Back Elevation)

TLS HARDWARE: Z+F IMAGER 5016

blue workflow®

Real-time registration on-site

Data and target verification

Multi-scanner support

Laser system

Laser class: 1

Beam diameter / divergence: ~ 3.5 mm @ 1m / ~ 0.3 mrad (1/e2, half angle)

Measurement range: 0.3 m ... 365 m (ambiguity interval)

Range resolution: 0.1 mm

Data acquisition rate: Max. 1.1 million pixel/sec.

Linearity error: ≤ 1 mm + 10 ppm/m

Range noise: 0,25 mm rms

HDR camera

Type: HDR, automatic, up to 11 exposures

Recording time: approx. 2 min, parallax free

Focus area: 1m - ∞

Panorama resolution: ca. 80 MPixel

Illumination system: integrated LED spotlights, 700 lm

Deflection unit

Deflection system: completely encapsulated rotating mirror with integrated HDR camera and LED spots

Vertical field of view: 320°, Horizontal field of view: 360°

Angular resolution, vertical: 0.00026° (0.93 arcsec)

Angular resolution, horizontal: 0.00018° (0.65 arcsec)

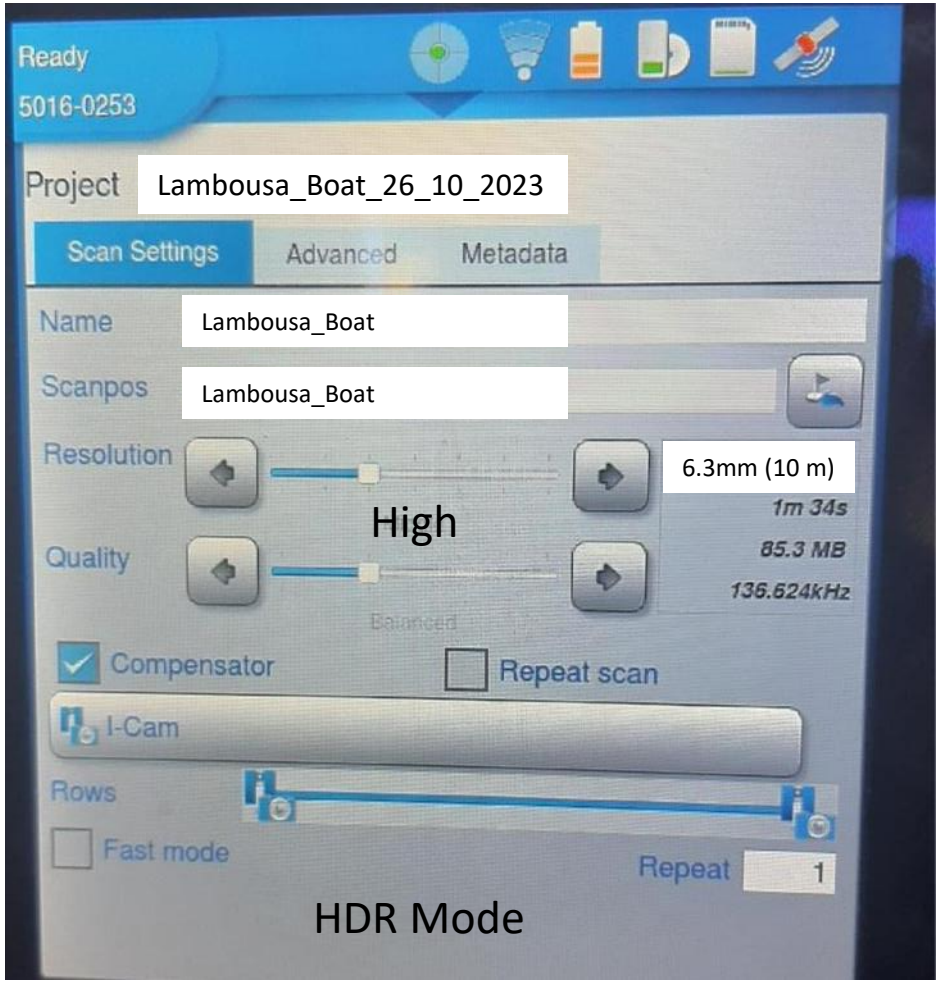
Vertical accuracy: 0.004° (14.4 arcsec) rms

Horizontal accuracy: 0.004° (14.4 arcsec) rms

Rotation speed: max. 55 rps (3,280 rpm)

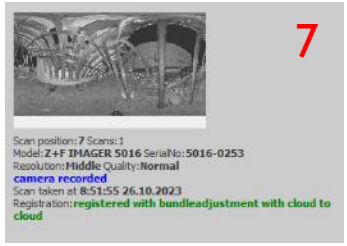
TLS SETTINGS

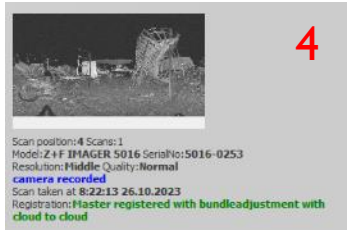
High Resolution Settings

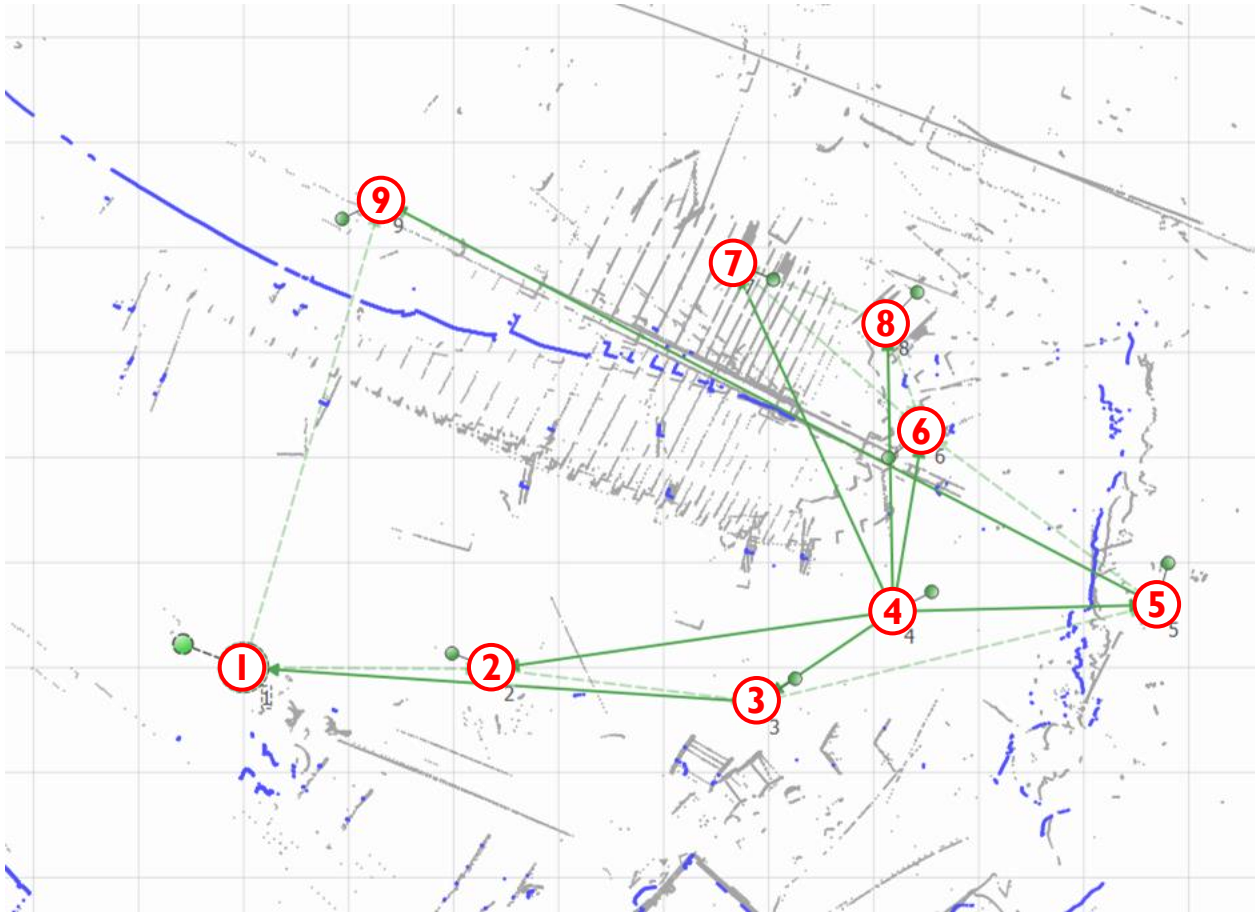


Medium Resolution Settings

Z+F LASER CONTROL SOFTWARE – SCANNING POSITIONS

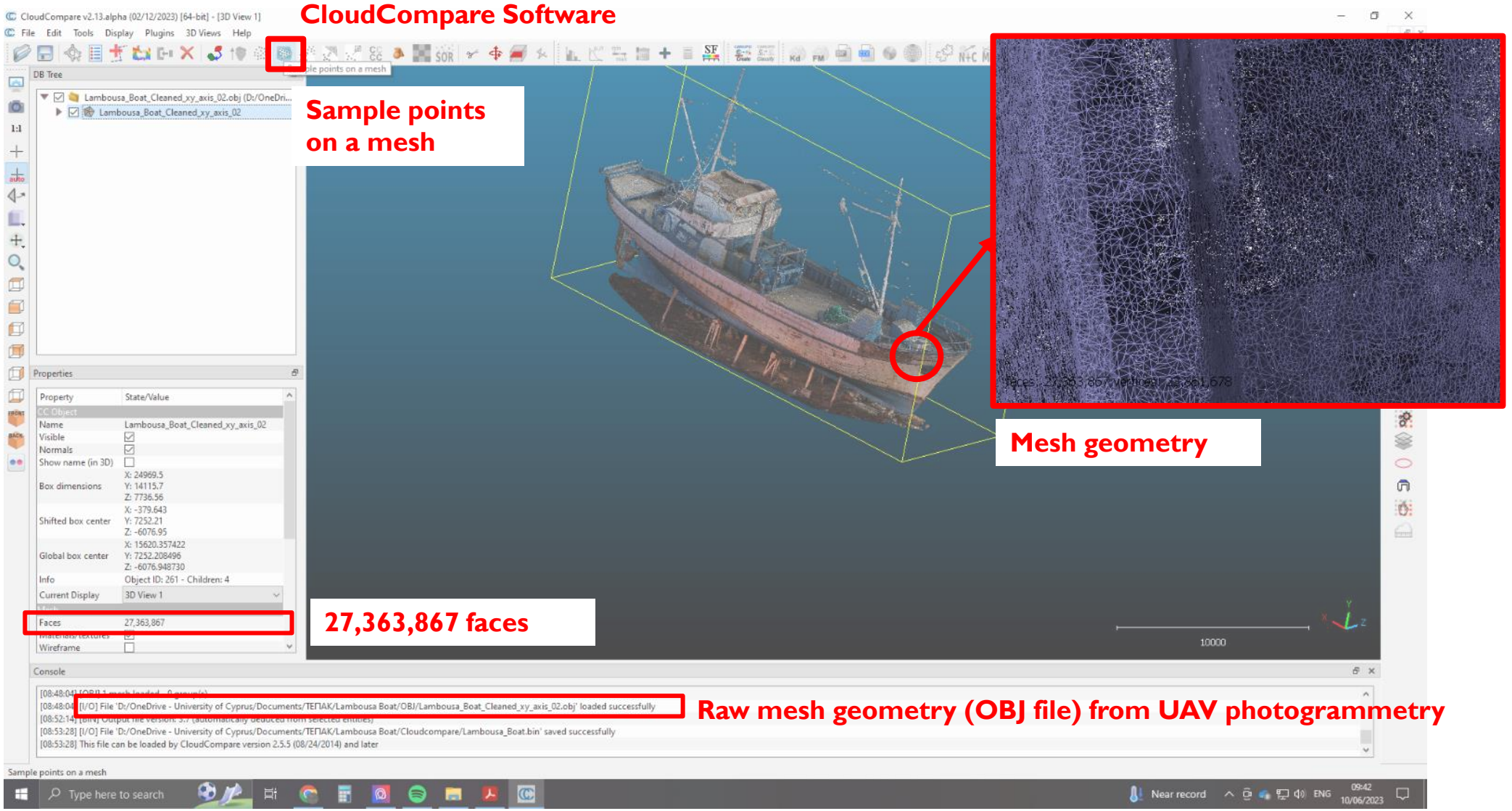




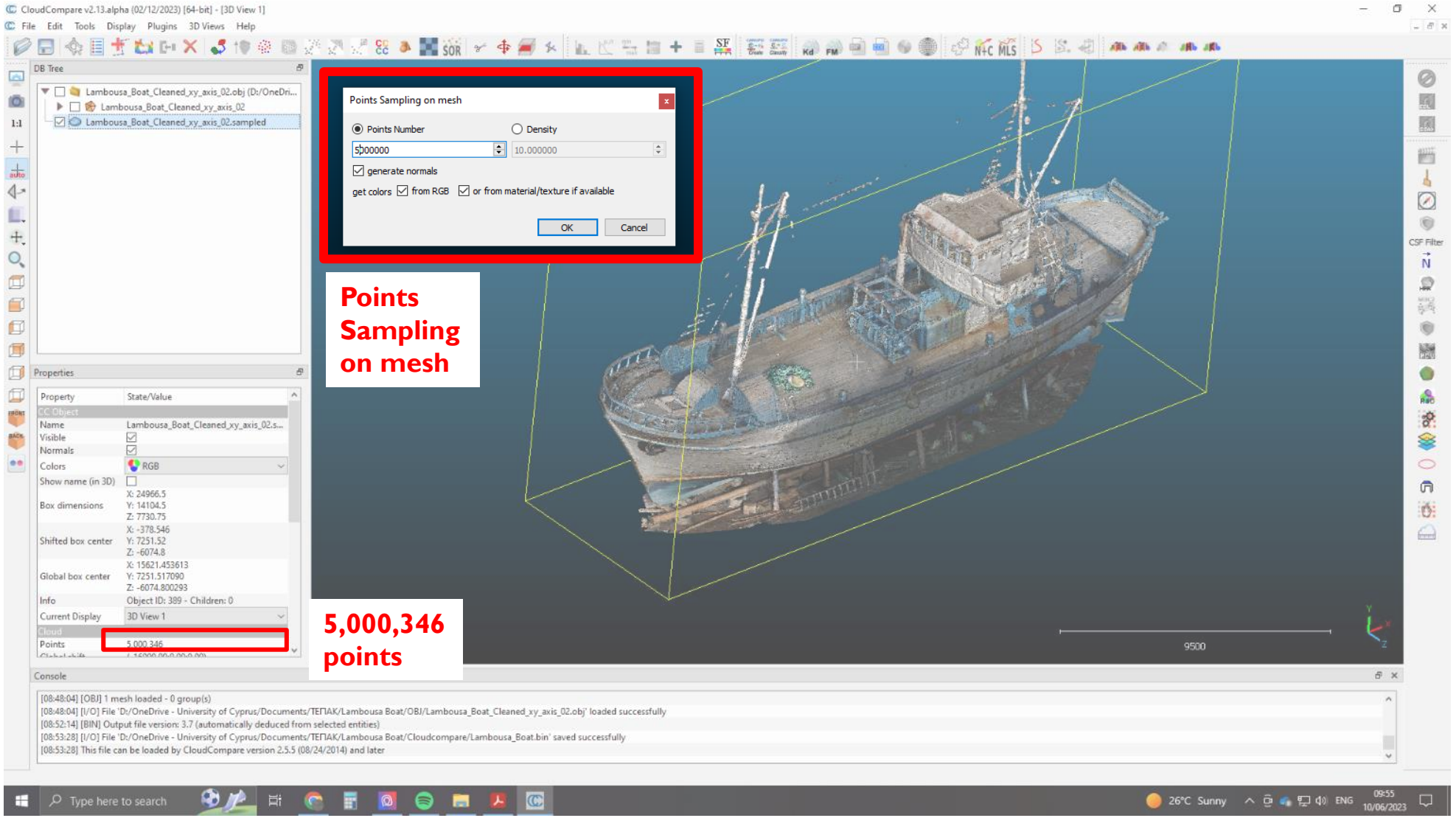


FROM POINT CLOUD DATA TO 3D MODELLING

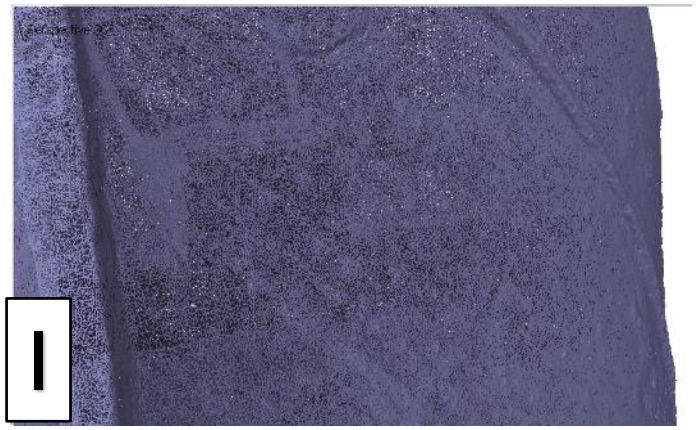
POINT CLOUD PROCESSING (CLOUDCOMPARE)



POINT CLOUD PROCESSING (CLOUDCOMPARE)



FROM POINT CLOUD DATA TO 3D MODEL (RHINO 7)



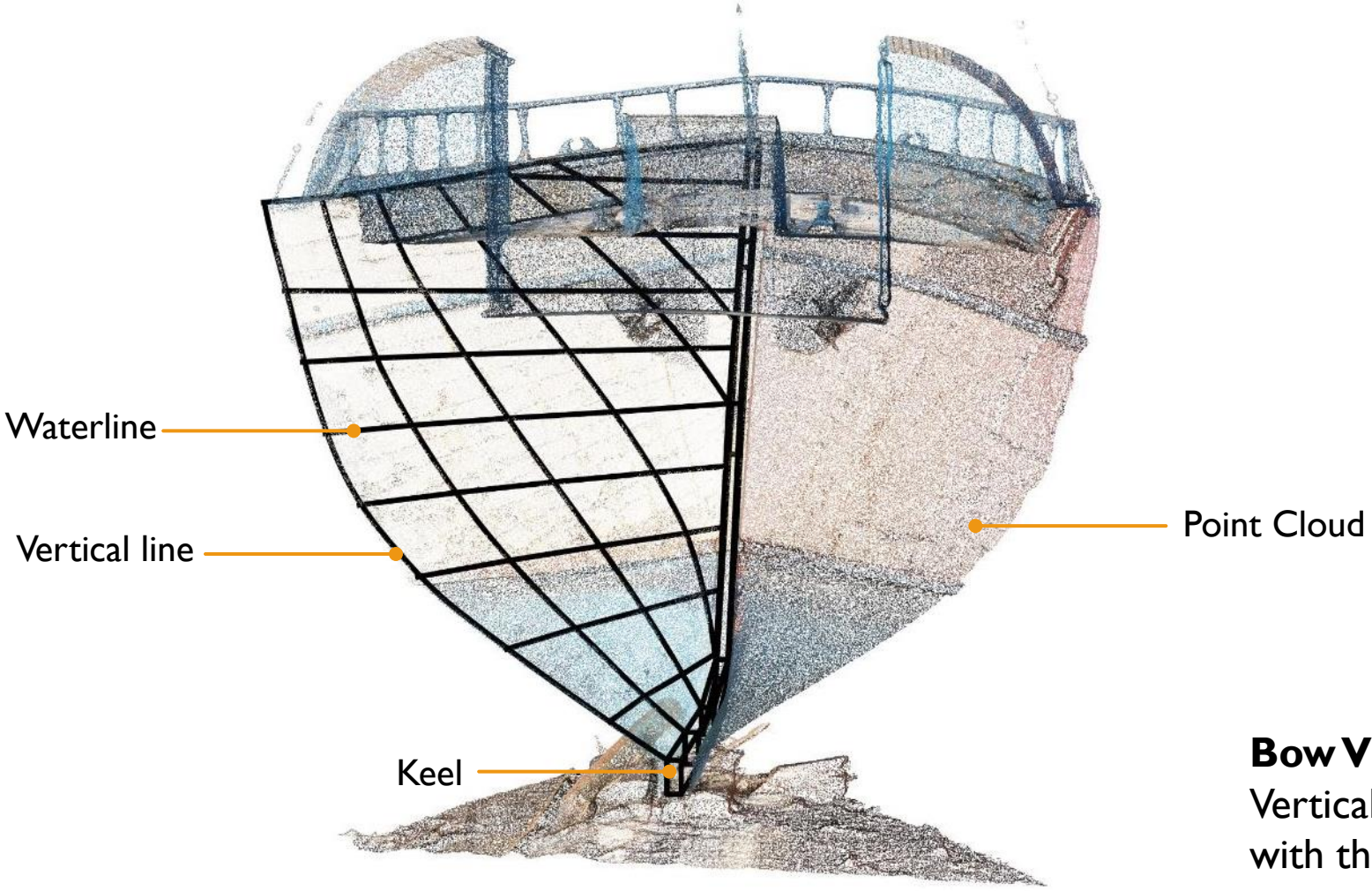
Mesh Geometry from photogrammetry

Downsampled Point Cloud

3D geometry produced in Rhino compared to point cloud (Shaded view)

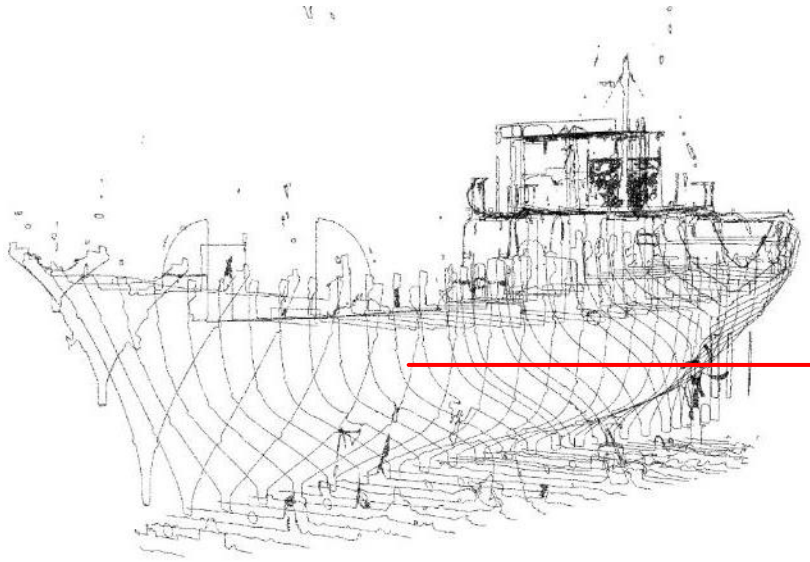
3D geometry produced in Rhino compared to point cloud (Rendered view)

Point cloud processing (Rhino)

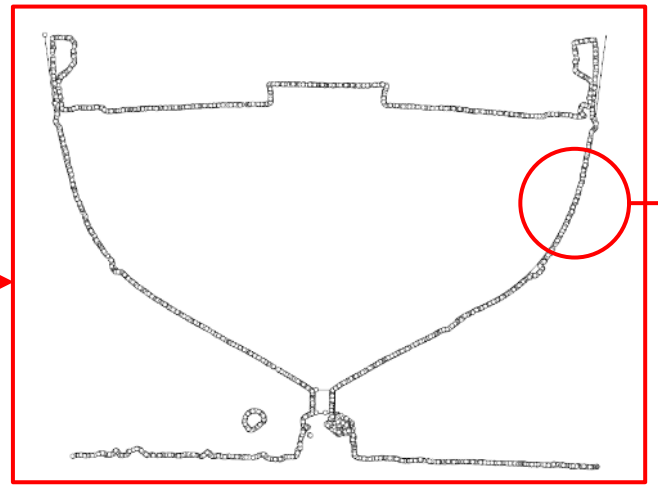


Bow View: Waterline and Vertical line NURBS aligned with the point cloud

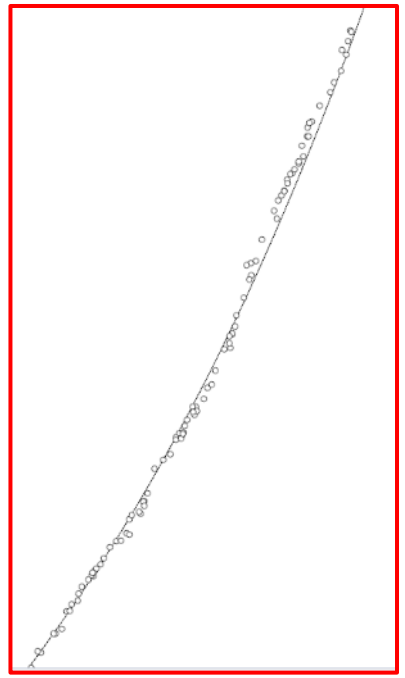
FROM POINT CLOUD DATA TO 3D MODEL (RHINO 7)



Vertical Cloud Sections (in the form of 3D set of XYZ coordinates)

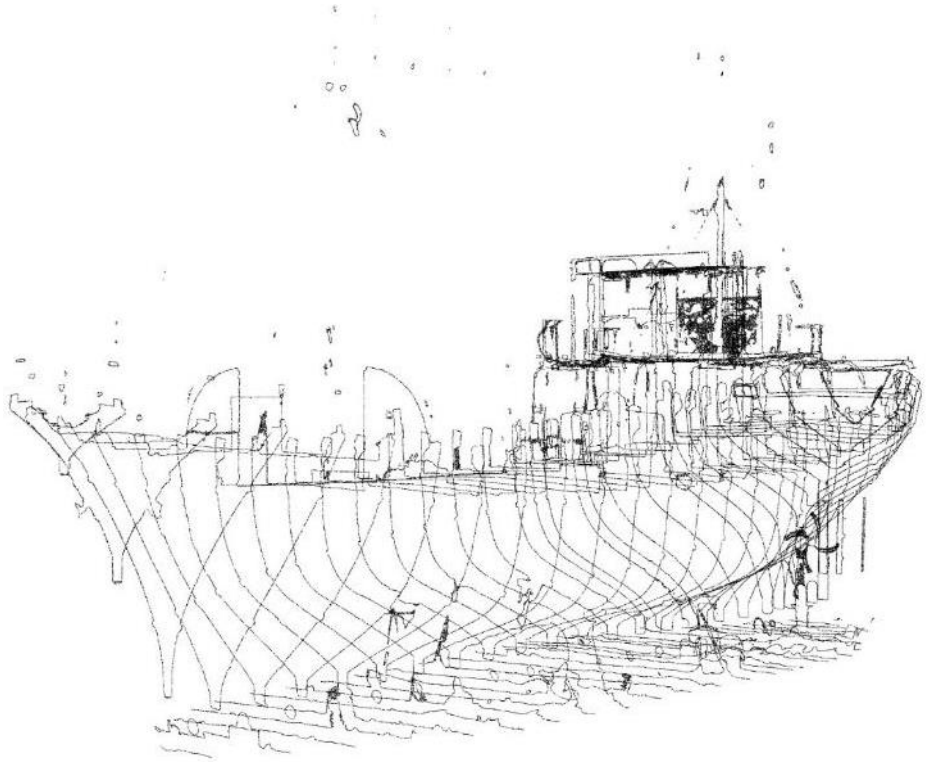


Points from a vertical line: Cross Section View

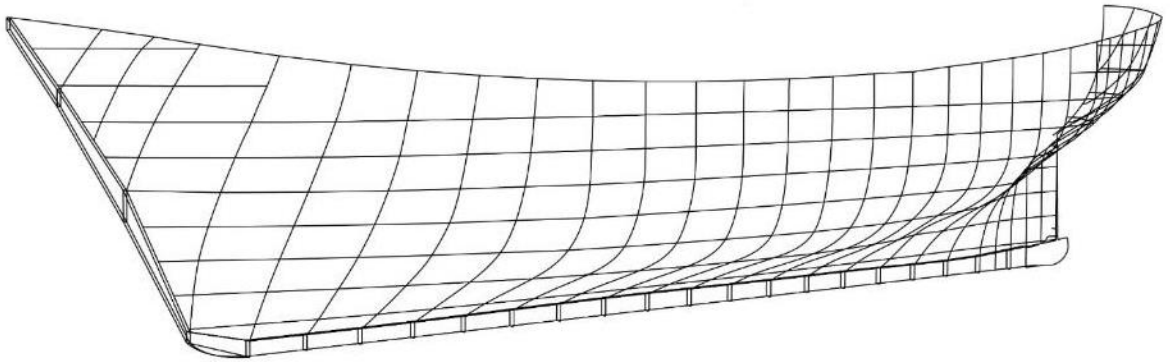


Non-**U**niform **R**ational **B**asis **S**pline **(NURBS)** curve creation based on points

FROM POINT CLOUD DATA TO 3D MODEL (RHINO 7)

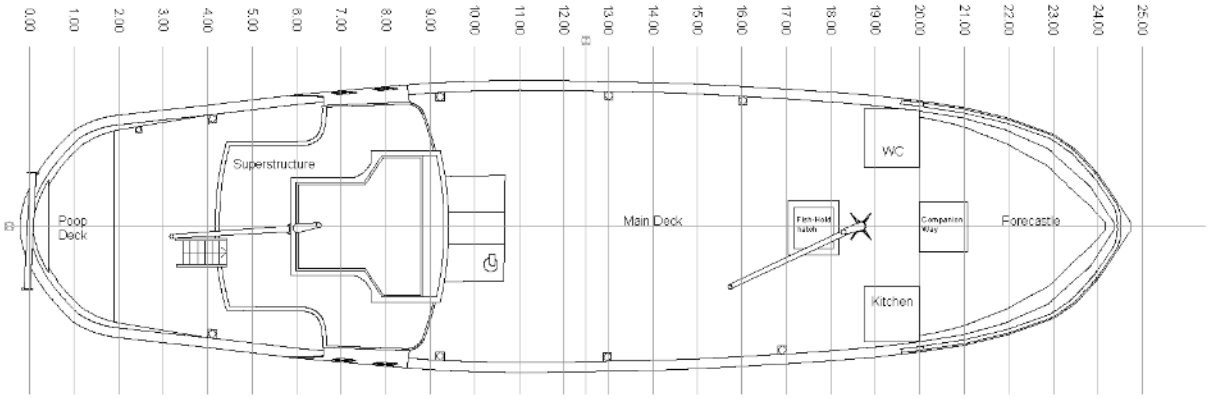


Vertical Cloud Sections (in the form of 3D set of XYZ coordinates)

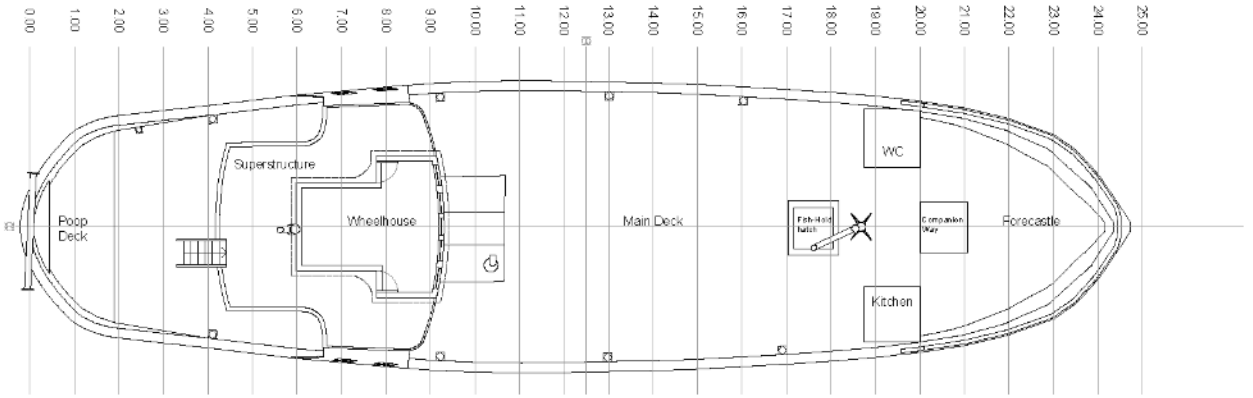


Waterline and Vertical NURBS of the Hull from Cloud Sections

PLANS

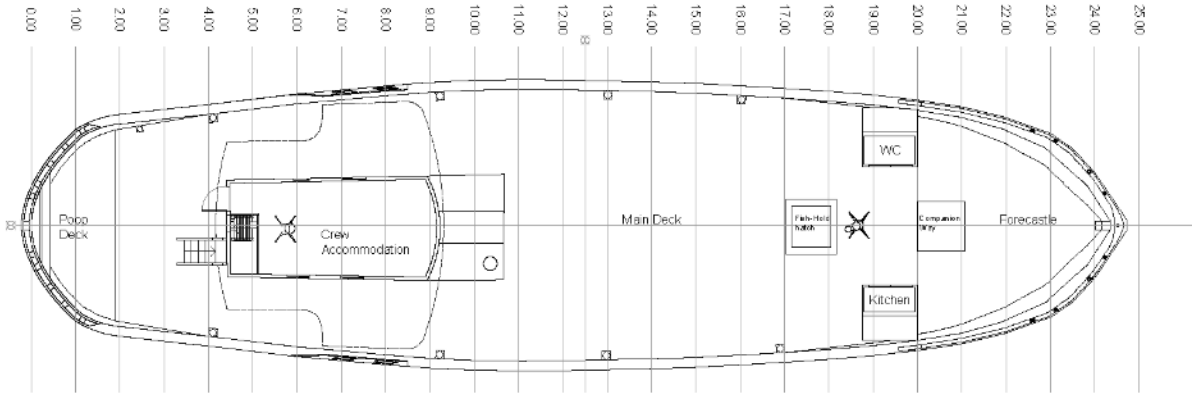


Top View

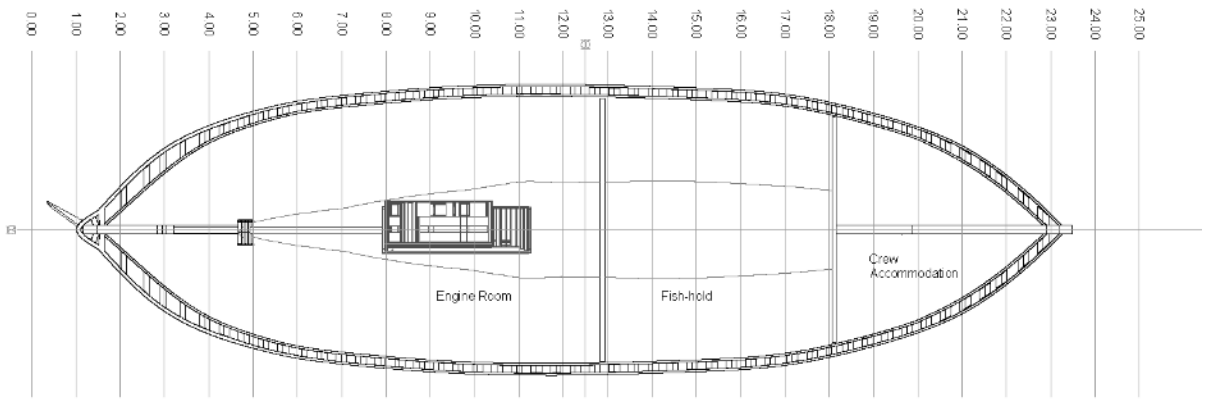


Plan View of Upper Deck - Level 6.60m

PLANS

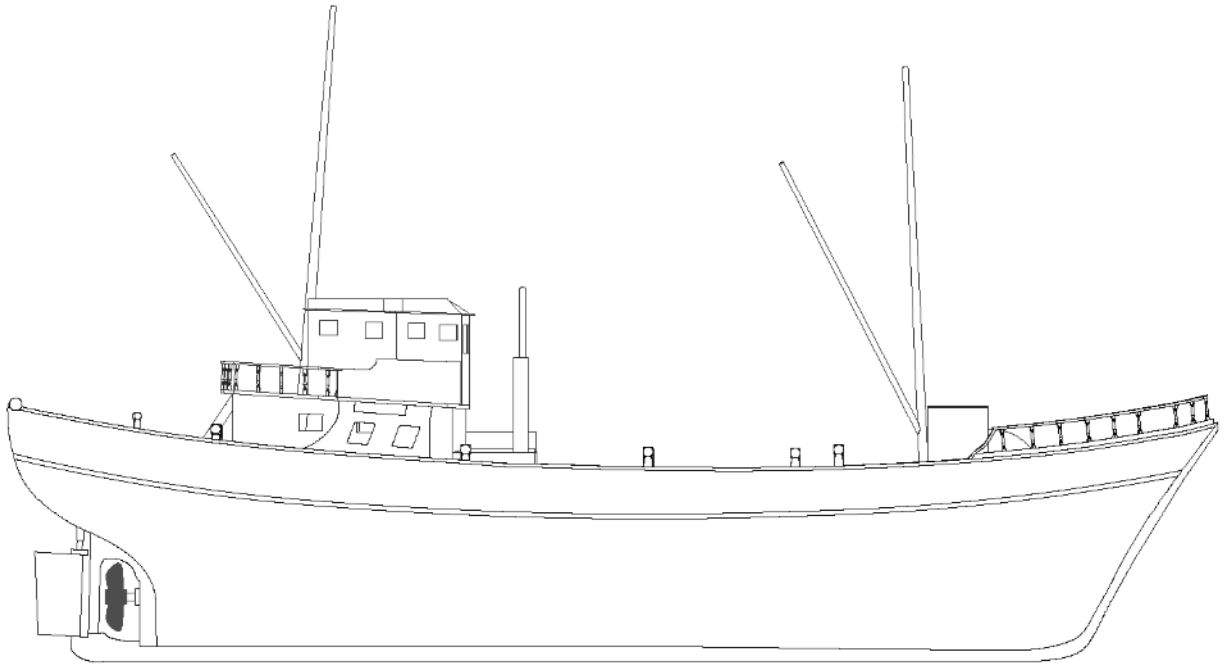


Plan View of Main Deck - Level 5.00m

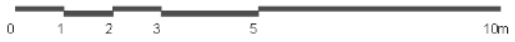


Plan View of Engine Room and Fish-Hold - Level 2.90m

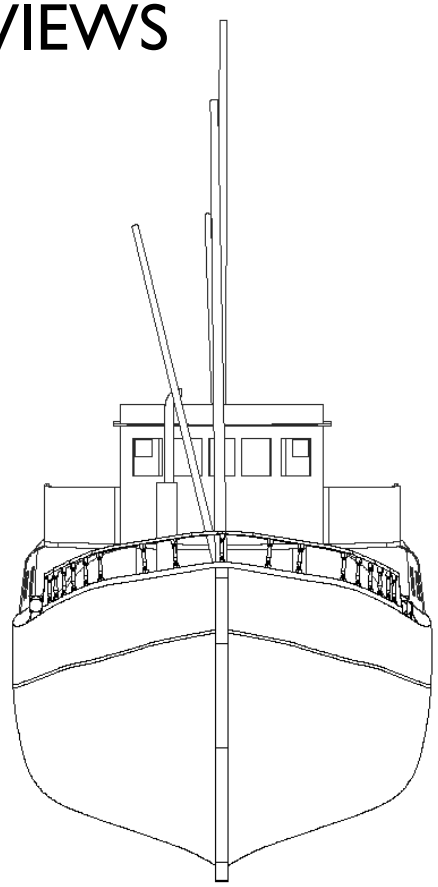
PROFILE VIEW



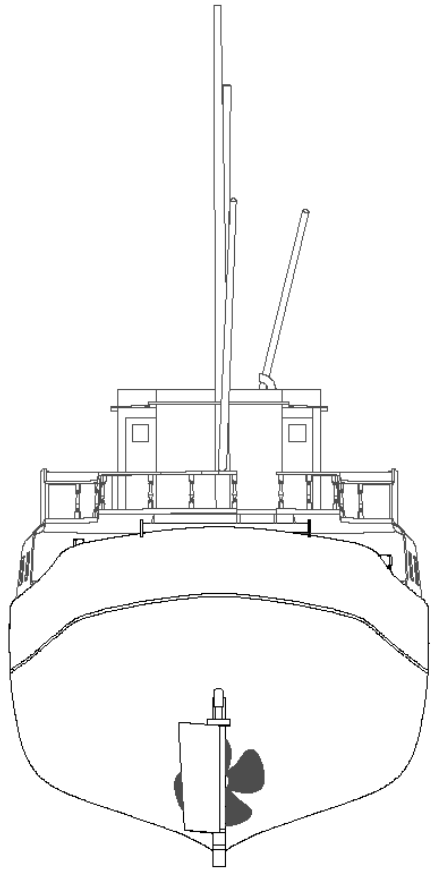
Profile



BOW AND STERN VIEWS

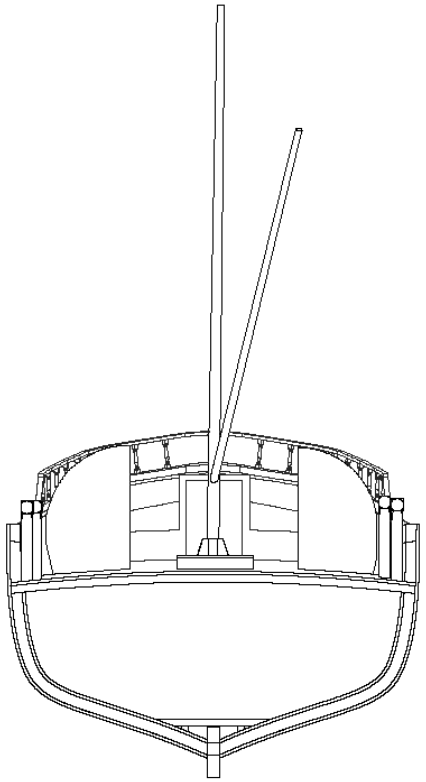


Bow View

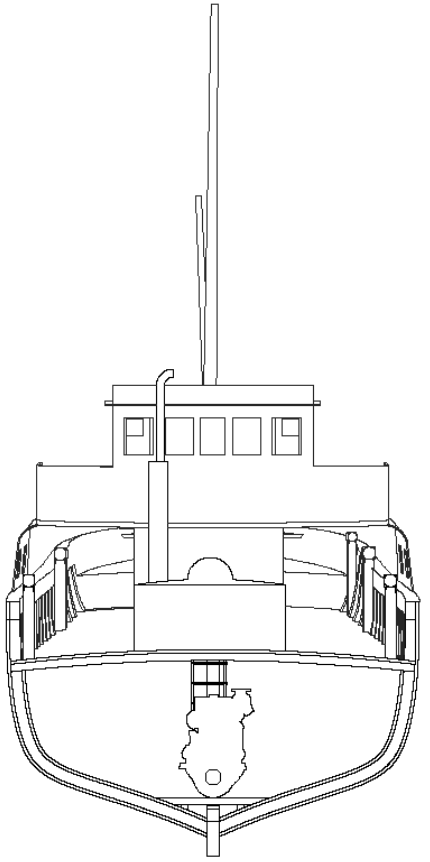


Stern View

CROSS SECTIONS



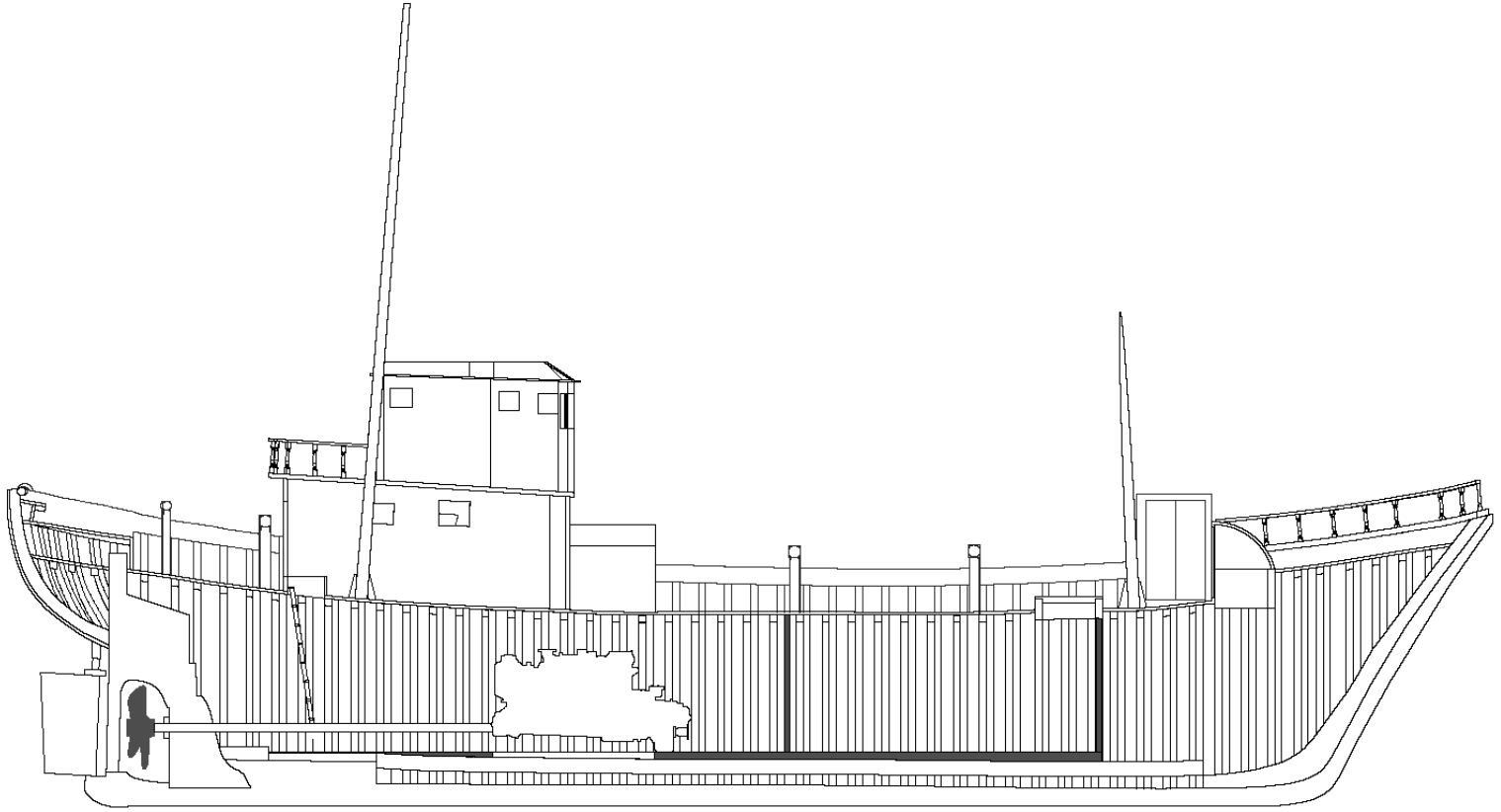
Cross Section (Bow)



Cross Section (Stern)

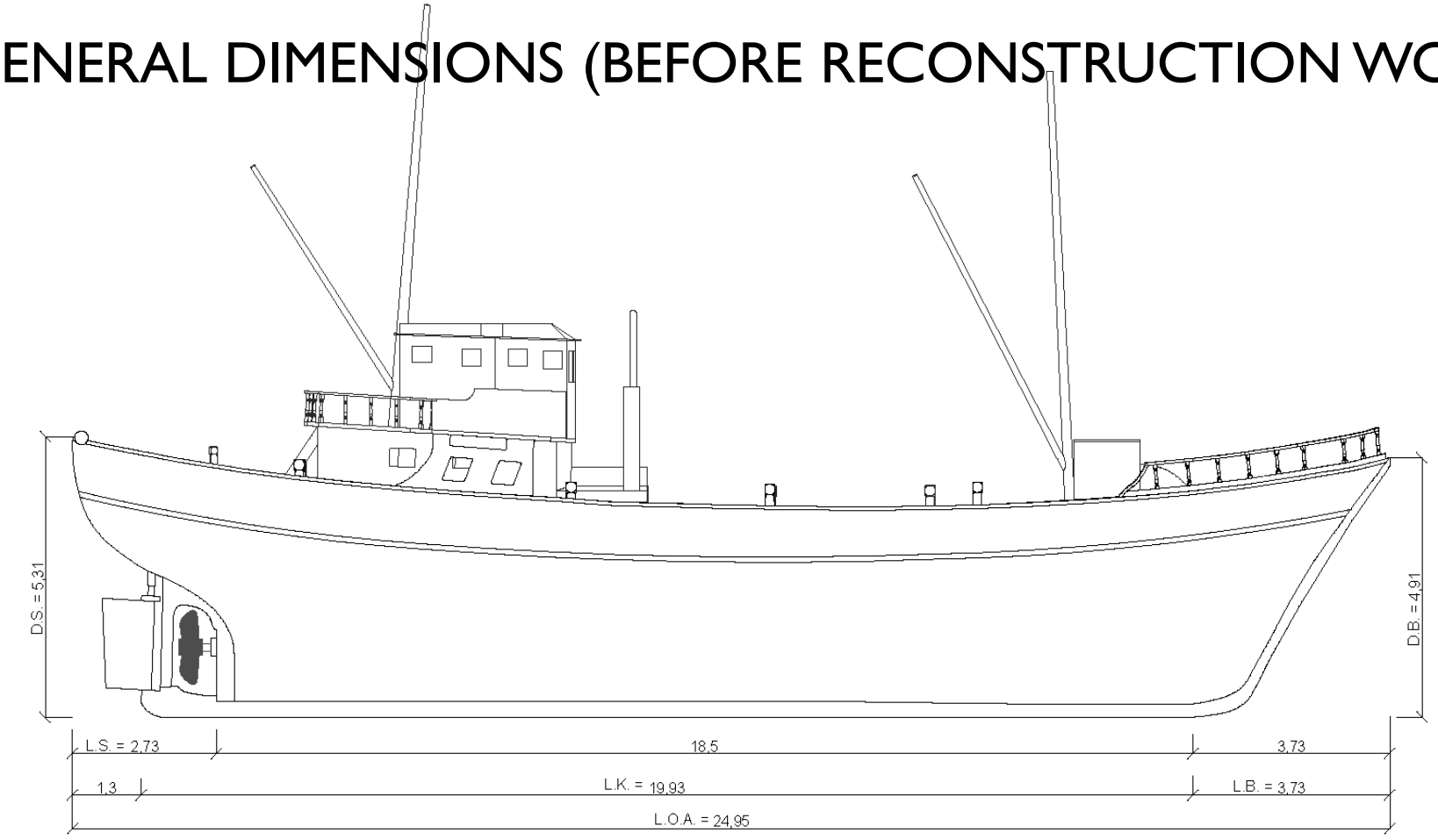
0 1 2 3 5 10m

LONGITUDINAL SECTION

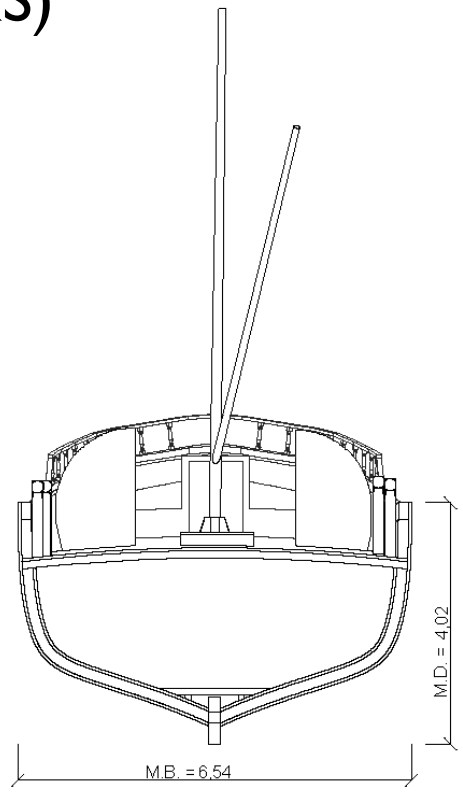


Longitudinal Section

GENERAL DIMENSIONS (BEFORE RECONSTRUCTION WORKS)



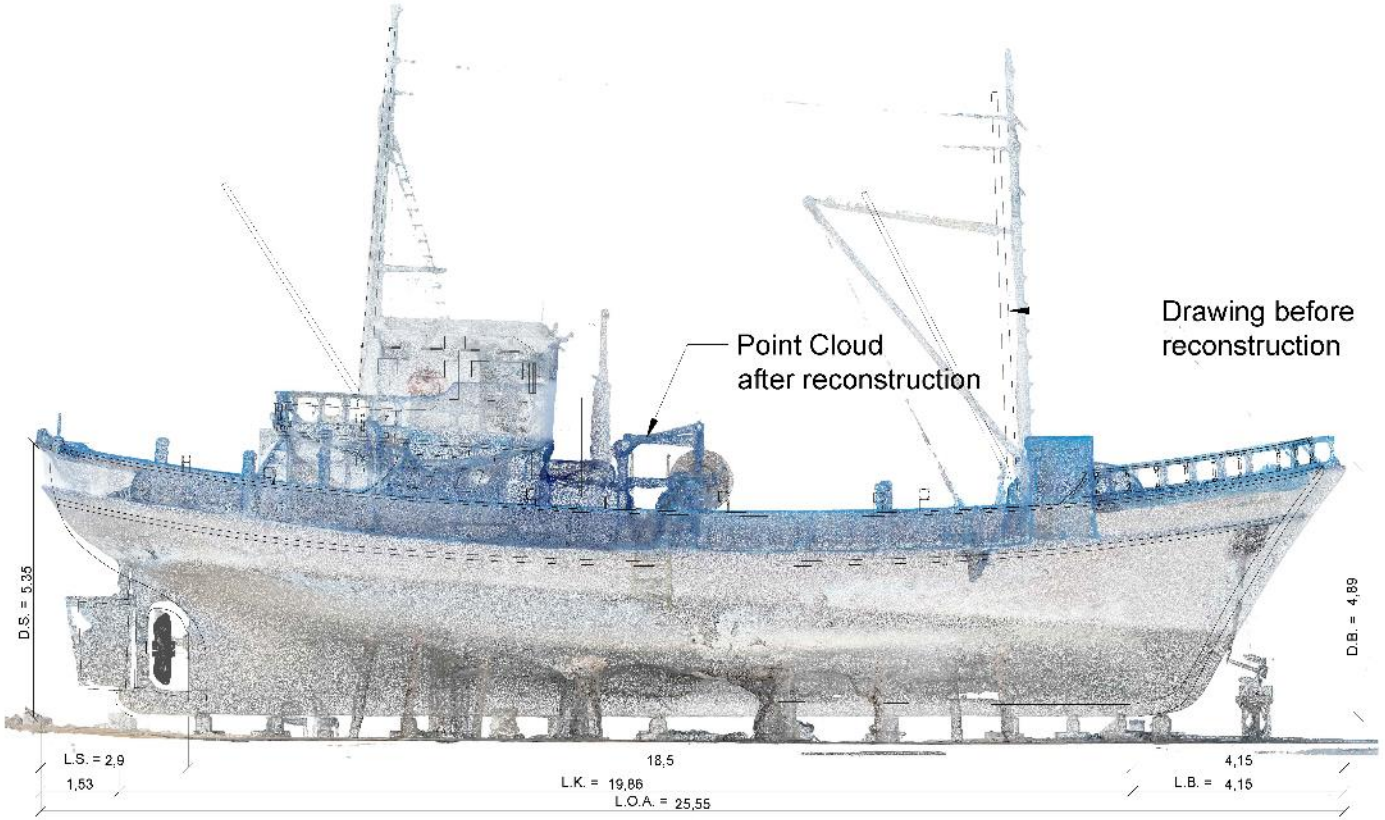
Profile



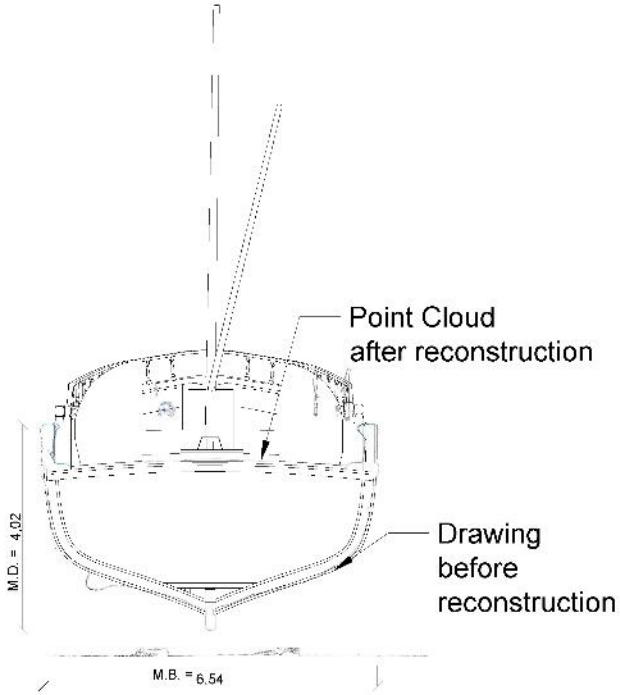
Cross Section (Bow)

L.O.A. = Length Over All
L.K. = Length of the Keel
M.B. = Maximum Breadth
M.D. = Maximum Depth
L.B. = Length of Bow
L.S. = Length of Stern
D.B. = Depth of Bow
D.S. = Depth of Stern

GENERAL DIMENSIONS (AFTER RECONSTRUCTION WORKS)



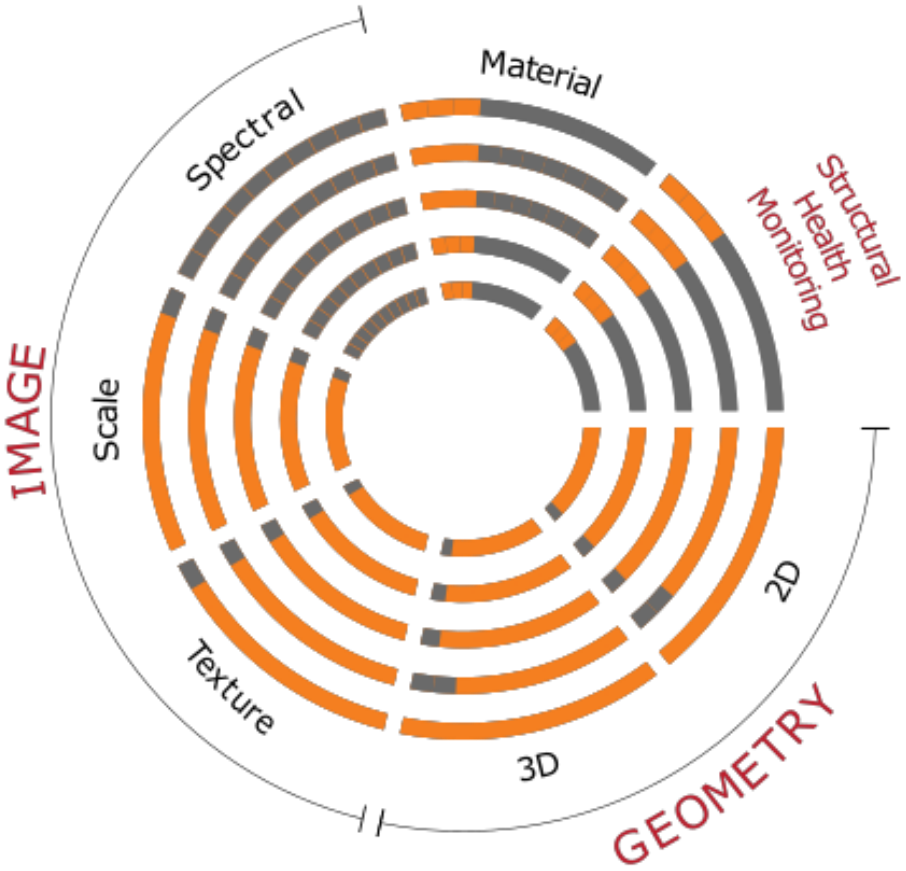
Profile

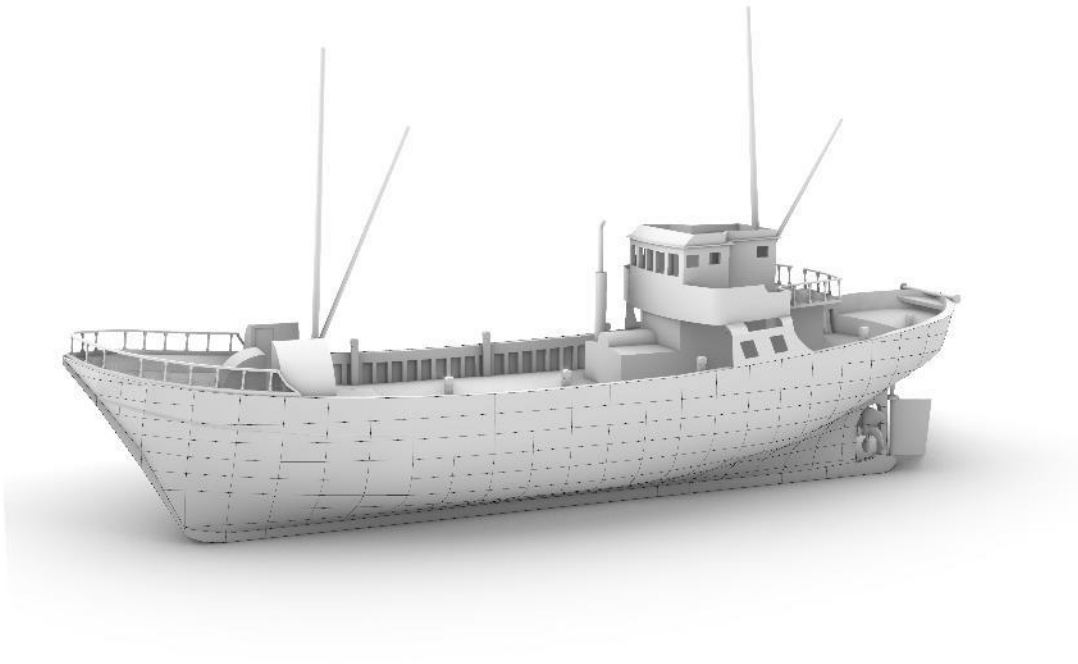


0 1 2 3 5 10m

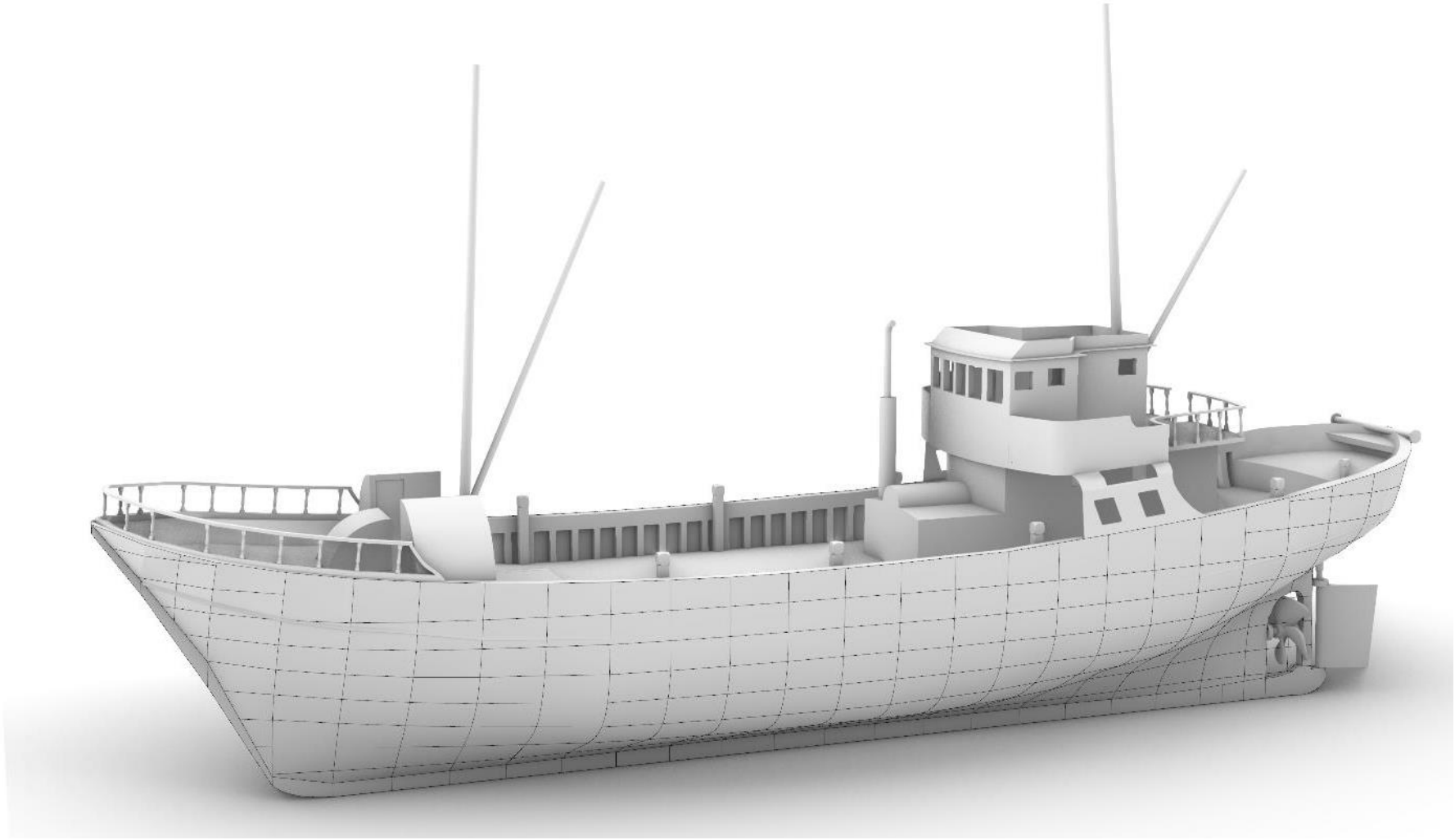
L.O.A. = Length Over All
L.K. = Length of the Keel
M.B. = Maximum Breadth
M.D. = Maximum Depth
L.B. = Length of Bow
L.S. = Length of Stern
D.B. = Depth of Bow
D.S. = Depth of Stern

PARADATA – QUALITY OF THE DIGITIZATION

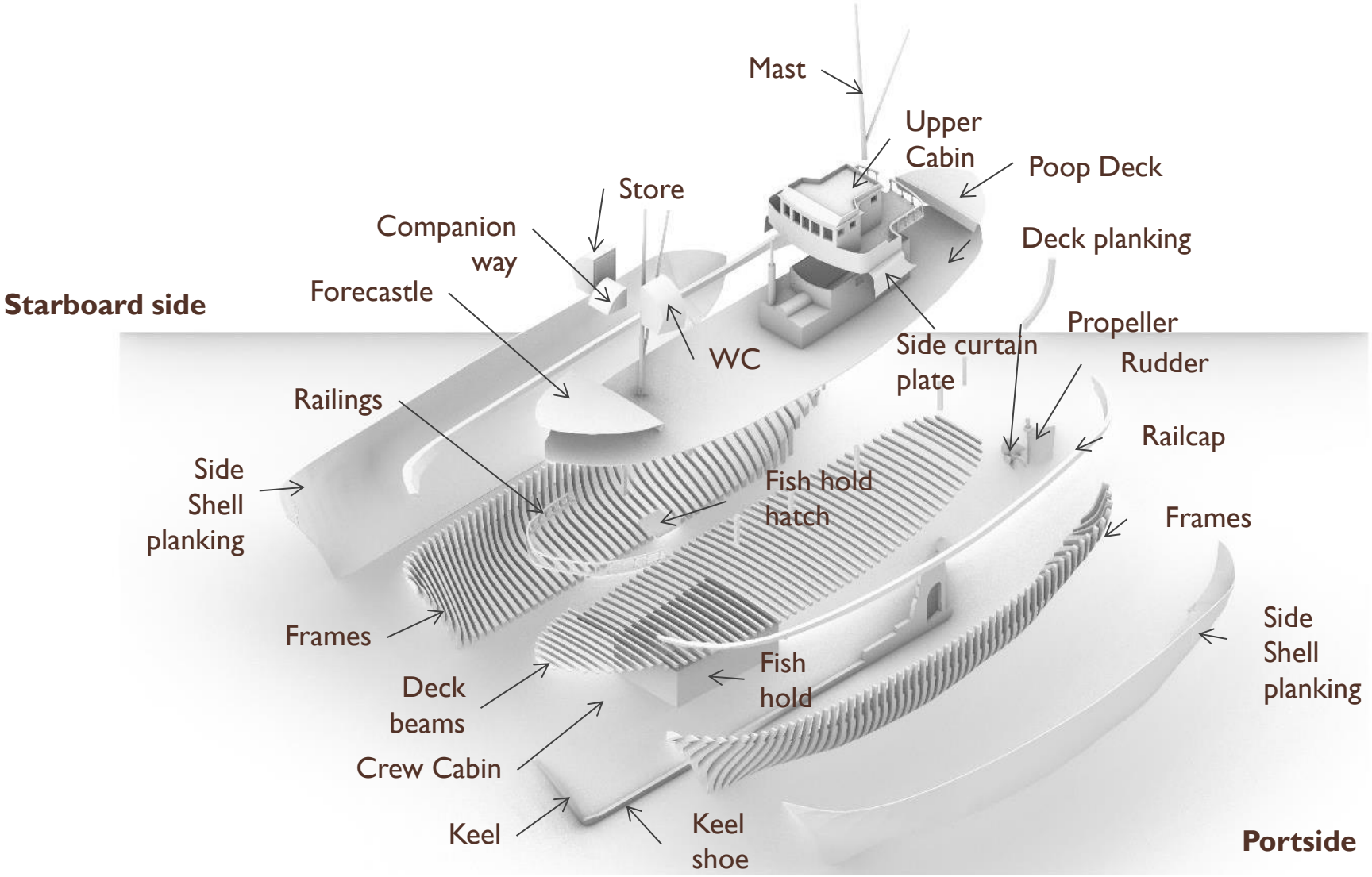




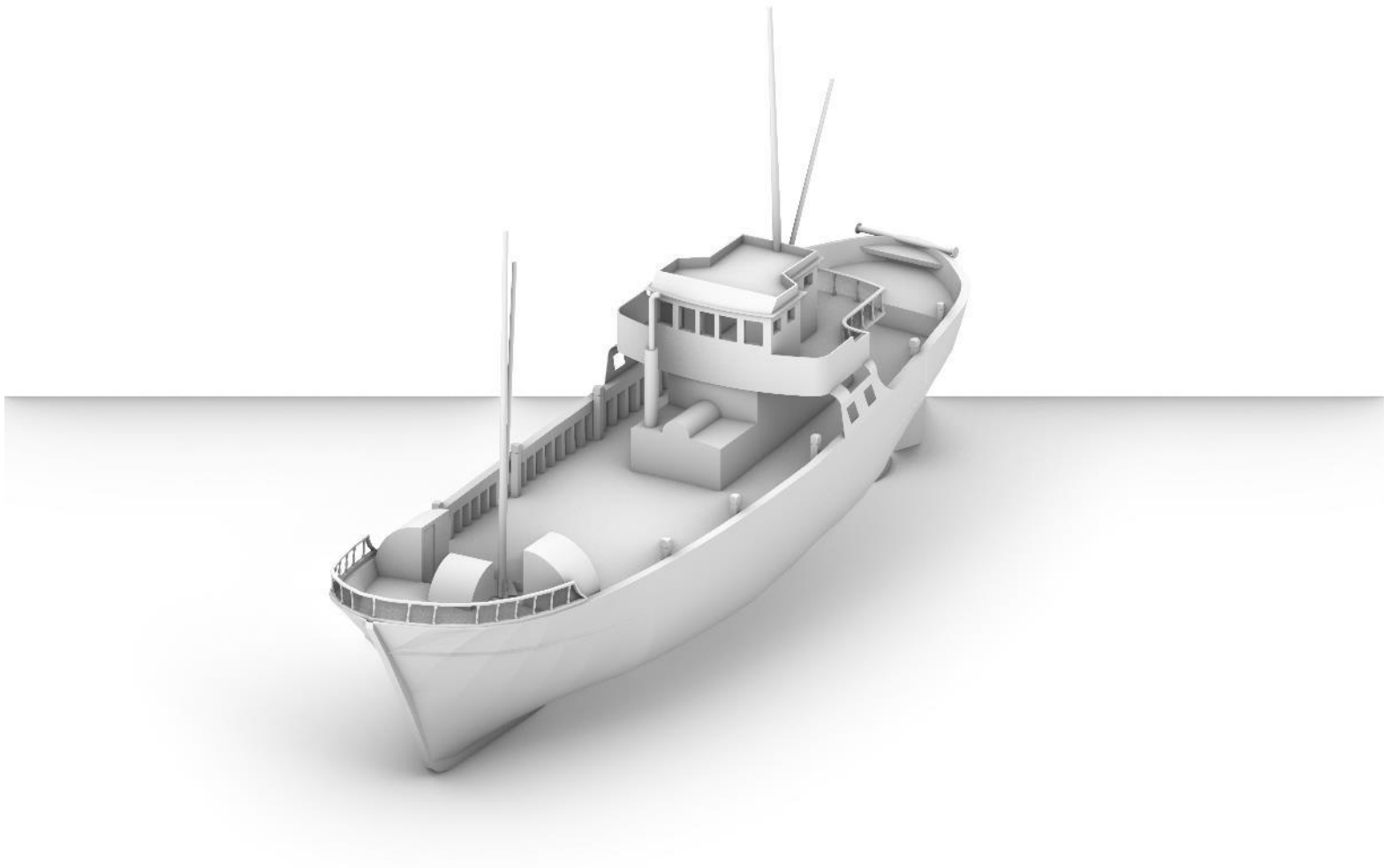
3D MODEL IN RHINOCEROS SOFTWARE



EXPLODED AXONOMETRIC WITH 440 COMPONENTS



AXONOMETRIC – BOW VIEW



AXONOMETRIC – STERN VIEW

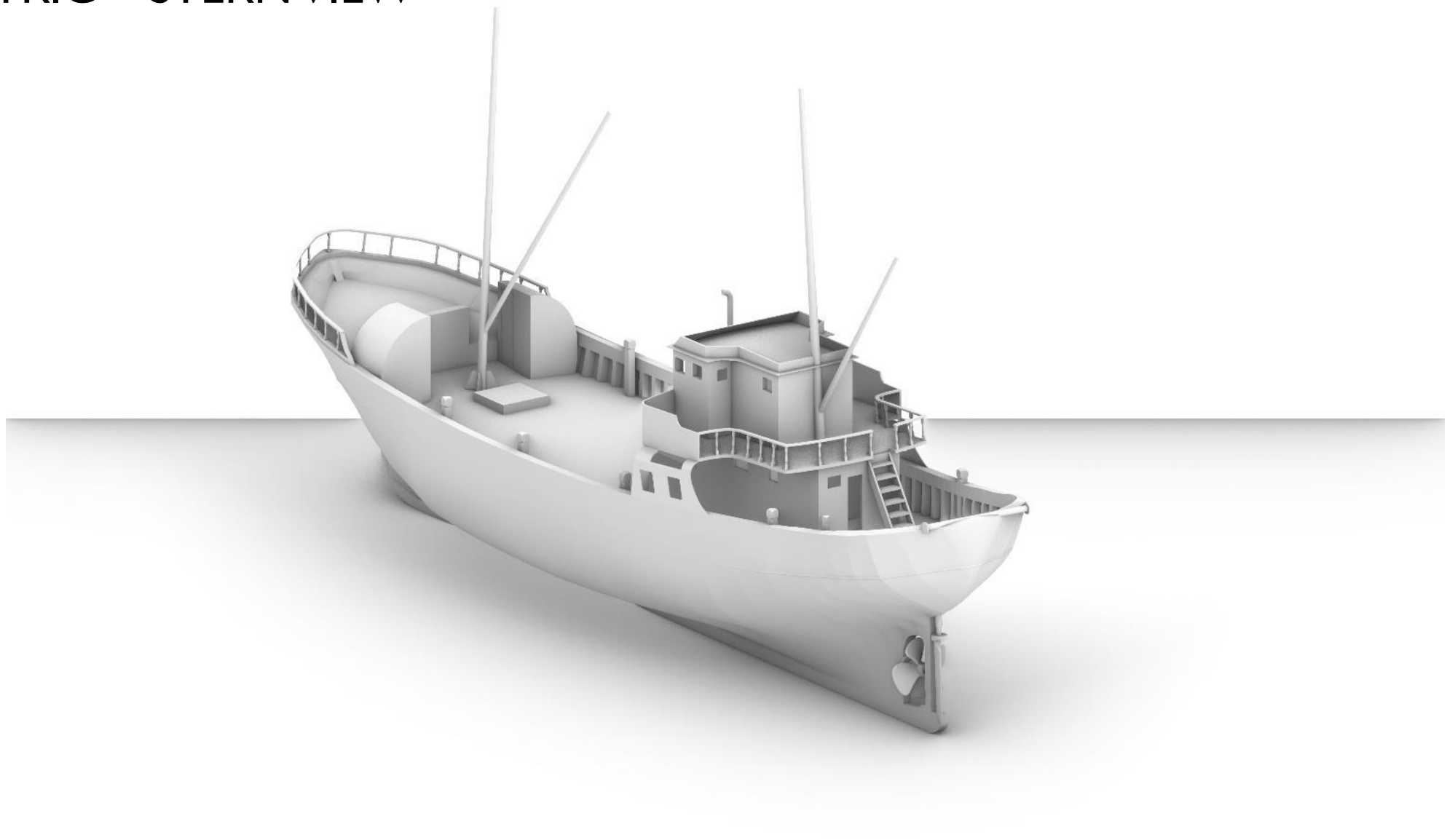
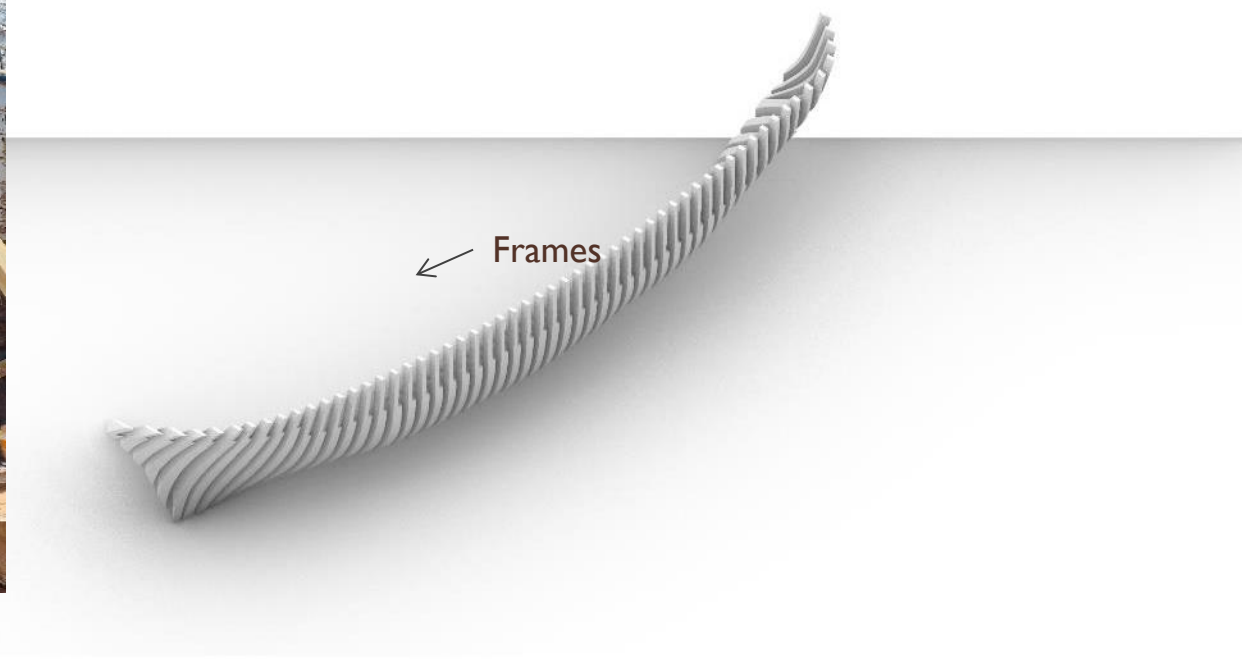


TABLE OF MATERIALS

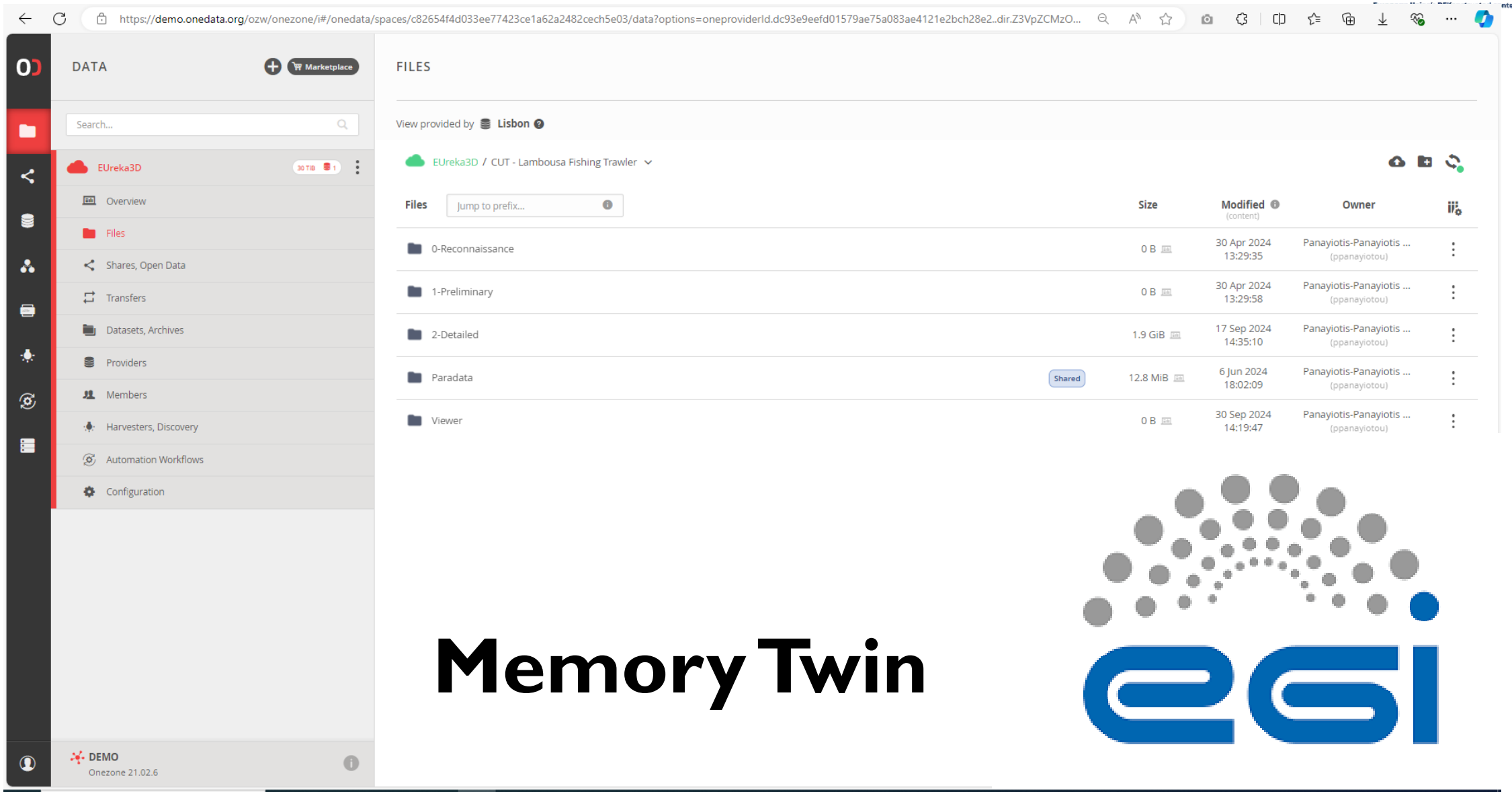
Materials	Type	Component
Wood	Pine Timber	Frames, Deck beams, Planking, Keel
	Oak Timber	Keel shoe
Metal	Steel	Side curtain plate, engine, mast, wire ropes, screws, nails
	Bronze	Propeller

PATHOLOGY EXAMPLE - FRAMES

DIGITAL Twin



AGGREGATION TO EUROPEANA THROUGH DATAHUB



Memory Twin

AGGREGATION TO EUROPEANA THROUGH DATAHUB

https://demo.onedata.org/ozw/onezone/i#/public/shares/2a642bf73bba6e98641118896b1a16cbcha546

The Lambousa Fishing Trawler

http://hdl.handle.net/21.T15999/R_mXbyY

Open Data | Files

Europeana Data Model (EDM) metadata

Visual | XML

Cultural Heritage Object

Title: The Lambousa Fishing Trawler - 3D Digitisation

Description: The Lambousa Fishing Trawler is considered a unique historical fishing boat of modern Cyprus culture with rich activity in the eastern Mediterranean waters. It was originally named Omonoia, and built at Perama, Piraeus in 1955 by Dimitrios Zacharias. It was given the name Lambousa when it arrived at the Famagusta port in 1965. The boat was used for fishing in the Mediterranean Sea for 50 years and is a 25-metre vessel with a 48-ton capacity and a top speed of 10 knots. The boat was then restored to its original state, and it was used during summer for organized visits with the aim of informing the public about fishing and maritime history and traditions of Limassol and Cyprus. During summer it was anchored at 'Molos' (Multifunctional seaside park), Limassol and in the winter, it was kept at the old harbour. The boat was repaired with European funding. Today, it is once again located at the Karnagio area in Limassol, for external and internal improvement works. Lambousa is one the last traditional fishing boats in Cyprus. Its type is no longer built neither in Cyprus or Greece. The boat was in active service until 2004, when it was given to Limassol Municipality by the Fisheries Department, following the government's decision to withdraw several vessels to protect marine life (Πλοιάριο, 'Λάμπουσα', n.d.). It is a representative example of the Greek shipbuilding tradition and an heirloom, a living reminder of the history of Cypriot fishing. Its rescue is a very important milestone in the field of digital cultural heritage, especially because, according to the Regulation (EU) No 508/2014 – the European Maritime and Fisheries Fund, certain fishing boats should now be destroyed. The historic fishing boat 'Lambousa', which is property of the Limassol Municipality and one of Limassol's popular visitable attraction has been docked for the past few years in a corner of the Karnagio shipyard, where it is eaten away by sea salt and weather conditions. Lambousa was chosen as a case study in the MNEMOSYNE project because it is the oldest existing fishing boat on the island and a unique and important landmark in the contemporary history of the island. It is worth noting that the Municipality of Limassol requested from the Laboratory to holistically document the fishing boat, in order to digitise, protect and preserve it in history using its advanced technology. This commission was part of a long-standing collaboration between the DHRLab and the Municipality of Limassol, in the context of the MNEMOSYNE project. Fishing boats have continued to be the major product of boatyards throughout the 20th century. Unique instances of the Greek boatbuilding history were lost in the late 1980s because of the adoption of the EU law on the reduction of the fishing fleet, dealing a serious blow to the maritime cultural legacy. Thousands of wooden fishing boats have been destroyed as a result of excessive subsidies for their demolition in the context of the renewal of the fishing fleet, which have persisted from all subsequent European Regulations in the programming periods that followed until the present. These subsidies were also accompanied by a lack of interest in calling for the preservation of traditional fishing vessels.

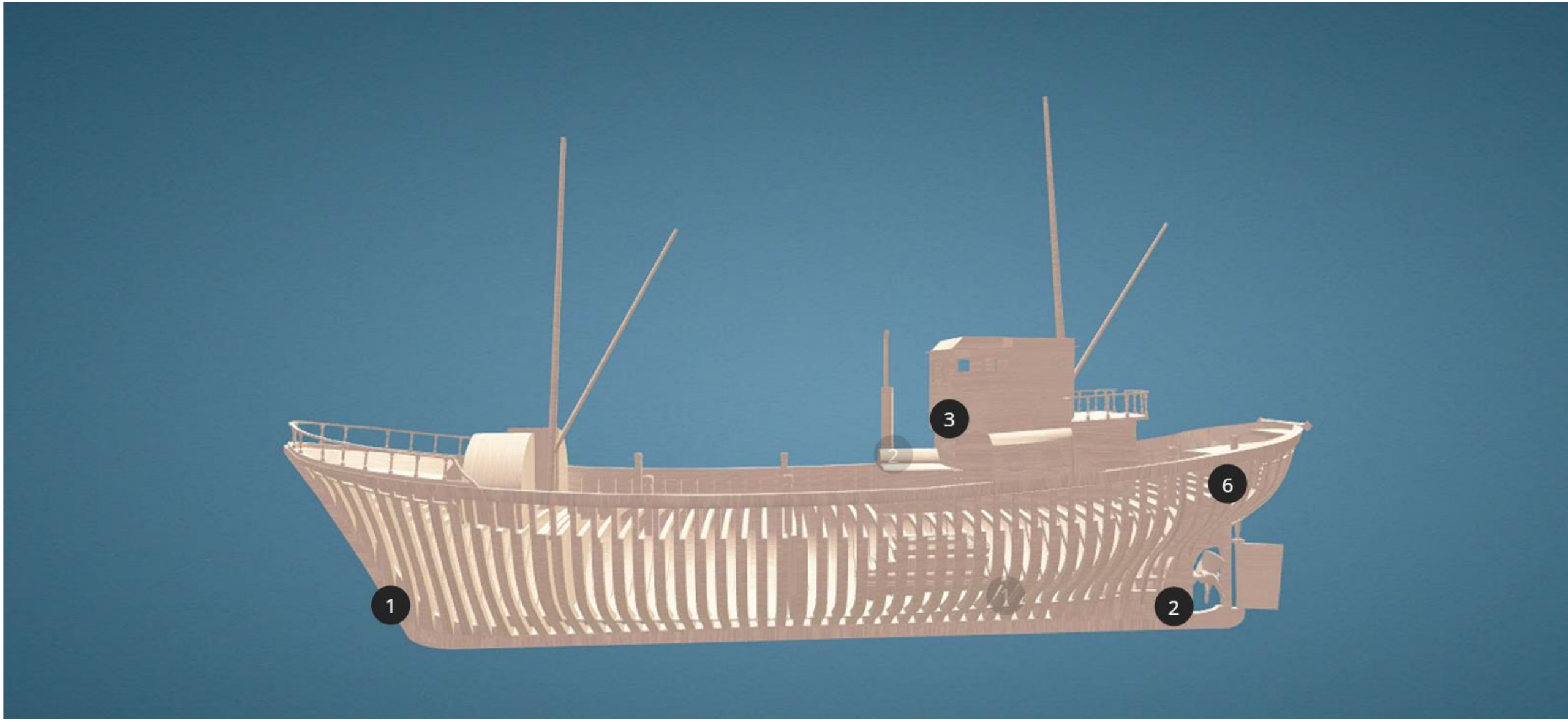
Asset type: 3D

Subject: The 3D Digitisation of Lambousa Fishing Trawler

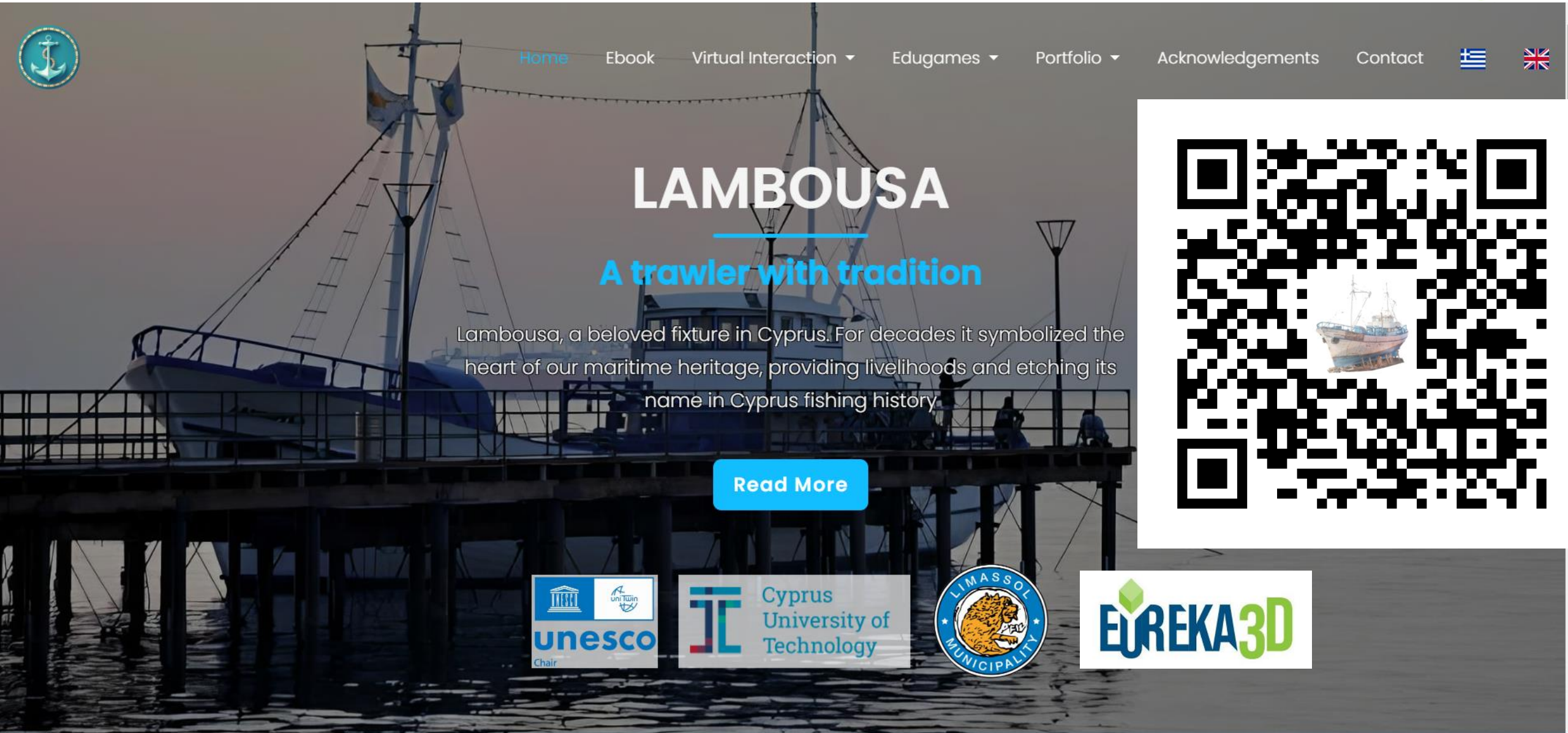
Type of object: Fishing Vessel

Material: Wood

AGGREGATION TO EUROPEANA THROUGH DATAHUB



OUR END RESULT



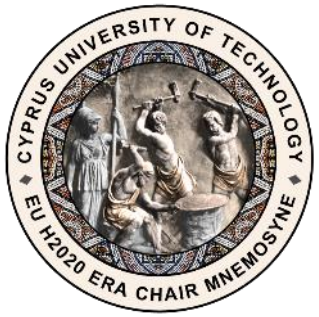

Twin iT!

THE IMPACT & ADDED VALUE

For the first Time in the EU
we are moving from a
Digital Twin to the **Memory Twin**

Cyprus University of Technology

EUREKA3D



#UNESCO_DCH
#ERA_CHAIR_MNEMOSYNE
#EuropeForCulture
#3DforCulture
#EU_Study_3D_CH
#CUTingEdge
#EOCULT

@EU.MNEMOSYNE

@UNESCO_DCH_ERA

@MNEMOSYNE_EU

@Digital Heritage Research Lab

www.unescochair-dch.eu
www.erachair-dch.eu