**ERC Advanced Grant 2021**

**Research proposal [Part B1]**

Connections…

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**Host Institution**: Universidade de Coimbra,

**Proposal duration**: 60 months

# Proposal Summary

We propose to develop a set of informatics tools with a special focus on ontologies, to identify, reformat, organize, relate, and share large collections of data related to the world histories of shipbuilding and seafaring.

These informatics tools will connect extensive chronological and geographical datasets, as those related to the early modern Spanish and Portuguese merchant networks in the Americas and in Asia, and relate them with a few particular subject, as the body of data accumulated over a decade of excavation of the Xlendi, Bronze Age shipwreck, or the early 17th century Portuguese Indiaman lost at the mouth of the Tagus – tentatively identified as *Nossa Senhora dos Mártires*. Our goal is to create a website to support our research and share it with an as wide as possible public, including domain experts, students, interested communities, and the public in general.

Our website will be designed to create a community of scholars, stakeholders, and curious participants, and contribute to change the secretive and hierarchical paradigm around which archaeology is sometimes organized. We propose to use maritime archaeology to encourage discussions about the past, the present, and the future of communities, emphasizing questions related to ecology, sustainability, peace, justice, and equity.

This project is framed by and follows the spirit of the Lagos Convention on the Value of Cultural Heritage (2005), promoting the cultural heritage as a useful resource for human development, cultural diversity, and intercultural dialogue. It encourages principles of sustainable use of resources and asserts the right to know and enjoy our common cultural heritage, as defined in the Universal Declaration of Human Rights, in syntony with the 2015 United Nations Sustainable Development Goals (2030 Agenda), with an emphasis on quality education. We aim at establishing learning environments that use historical perspectives to promote discussions on problems like poverty, inequality, hunger, health, culture, gender equality, industry, pollution, sustainability, clean energy, or human rights.

The study of shipwrecks is entangled with stories of treasure, pirates, voyages of exploration, migration, and utopia, and shipwrecks tend to evoke emotions that make them a popular subject around the world. We believe that we can use the history of seafaring to seduce a wide public to reflect on our common history, and in particular on the cases where archaeology shows diverse communities cooperating and cosmopolitan words thriving.

From a scientific viewpoint, the sample of shipwrecks available for study is growing continuously, as the number of maritime archaeologists operating in every continent, and these facts are facilitating a cultural shift, where scholars are sharing data faster and more effectively. This creates a large body of available data that presents opportunities for organization and sharing in standardized ways that are clear enough to simplify comparative studies, and flexible enough to accommodate different interpretations, which create different narratives, by different voices, with different viewpoints.

In a 1994 paper, archaeologist Roger Hill laid the basic development lines for the application of computer technology to archaeology. He noted that the data have been deposited in the ground by a range of dynamic processes, and that time and human activity have made the it “*a database in which an imperfect memory of those processes is retained*.” The purpose of archaeological recording, Hill argued, was “*to transfer the ground-based record system into a form accessible not just to the site archaeologist, but to all potential users*.” The most important part of Hill’s paper was, however, a call to understand that the nature of the output generated by computers should be the primary concern in the adoption of computers to record archaeological sites: “*the technology used to record the data (…) is central to the activity of archaeology properly considered*.” Hill was proposing a paradigm change in archaeology by making the possibilities of digital technology the base for a new philosophy “*for planning and managing the recovery of the soil database, recording deposited materials*,” and modeling the site formation process (Hill 1994). At the same time, J. Richard Steffy wrote that as nautical archaeology was entering the computer age, an effective utilization of the available technology called for the development and adoption of a more complete and effective method of recording ship hull information (Steffy 1995).

Twenty-five years later, computers are faster, the internet is ubiquitous in the academic world, and the discipline of maritime archaeology has widened its scope to include the study of the landscapes where ships were built, sailed, and lost. The study of the evolution and the variation of wooden ship types is now part of a wider study of the ecological environments where they were conceived and built. We want to create tools that make all things maritime easy to access, interpret, and discuss for a wide group of stakeholders and participants, including domain experts and the lay public, students and policy makers, the media and the scholarly world.

# Section a: Extended Synopsis of the scientific proposal

# The problem: why ontologies?

This project is about connections. Ontologies connect things that already exist with things that are being discovered and create new relations and understandings between sets of data (Drap et al. 2019). During the past 15 years we have developed important sets of data related to the histories of seafaring and shipbuilding since the Paleolithic, and we have created a community of over 200 scholars and students from over 40 countries willing to share and discuss published and unpublished data and ideas (Borrero et al. 2020).

Ships are repositories of information: they were built somewhere, with knowledge that resided in particular places, following tastes and technological options influenced by local environments, or imported from other maritime landscapes. The materials used were probably local before the earliest maritime trade networks developed in the Indian Ocean, and then partly local and partly imported. The same can be said about the labor hired to build and sail ships. Vessels were sold, commandeered, or taken by peoples from other cultures, and adapted, changed, or repaired. Each venture, be it commercial, of exploration, or of war, was different. Each ship is a compound of peoples, artifacts, and ideas from many different places. And everything about these vessels is a potential contribution to the study of the human adventure from an anthropological viewpoint. The crews, the foods, the scents, the arts, the tastes, the chants, the worldviews, and the religiosity of the peoples travelling, all are important to our understanding of what it means to be human: people named their vessels, gave them magical protections, prayed on them, sailed from sanctuary to sanctuary, negotiated their survival with the available deities, used spoken formulas, sacrifices, and other strategies to ensure the safety of their voyages. The more pragmatic seafarers created and developed insurance systems. Ships and exchanges influenced the development of harbors, coasts, regions, and states of the world.

We have established a small number of basic datasets on which to build our tools (Table 1). These datasets have been carefully chosen to help us develop connections between them, both in abstract – through the development of ontologies – and framed in time and space.

This project will therefore encompass two parallel activities: one will consist of intense archival research to expand the datasets, in number, size, and scope; and another will consist of the creation of an expandable set of tools that can be easily replicated and serve to connect new types of ships, peoples, artifacts, rituals, stories, chronologies, and scientific or artistic creations.

An important component is the two activities will be datamining: we intend to connect all available and reliable bodies of research and integrate them in our ontologies. The goal of the project is to create an organized network of maritime-related datasets that can be explored to promote a better understanding of the human adventure.

**Table 1. Basic Datasets**

|  |  |  |
| --- | --- | --- |
| **Dataset** | **Geographical Area** | **Time Frame** |
| Shipwreck Sites (Second Millennium BCE to Present) | Approximated Geographic Coordinates | Approximated Dates of Construction and Loss |
| Historical References to Shipwrecks | Approximated Geographic Coordinates | Approximated Dates of Construction and Loss |
| Ship Images | Approximated Geographic Area | Approximated Date |
| Ship Types | Approximated Geographic Area | Approximated Chronological Range |
| Technical Texts on Shipbuilding | Approximated Geographic Area | Approximated Chronological Range |
| Amphorae Database | Approximated Geographic Area | Approximated Chronological Range |
| Anchors Database | Approximated Geographic Area | Approximated Chronological Range |
| Guns database | Approximated Geographic Area | Approximated Chronological Range |
| Astrolabes Database | Approximated Geographic Area | Approximated Chronological Range |
| Ships’ Bells Database | Approximated Geographic Area | Approximated Chronological Range |
| Ships’ Rams Database | Mediterranean | First Millennium BCE |
| Sounding Leads Database | Approximated Geographic Area | Approximated Chronological Range |
| Rigging Elements Database | Approximated Geographic Area | Approximated Chronological Range |
| Olive Jars Database | Approximated Geographic Area | Approximated Chronological Range |
| Xlendi Dataset | Eastern Mediterranean | First Millennium BCE |
| *N. S. Mártires* Dataset | Europe, Africa, and Asia | XVI and XVII Centuries |

*The importance of this project*

To achieve our goal of presenting a kaleidoscopic view of part of Humanity’s seafaring history we need to focus first on the building blocks of our project, such as: a) scholarly-built datasets pertaining to the history of shipbuilding, focusing both on the conception and the construction of these complex artifacts; b) databases of artifacts; c) a wide range of chronologies, for the histories of ideas, science, economy, technology, and artistic taste, as well as political chronologies, for historical periods, dynasties, conflicts, or discoveries; d) organized datasets from archaeological excavations, such as those generated by the excavation of the Bronze Age Xlendi shipwreck, or the early XVII century *N. S. dos Mártires*.

The history of shipbuilding will deserve a special attention (Castro et al. 2018). Starting in the 1980s, J. Richard Steffy saw computers as promising tools for the study of shipbuilding as a component of the histories of ideas, technology, and science. Comparative studies seemed to him, as they seem to us now, like a natural way to understand shipbuilding as a particular type of human behavior, and his first step was inventorying and comparing construction features. This was not an easy endeavor. Of the ships studied by Steffy for his original database, he found that little more than half had been formally published, and that on the ones that were published, the details recorded varied with different academic priorities, and as such the information reported was difficult to compare across wrecks. In the mid-1990s J. Richard Steffy developed a database of ship components and wrote a seminal book where he set the theoretical frame to better study the history of wooden shipbuilding [Steffy 1990, 1994]. These components were described as segmented in units of knowledge that described their function, design, manufacture, and relation to other components, and tried to encompass a wide array of western shipbuilding traditions which developed through time and space, sometimes separately, other times by diffusion of concepts and innovations. The main purpose of Steffy’s work was to establish relations between conception and construction traits in a manner that allowed comparisons between objects and concepts.

Around a decade later, Carlos Monroy transformed Steffy’s database into an ontological representation in RDF-OWL and expanded its scope to potentially include other archaeological materials [Monroy 2010]. After establishing a preliminary ontology, completed through a number of inter- views with naval and maritime archaeologists, Monroy combined the database with a multi-lingual glossary and built a series of relational links to textual and iconographical evidence, which aimed at contextualizing the archaeological information contained in the database. His work proposed the development of a digital library that combined a body of texts on early modem shipbuilding technology, tools to analyze and tag illustrations, a multi-lingual glossary, and a set of informatics tools to query and retrieve data (Monroy et al. 2007a, 2007b, 2007c). In this context, a team of diverse scholars from different institutions developed a repository of data related to ships (https://nadl.tamu.edu/), seafaring and maritime landscapes built as a community project with the objective of making data sets available in an organized matter for comparison purposes (Monroy et al. 2006).

*The state of the art*

***…***

*Shipwrecks*

Nautical archaeology studies and attempts to reconstruct lost types of watercraft from the remains of ships, crews, and cargoes archaeologically excavated. It encompasses underwater archaeology, a set of methods to work in submerged environments, and maritime archaeology, which is the study of aquatic ecological niches, landscapes, and cultures, from the material remains that survived in time.

Most data available comes either from non-intrusive survey methods, from vague news of shipwrecks found and destroyed by looters of treasure hunters, or from shipwreck summarily excavated and never fully published. The retrieval, storage, analysis, and interpretation of these data requires both the simplification of the processes of collection and analysis of archaeological data, and the development and analysis of possible relations between measurable objects and concepts.

# The objectives

As stated before, the main objective of this project is to develop informatics tools that will connect information from diverse sources and help re-write the last three millennia of the history of European seafaring.

Archaeologists construct and deconstruct past narratives and have the power to impact society by making multiple narratives of the same event available to the general public and invite citizens to understand the plurality and diversity of viewpoints that make each accepted narrative. Moreover, we want to make this knowledge accessible not only to researchers, but also to students with a wide range of backgrounds and ages, and the general public. The dissemination of knowledge to wide publics is not a trivial problem. Making research accessible requires the definition of pedagogic strategies to disseminate the conflicting viewpoints and narratives that make the history of everyday life.

Archeology can no longer the activity of isolated scholars with the means and the power to define their own publication agendas. The survival of the discipline depends increasingly on the public recognition of its social value, and this recognition entails a vast program of data sharing in ways that can be enjoyed by a public with no special computer skills.

We want to extend these efforts into the collection of data, expansion of the analysis of measurable objects, and lay the base for the construction of extensive taxonomies of archaeological items.

The applications of this theoretical approach are obvious. It simplifies the acquisition, analysis, storage, and sharing of data in a rigorous and logically supported framework. These four advantages are particularly relevant in the present political and economic world context, where financial resources for long term projects are scarce.

# The research team

This project is multidisciplinary and based on rather diverse sets of skills. The team will be composed by a PI, xxxx senior researchers, xxx post-doctoral researchers, a Project Manager (Senior Staff), and an IT team. Additionally, to fulfill the training component, the team will be completed with two PhD students, enrolled in the Doctoral program in xxx

Pierre Drap *Architecture*

Pierre’s former student *Development*

Timmy Gambin *Dataset 3*

Richard Furuta *Digital Libraries*

Ergun Akleman *Visualization*

Alexandre Monteiro *Dataset 1*

Miguel Martins *Dataset 2*

José Virgílio Pissarra *History*

Tania Casimiro *Artifact collections*

Gonçalo Calado *Ecology*

Two PhD Students

Administrative manager

# Novelty and relevance of the proposal

This project will identify, classify, study, relate, and make available a large variety of datasets related to the history of European seafaring and the continent’s relation with rivers, lakes, estuaries, coasts, and oceans.

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**Texts to canibalize**

Shattering the secrecy that traditionally surrounded archaeological excavations. In light of this new climate, uniformity in the methods used to publish archaeological data is more important than ever, and as such it is appropriate to re-issue J. Richard Steffy’s 1995 proposal to standardize the publication of shipbuilding data.

The traditional situation of secrecy and lack of circulation of images and primary data in archaeology is changing drastically, together with the global rate of literacy, and it seems safe to assume that in a near future archaeology will be a cosmopolitan a discipline, producing cosmopolitan narratives, based on a much wider concept of culture than in the past century. The most important factor in this situation is the need to publish and make available every excavation in the world. Title XIV of the rules the UNESCO Convention for the Underwater Cultural Heritage is clear on the importance of the dissemination of knowledge. Only a few years ago, in his introduction to the Oxford Handbook of Maritime Archaeology (2011), George Bass pointed out that, as a class, archaeologists have a past track record of negligence: it seems that we publish approximately 25% of the sites excavated. Bass’ assumption is based on a number of studies suggesting that over the last 50 years, less than 25% of the materials and results of professional archaeological excavations have been properly published (Boardman 2009), 70% of the Near East excavations have not been published (Atwood 2007 and Owen 2009), and that perhaps 80% of all Italian archaeological materials remain unpublished (Stoddart and Malone 2001). It is difficult to argue that the situation in maritime archaeology is better than those mentioned above, and the authors intend this paper as a manifesto on the urgency of a wide and complete sharing of archaeological information in maritime archaeology. With the progressive growth of the field and the anticipated increase in ship excavations, standardization of the recording process is a necessity.

Ships can be studied from four basic viewpoints: from a social-oriented viewpoint, as “a part of everyday existence and (…) as evidence for aspects of the past that can be known imperfectly from other kinds of evidence,” (Upton 1983); from a culture-oriented viewpoint, looking at their construction features as memes – here understood as units of cultural ideas that can be transmitted and modified – related to the different European cultures at play, something that Ole Crumlin-Pedersen called cultural fingerprints, and Eric Rieth referred to as architectural signatures. (Upton 1983; Crumlin-Petersen 1991; Rieth 1998); from a symbolic-oriented viewpoint, focusing on decorative and aesthetic elements, as well as the symbolic character of architectural solutions and the images ships evoked in people’s minds (Bachelard 1957; Upton 1983); and from a more prosaic viewpoint, which we will call an object-oriented viewpoint, concerned with the ships as artifacts. This last viewpoint is fundamental and, we would argue, precedes the former. To understand ships we need to know when they were built, how they were conceived, built, and improved, how quality was perceived, where did knowledge reside, and how it was it transferred (Upton 1983).

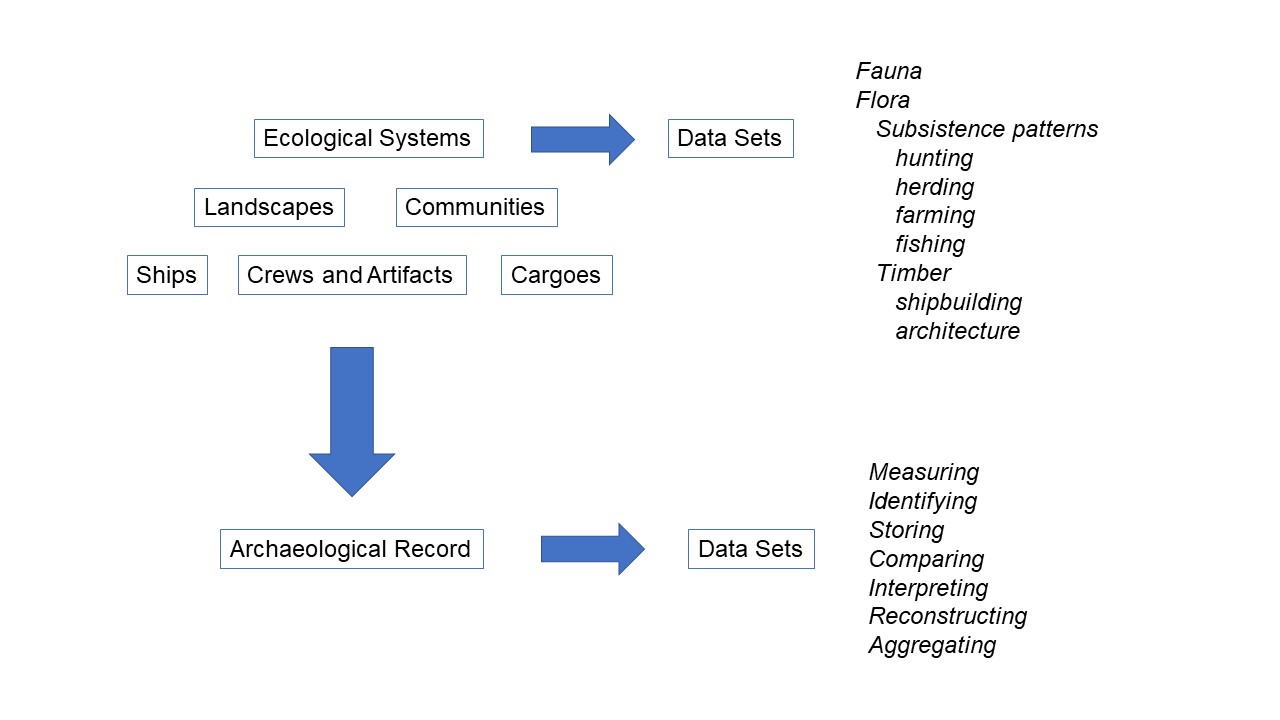
This first step encompasses the study of ship remains. Ships are wooden artifacts built for transport, fishing, war, or pleasure, and must be studied from a technological viewpoint, which is a part of the process that aims at understanding their importance as means of deploying power, transferring wealth, carrying merchandise, people, diseases, and ideas. Ships have been vectors of commerce and exchange, and they are intimately related to the creation and accumulation of wealth and power. Technological differences between the ships of different core and periphery regions – to borrow the Eurocentric spatial/economical concepts from Immanuel Wallerstein’s World Systems framework (2011a; 2011b) – must be discussed in terms of performance, cost, durability, and purpose, as the study of ship design and construction. Studied in combination with an archaeological framework, this analysis may help anthropologists, sociologists, and historians understand comparative advantages between the ships of the last millennium. Tonnage, displacement, cost, number of crew members per ton, capacity in relation to displacement, speed, structural strength, and lifecycles are important factors influencing the development of a region, and nautical archaeology is capable of retrieving data that speaks to these aspects.

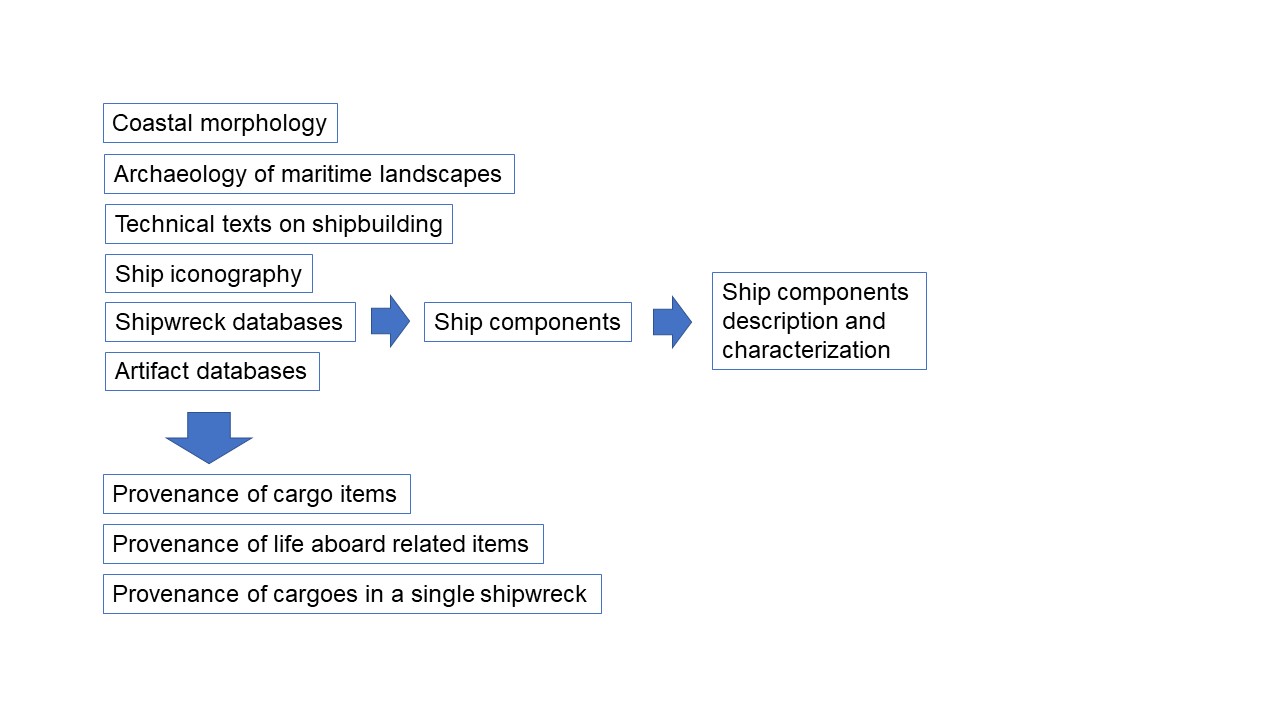
Ships carried people, goods, and ideas. The history of seafaring is an important component of the history of mankind, and ships are among the most complex machines built and used by any culture.

The European history of seafaring is the base of an important number of narratives that make the European identity and help define its culture. Watercraft connects us and transporting weights over water is considerably cheaper and faster. The study of shipwrecks is an invaluable source of information about ships, crews, cargoes, routes and the societies that built and manned them. Ships are repositories of information, clusters of ideas, tastes, materials, peoples, and cargoes with vastly different origins and destinations, found together aboard due to serendipitous reasons. Unlocking their secrets requires a holistic approach, based on data mining strategies designed by a variety of domain experts with multidisciplinary skills and, above all, the definition of ontologies to describe them that can adapt as knowledge evolves, and encompass enough flexibility to establish connections and operate on networks of information with diverse levels of uncertainty.

Our preliminary task will be to develop lists of historical facts, variables, and sources. The main purpose of this project is to design ontologies that relate shipwreck data and can be queried in order to understand patterns of behavior such as webs of commerce, social and economic environments, maritime landscapes, or technological asymmetries, but also mentalities, gestures, tastes, and personal worldviews associated with the vast and complex world of seafaring.

We will focus on three starting sets of data, two horizontal, composed of all the Portuguese shipwrecks known around the world and all the shipwrecks known on the coast of Portugal, and one vertical, pertaining to the decade long excavation of the late Bronze Age Xlendi shipwreck, in Malta.Our relationship with water bodies is old and runs deep, and ships and coastal communities have been preferred habitats for many cultural groups since long. Rivers, lakes and oceans connect people, and communities connected to water bodies develop particular cultures or, in the words of sociologist Fons Trompenaars, ways of solving problems together [1]. Moreover, culture is all encompassing: artifacts and cultural facts of every maritime community are interconnected in synchronic and diachronic ways.





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