



# Report

# Deliverable D.2.1.2

Digitized drawings of historical boats

Project Acronym: TOFOLA  
Project number: ITHR0200352





## Italy – Croatia

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### Title **DIGITIZED DRAWINGS OF HISTORICAL BOATS**

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Author(s)	MARSERVIS Ltd
Contributors	Centro Consorzi, Laguna
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## 1. Deliverable D.2.1.2 background

Within the framework of the TOFOLA Project, which focuses on preserving maritime heritage through digital innovation, for deliverable D.2.1.2 “DIGITIZED DRAWINGS OF HISTORICAL BOATS” two emblematic vessels were selected as pilot cases: the Croatian batana and the Italian bragozzo. These traditional boats represent the cultural and technical richness of Adriatic seafaring and serve as models for exploring new methods of heritage conservation, including 3D digitalization and sustainable restoration.

The two case studies illustrate strategies for restoration, conservation and optimization and together contribute to the TOFOLA Project’s broader goals of cultural preservation, digital accessibility, and sustainable maritime innovation.

Given that the two acquired vessels differ in both model and conservation status, the present report has been structured accordingly. Chapter 2 is dedicated to the Croatian pilot boat, while Chapter 3 focuses on the Italian pilot vessel. Each section provides a detailed account of the condition assessment, restoration methodology, and associated interventions specific to each case study.

### 1.1 Objective

The objective of this report is to document and present the procedures undertaken in the digitalization of the two boats, along with a brief explanation of the rationale behind their selection.



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### 2. Croatian pilot boat

Batana is a historical wooden boat used mostly for fishing and transportation in the northern part of the Adriatic. It is flat bottomed, from 4-8m long, designed for shallow waters. Its name comes from the Italian word "battere" (to beat), referring to the sound the flat bottom makes when hitting the water.

Traditionally, batana boats were handcrafted from wood, using local materials and simple shipbuilding techniques. The boat was commonly rowed using oars or sailed with a small lateen or lug sail. Over time, some batanas have been modified with small motors, but the traditional rowing and sailing versions remain popular for cultural preservation.

The Rovinj Batana is one of the most famous versions, recognized as an important part of Istrian maritime heritage. In 2004, the Batana Ecomuseum was established in Rovinj to preserve and promote the tradition of batana boatbuilding and navigation. In 2016, UNESCO recognized the Batana Ecomuseum as an example of best practices in preserving intangible cultural heritage.

Today, batanas are still built and used for fishing, tourism, and cultural events. Many coastal communities host batana regattas and workshops to keep the tradition alive. The shift toward sustainable materials like flax fibers and bio-epoxy resins is an emerging trend in modern reconstructions, blending tradition with eco-friendly innovation.

The batana acquired serves as a representative example of the Croatian pilot boat in TOFOLA Project.



## 2.1 Overview of the Activities Undertaken

### Investigation and purchase of the vessel

As part of the restoration strategy in Croatia, a deliberate decision was made to acquire a batana requiring extensive restoration work. Accordingly, a 33-year-old vessel measuring 6 meters in length, and currently in a deteriorated state—as documented in the photographs in Annex I—has been procured.

### Digitalization

Prior to the initiation of any physical restoration work, the vessel's geometry and structural integrity were digitally captured through a hybrid methodology, integrating a modern 3D point scanner (PROLINER) with traditional surveying techniques. The vessel was carefully positioned on an even keel to ensure precise alignment for digital acquisition. The process commenced with the identification of specific reference points along the vessel, which were subsequently transferred to a digital environment. Using advanced naval architecture software, these points were interconnected to generate a network of lines, which were smoothed to achieve the requisite level of precision. The resulting lines were then used to define surfaces, which were extruded to corresponding thicknesses determined through conventional measurement methods. This comprehensive approach resulted in an accurate and fully detailed digital model of the vessel's structure. The results of this digitization process are documented in Annex II.



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### Repair activities

The restoration activities were initiated with the removal of the inboard propulsion system, comprising the engine, shaft, and propeller. Subsequently, all deteriorated or structurally unsound wooden components were dismantled, with only the elements assessed as stable and in good condition retained. The entire hull surface was then stripped of paint to allow for a thorough structural assessment and to ensure optimal adhesion for subsequent restoration treatments. In line with conservation and heritage preservation guidelines, only wood species and dimensional profiles equivalent to the original materials will be used, in order to safeguard the historical authenticity and traditional construction techniques of the batana.

### 3. Italian pilot boat

The bragozzo (also known as baragozzo or bracozzo) is a traditional fishing and/or cargo vessel typical of the central and northern Adriatic Sea, historically used for coastal trade extending as far as the Ionian Sea.

The bragozzo acquired serves as a representative example of the Italian pilot boat in TOFOLA Project. Dating back to 1948, is in excellent condition both structurally and in terms of its decorative elements. It measures 9.9 meters in length and 2.3 meters in beam.



### 3.1 Overview of the Activities Undertaken

#### Investigation and purchase of the vessel

The main evaluation criteria adopted in conducting the market survey for the selection of the vessel that has been purchased were as follows:

- Structural conditions of the vessel: hull solidity and integrity of the load-bearing components.
- Historical value: degree of preservation of original elements and authenticity.
- Propulsion efficiency: engine condition and suitability for the intended activities.
- Restoration costs: estimation of the interventions required for full functional recovery.

A wider range of options was initially expected; however, the majority of the available boats were found to be in a state of severe deterioration, which substantially extended the duration of the search beyond initial expectations.

In the end, a boat already in good condition was selected in order to streamline and optimize the subsequent digitalization process.

The selected bragozzo represents the best compromise between historical value and technical performance, minimizing costs and intervention time required for restoration.

Its characteristics make it particularly suitable for achieving the objectives of the TOFOLA project, ensuring a high-quality standard and a swift commissioning process.



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### Digitalization

A comprehensive analysis was undertaken to identify the most appropriate and cost-efficient method for the digitalization of the boat. Based on the results of this evaluation, the chosen approach involved the use of a professional 3D scanner equipped with laser sheet detection technology (Artec Ray).

To further enhance the accuracy of the digital model, this method was combined with photogrammetry.

The boat was removed from the water and relocated to a sheltered indoor area to facilitate operations within a controlled environment. This precaution was implemented to mitigate the potential impact of wind, which could have adversely affected the accuracy of the digitalization process by introducing vibrations or instability in the scanning equipment.

The boat was scanned using both laser sheet detection and photogrammetry techniques. The scanning process was conducted in two stages: initially from the exterior, capturing the vessel from multiple angles, followed by scanning of the interior. The interior scan was performed in two phases: first with the flooring in place, and subsequently without it. This approach enabled the creation of a comprehensive 3D model, incorporating detailed information regarding the boat's internal structure.

Each scan generated a highly precise 3D file, achieving an accuracy of up to 0.5 millimeters. Subsequently, all individual scans were aligned and integrated into a single cohesive file through the matching of corresponding surfaces, resulting in a comprehensive and coherent digital model of the boat. Additionally, ultra-high-resolution photographs were captured to



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create the appropriate texture for the 3D model, thereby ensuring both geometric precision and visual authenticity.

During the 3D scanning process of the vessel, certain gaps were identified in the final mesh. These imperfections are primarily attributed to the unconventional support method employed during the scanning procedure. To prevent any direct contact or undue pressure on the decorated surfaces—many of which feature fragile or recently restored historical elements—it was necessary to adopt a non-traditional support strategy. While this approach was crucial for safeguarding the integrity of the decorative features, it restricted access to specific areas, thereby limiting the scanning equipment's ability to capture complete coverage of the vessel. The presence of these gaps was anticipated and deemed acceptable, as the preservation of the historical asset's integrity was prioritized over the absolute completeness of the digital model.

However, through post-production procedures, the missing components were integrated, resulting in the finalization of a fully defined model.

### Repair activities

To ensure the vessel's maintenance in optimal condition, preliminary conservation measures were undertaken prior to the implementation of the planned accessibility modifications. These interventions encompassed the application of antifouling treatments, the rectification of discrepancies in onboard accessories, and the remediation of minor hull defects, including small perforations.



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4. Annexes

Annex I – photos of the batana



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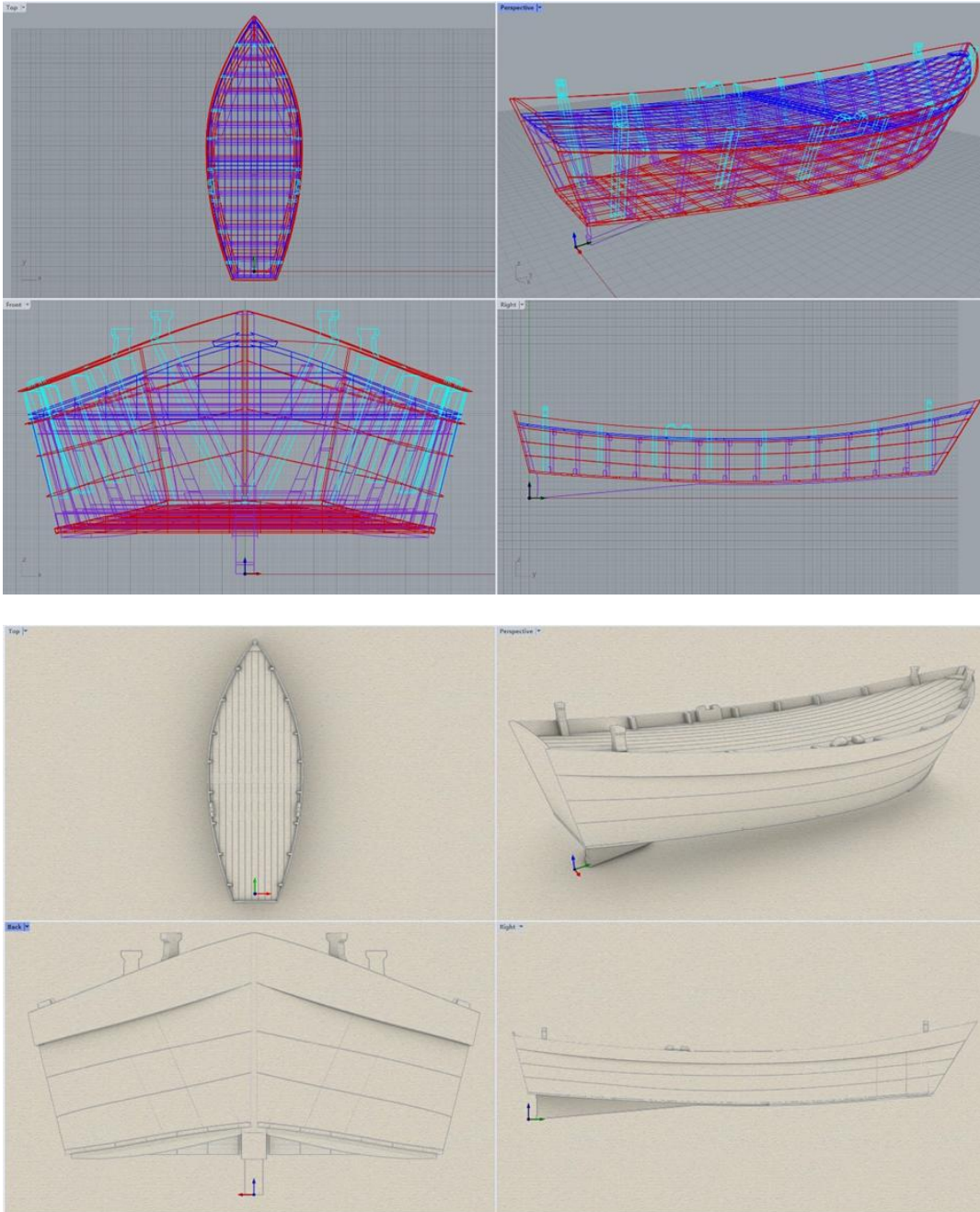
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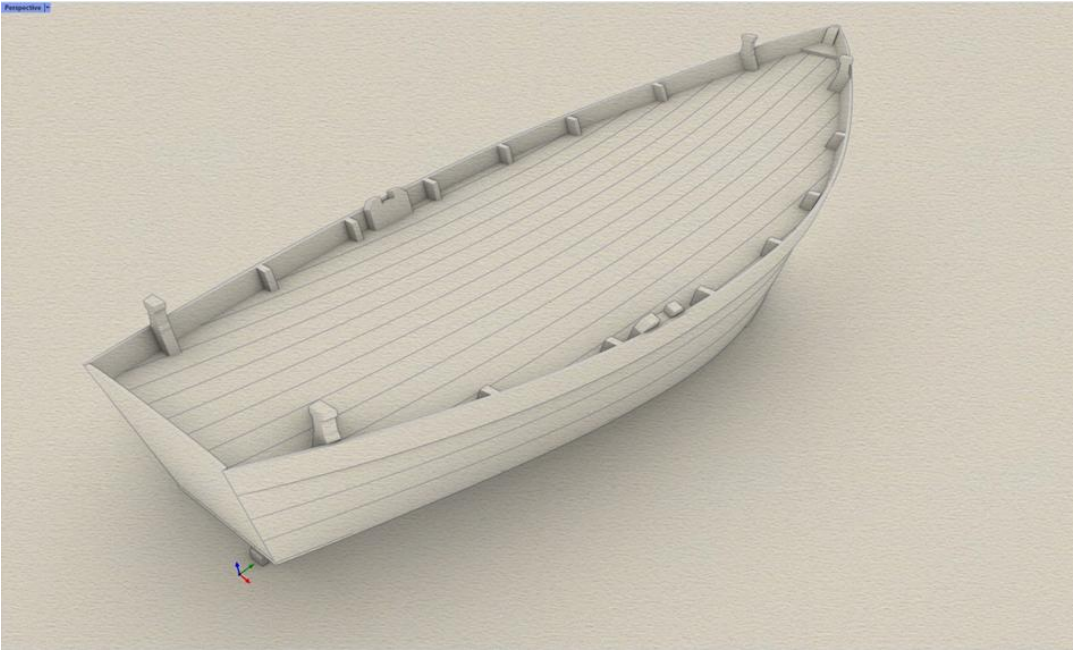
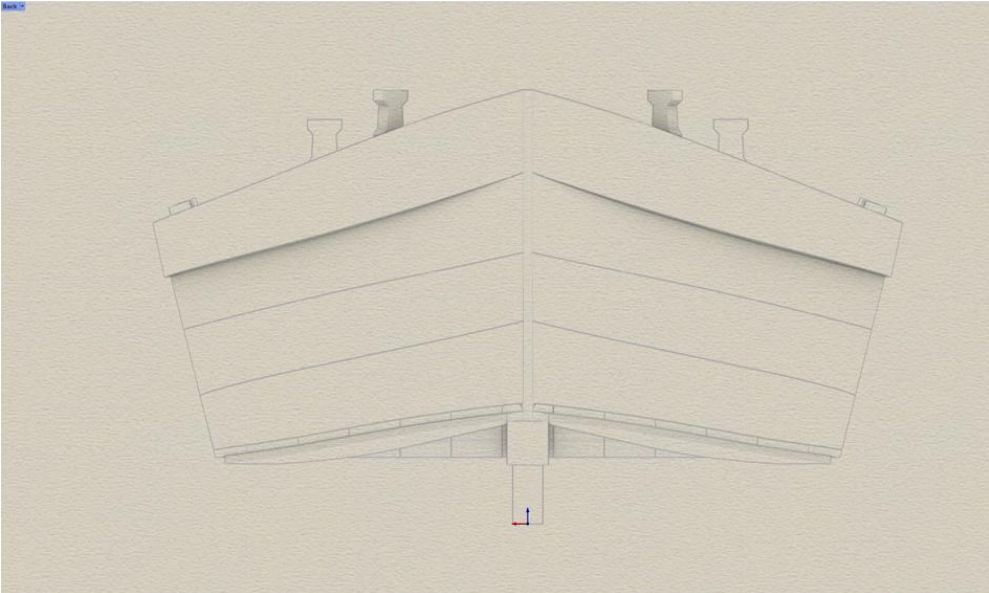


Annex II – The batana digitized drawings



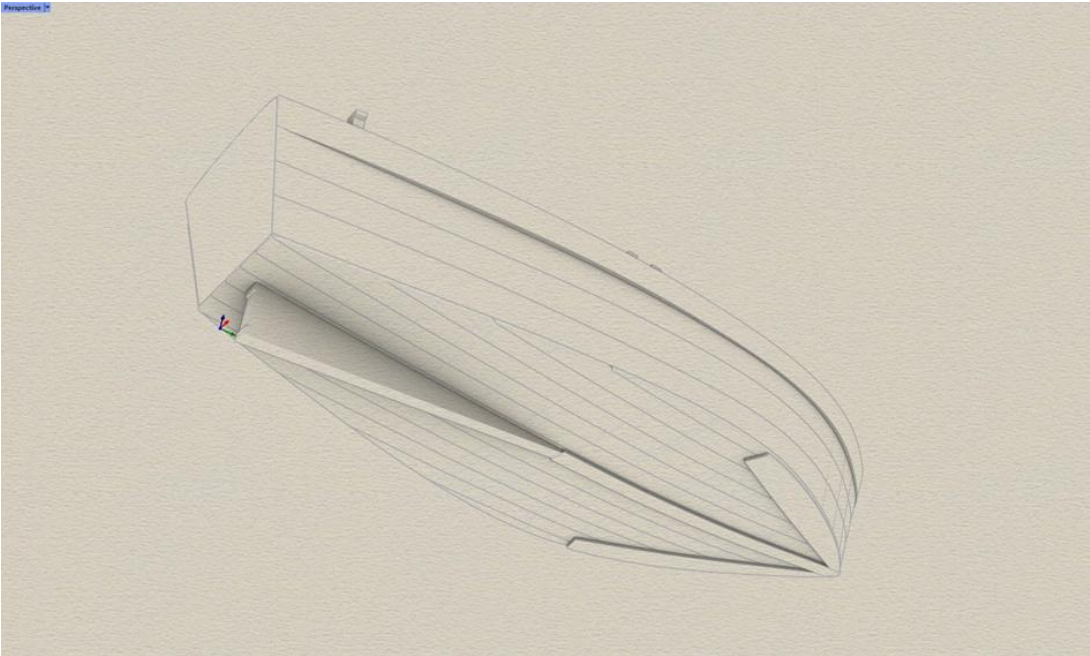
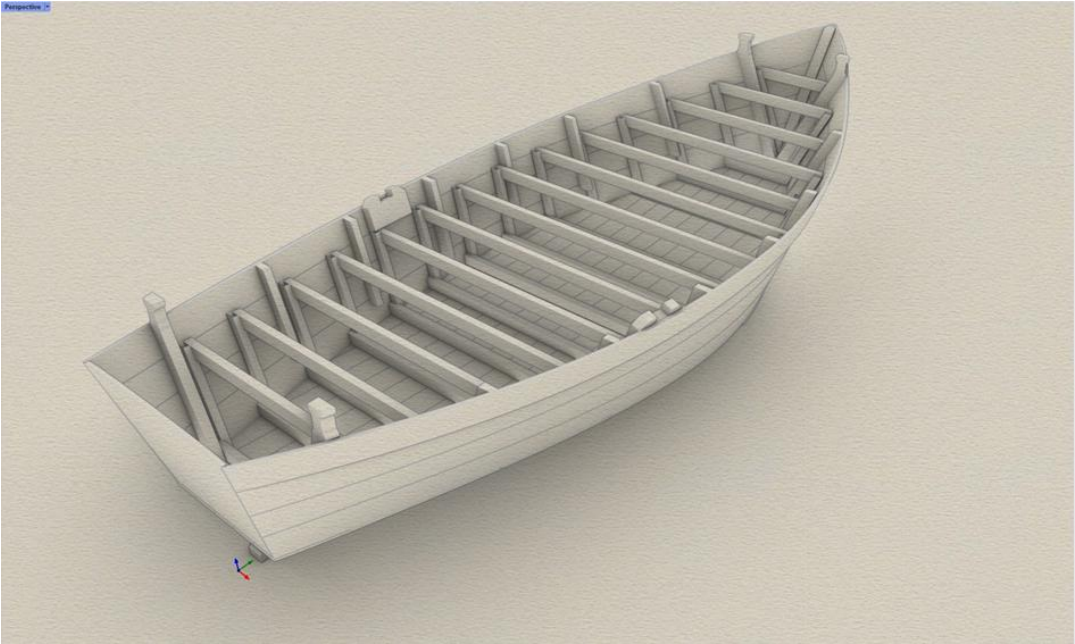


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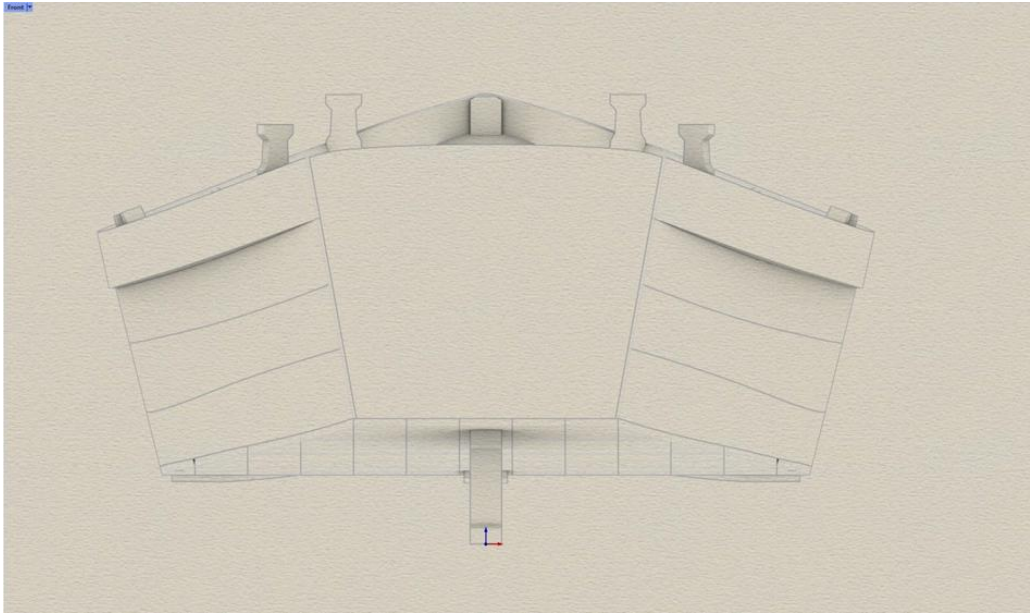
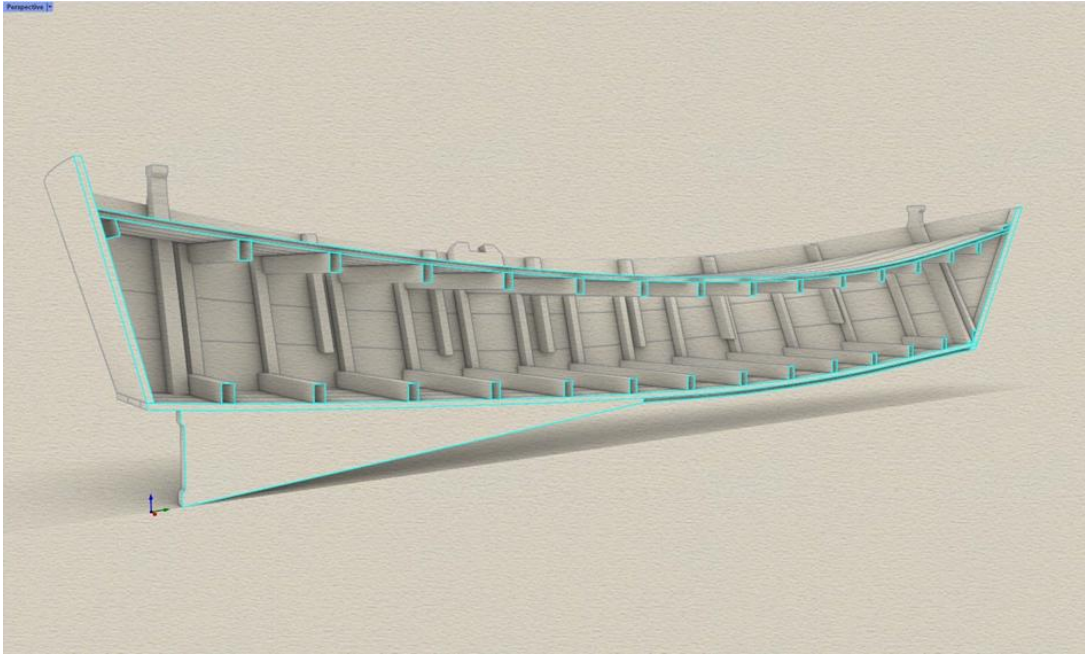


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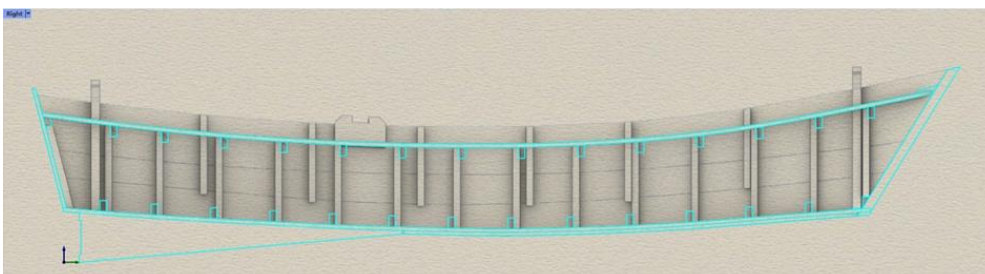
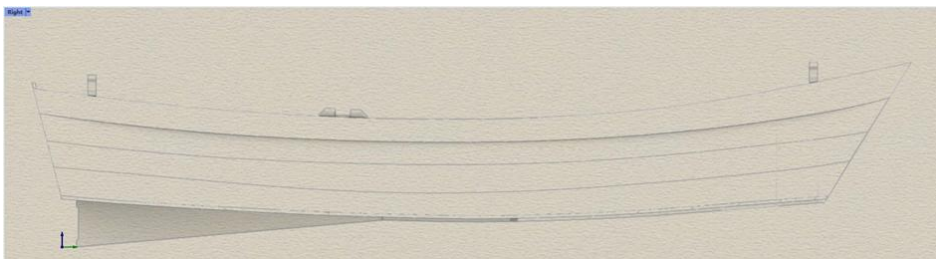
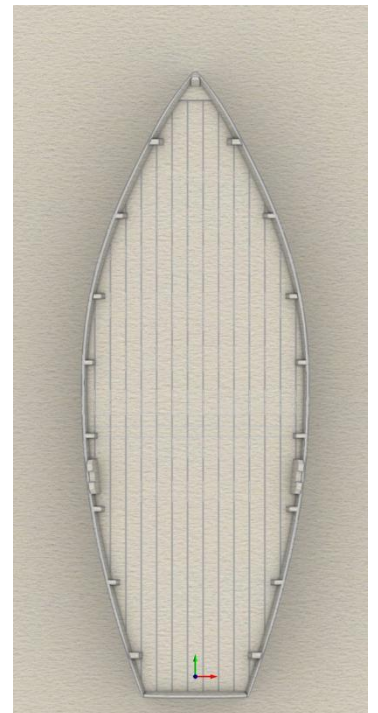
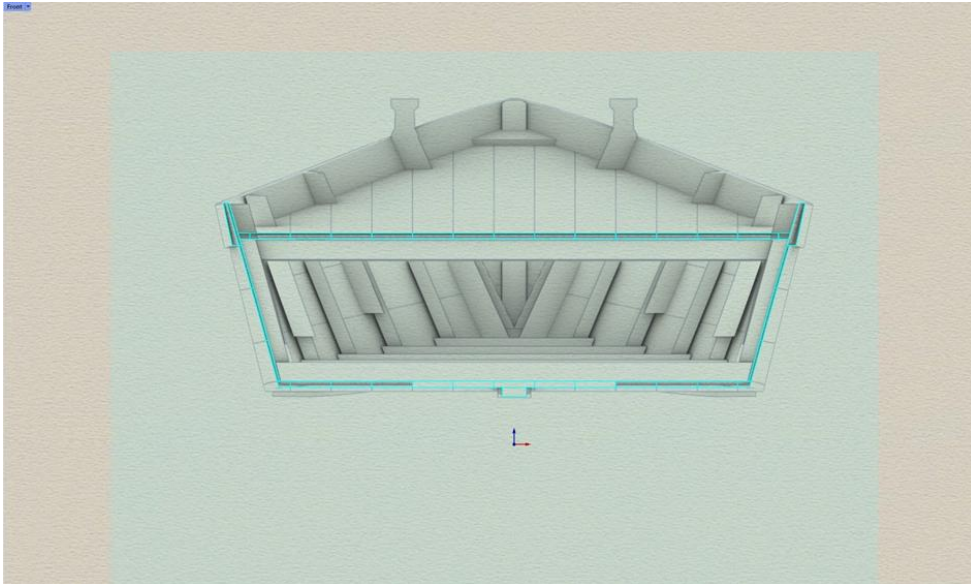
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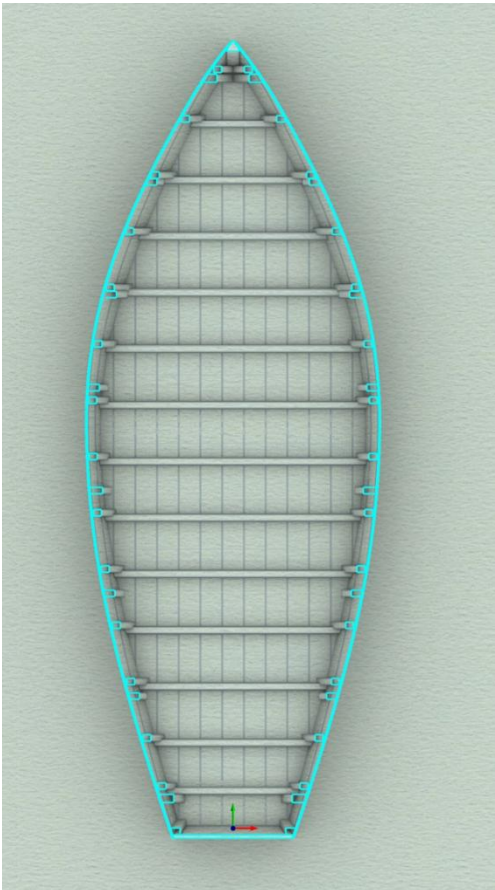
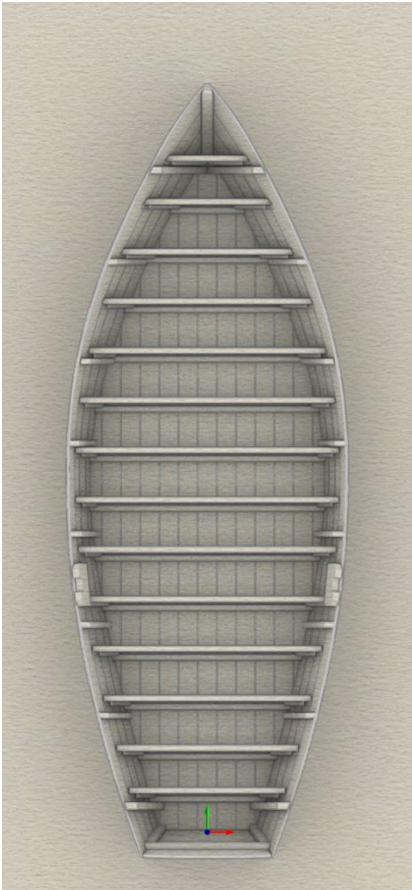


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Annex III – photos of the bragozzo  
*3D scanner*



*The Bragozzo acquired*



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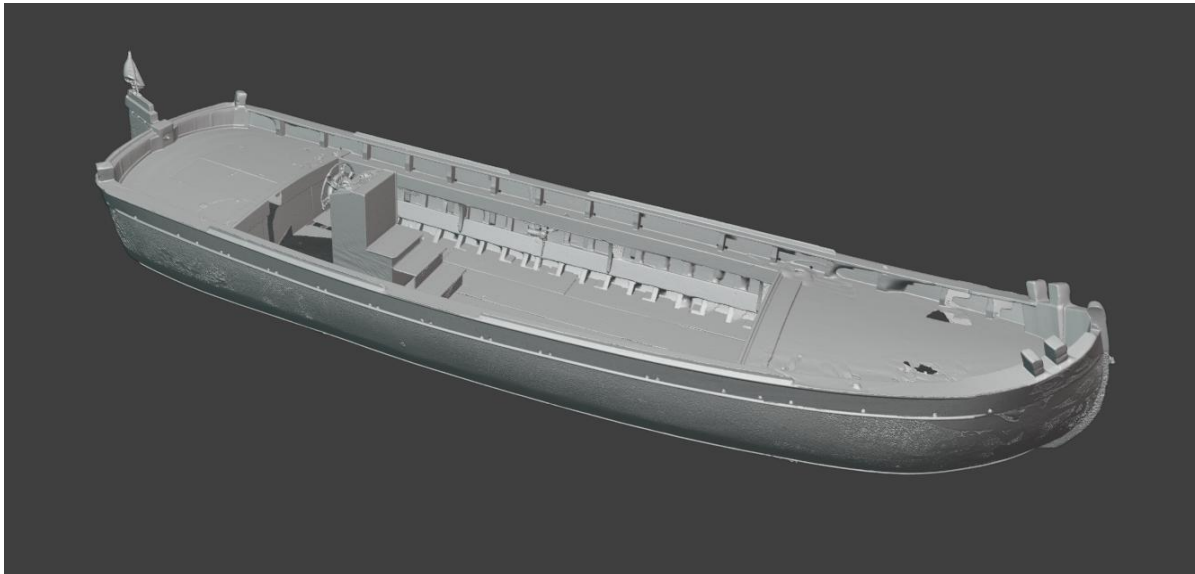
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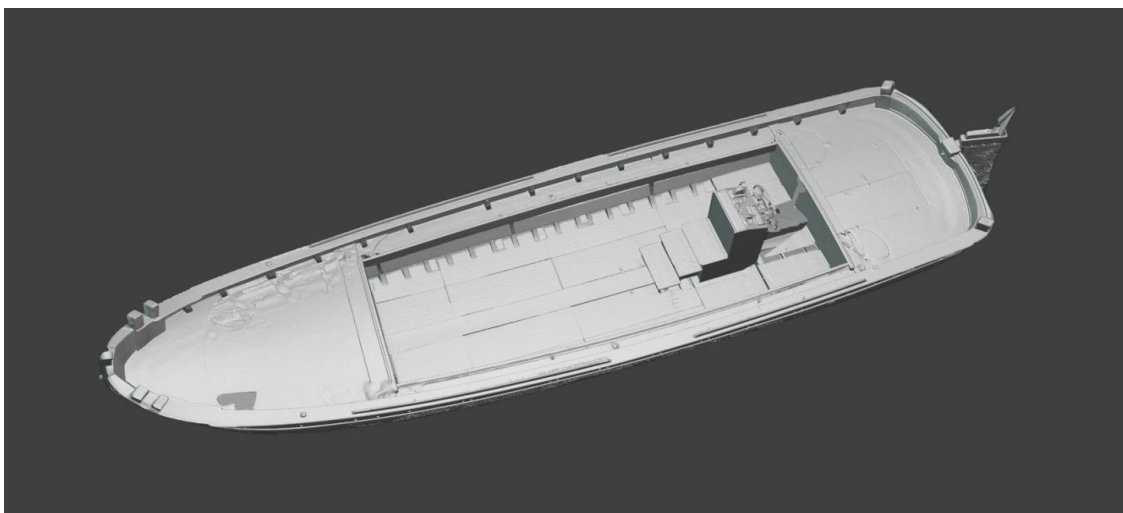


### Annex III – The bragozzo digitized drawings

#### Full boat



*Full view of the 3D model, from the front, slightly angled to the side.*

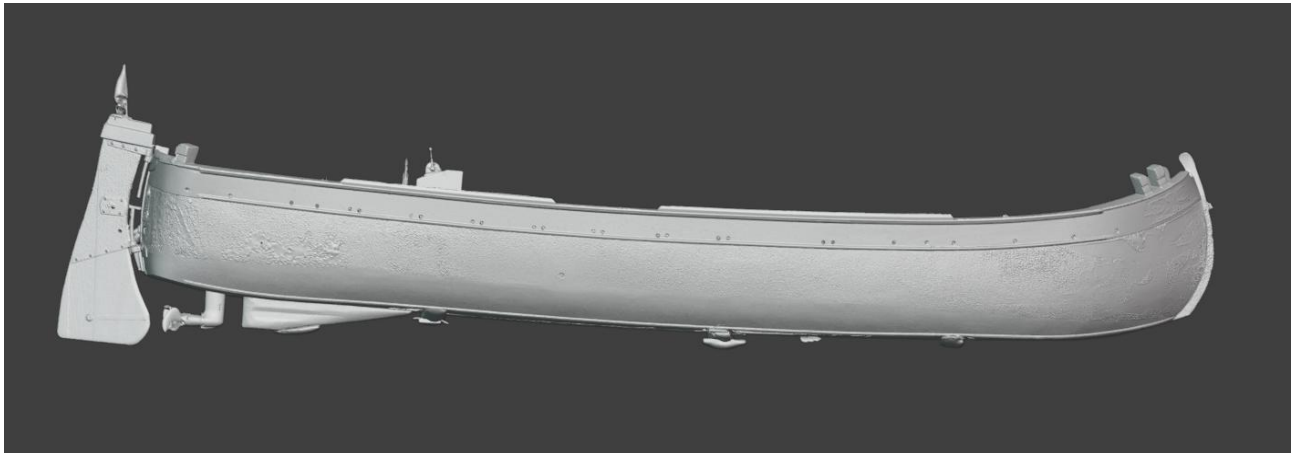


*Full view of the 3D model, from the top, slightly angled to the side.*



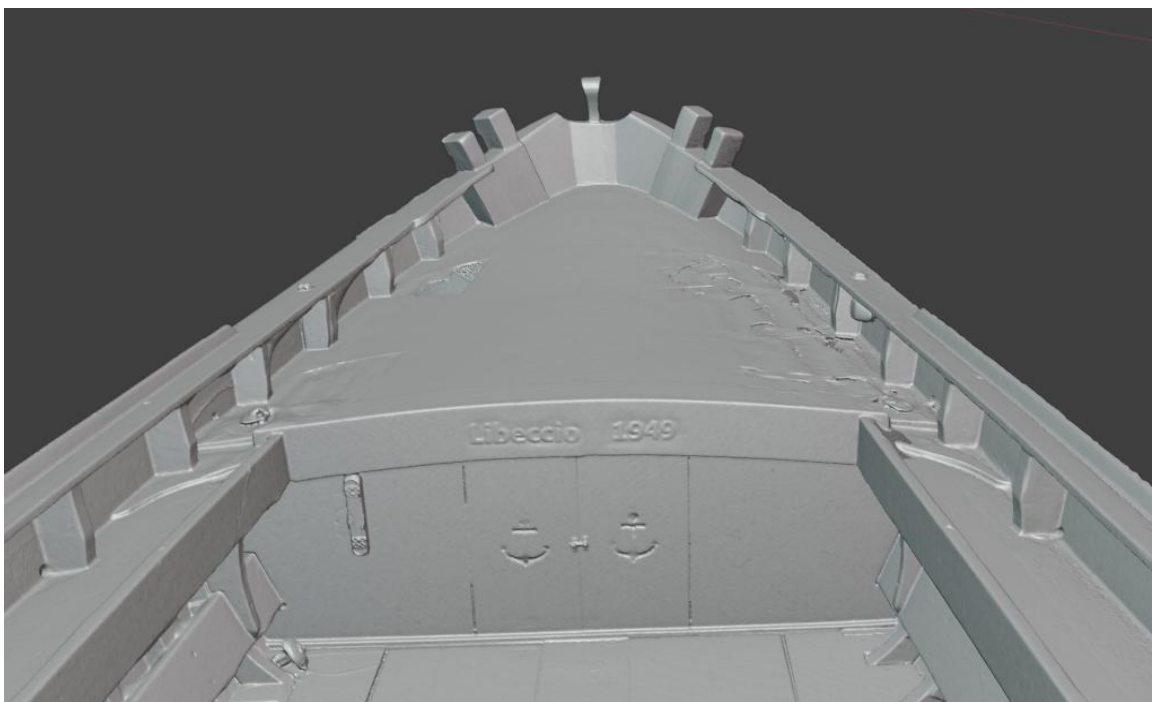
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*Side view rendering of the 3D model, with visible hull details and surface texture.*

Details



*View of the front interior of the 3D model, with the year of construction (1949) clearly visible.*



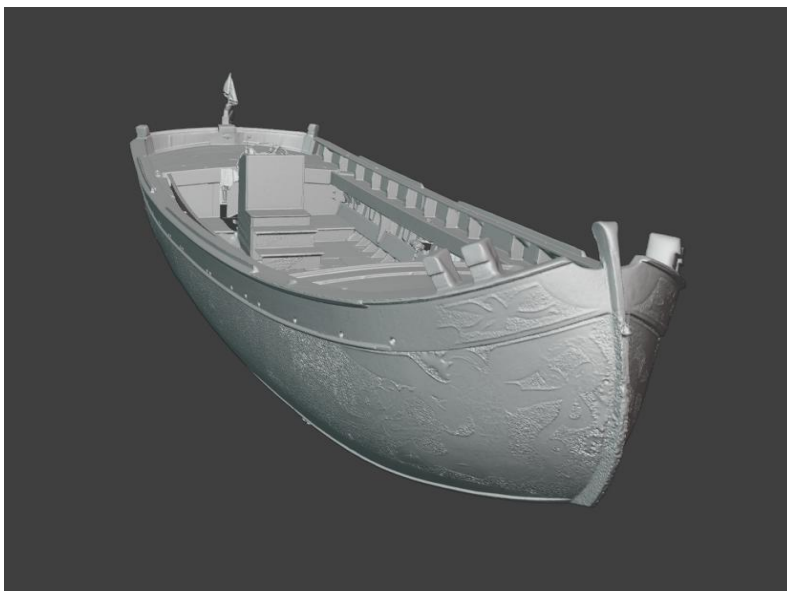
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*Rear underside view of the 3D model, showing the rudder blade and engine turbine clearly.*

Foreshortenings

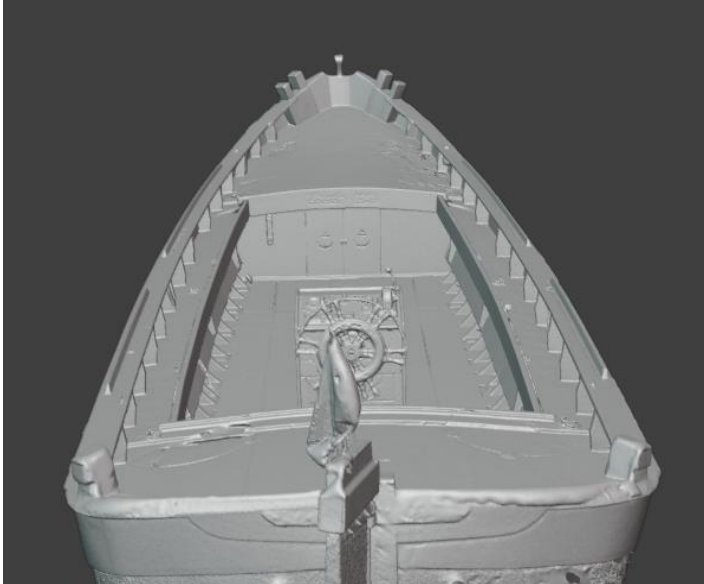


*Foreshortened front view of the 3D model, with mooring bollards clearly visible.*



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*Rear interior view of the 3D model, showing the helm and seating arrangement.*

### Texture



*Close-up of the bow area the 3D model, displaying painted decoration.*

