

Methodologies for the valorisation of research applied to the fortified heritage. The INFORTREAT project

Original

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Michele RUSSO, Marta ACIERNO (Eds.)



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Methodologies for the valorisation of research applied to the fortified heritage. The *INFORTREAT* project

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Abstract

This contribution focuses on data communication and on the enhancement of research outputs developed within the PRIN2022 *INFORTREAT* project. Among the numerous challenges addressed by the project – ranging from the study of architectural treatises to field applications through advanced surveying and parametric modelling techniques – emerges the need to valorise information and results for their dissemination and reuse, both within and beyond the scientific community. At the core of the work lies the definition of a dynamic digital infrastructure – or information architecture (IA), the structural framework of a digital system – designed to facilitate the retrieval of materials and to collect useful information for future investigations in the field of fortifications, in accordance with the principles of Open Science. The system is based on the data collected during the study of selected treatises considered fundamental for discipline. Accessible through the project's website, the database organises this information to create links between the addressed themes, thus enabling cross-searches by multiple keywords and allowing the extraction of data on specific topics from different sources and authors. The platform, open and dynamic, goes beyond the mere restitution of objective data, as it also integrates interpretations elaborated by the research group through in-depth studies. The systematisation of these materials not only highlights disciplinary relationships among the authors of historical treatises but also simplifies access to data, gathered within a single digital space. The proposal therefore illustrates a research and design methodology oriented towards the creation of a system able both to valorise the work already carried out and to support and enrich future investigations. Thanks to its flexibility, the platform is conceived to be implemented and expanded over time. As such, it envisages a system which – like the fortifications under study – can withstand the passage of time, evolving and fostering the active participation of the scientific community dedicated to the study of fortifications.

Keywords: INFORTREAT, Open Science, military architecture treatises, enhancing research.

1. Introduction

The contribution presents part of the progress of the National Research Project – PRIN 2022 entitled *INFORTREAT*. Reconstructing the Early Modern bastioned front. Information models for the fruition of constructive knowledge in FORTified architecture TREATises (16th–18th Century): a new integrated analysis tool for the interpretation, restoration and maintenance of early modern fortified heritage. The partners involved are: University of Pisa, Politecnico di Torino, University of Padua and Sapienza University of Rome. The project develops digital information systems to collect, translate and make accessible the knowledge on bastioned fortifications contained in early modern military architecture treatises (16th–18th century), to support the conservation of fortified heritage. Through the analysis of historical sources, textual and visual information is processed into 3D models and H-BIM environments. The project produces a BIM library of parametric components of historical fortifications and enables the generation of specific digital models, which are then compared with real case studies. In addition to digital modelling, a relevant part of the project is dedicated to the identification of authors and treatises considered fundamental for the development of the discipline. These sources have been analysed and studied through a process of critical cataloguing, applied to a selection of 24 treatises - chosen among those considered as key reference in the history of theory of fortifications - divided among the researchers involved in Work Package 3 – WP3. selection and digital database construction of military architecture treatises, carried out by the University of Pisa and Politecnico di Torino.

2. *INFORTREAT* Open Science

This contribution focuses on the theme of accessibility and digital dissemination of scientific research, proposing a reflection on the enhancement of results through the analysis of an applicative case study in the field of fortifications, developed within *INFORTREAT*. Among its main objectives, the project aims to ensure accessibility and sharing of the results achieved by the research group, in line with the principles of Open Science. At the core of this contribution, and in accordance with the general objectives of the *INFORTREAT* project, lies the definition of a dynamic digital platform, designed to facilitate

the retrieval of scientific materials and to collect useful information for a heterogeneous audience, with different levels of expertise, interested in the world of fortifications. This paper, therefore, focuses on the methods of enhancing the cataloguing process, with reference to the design activity named Web-Based Digital Platform, foreseen in WP7. The authors contribute to the project with the intent of enhancing the results obtained, paying particular attention to the web usability of digital information models and the consultability of the outcomes of the historical studies on early modern military architecture treatises.

3. Towards an Open Science: practices, challenges and international perspectives

Effective research is not necessarily measured by its ability to provide definitive answers, but rather by its openness to new insights, interpretations and future developments. This perspective introduces some fundamental and shared ethical principles that overcome rigid disciplinary boundaries, as they are, or at least are expected to be, based on concepts such as the replicability of data, key elements for the progress of scientific research (Moedas, 2016). It is in this sense that the principles of Open Science (OS) are positioned: a set of practices that promote the accessibility, clarity, and implementability of data, tools and scientific evidence, making the process replicable and further developable by other researchers (Nowotny, 2015). Its cornerstones include: open access to publications (Open Access), the sharing of research data (Open Data), the transparency of scientific processes, the involvement of society, and the use of open digital infrastructures. Underlying these elements is a fundamental ethical principle, particularly concerning the respect of copyright. The European Union strongly promotes this strategy, highlighting how data transparency fosters the construction of a structured and interdisciplinary network, capable of enriching research and bringing it closer to society. It is no coincidence that, in the European Horizon Europe calls, the promotion of scientific data and results through Open Science systems is mandatory (European Commission, 2025). A decisive criterion for assessing compliance with OS is adherence to the FAIR principles (Findable, Accessible, Interoperable, Re-usable), which do

not define specific technologies but rather shared objectives to make data more usable (Wilkinson et al., 2016). The push towards the adoption of these principles aims at improving research infrastructure. However, the approach is still in an evolving and consolidating phase, as highlighted by numerous studies analysing its advantages and criticalities, particularly the difficulty of defining common guidelines and shared communication systems (Klebel et al., 2025; Dudda et al., 2025; Van Vaerenbergh et al., 2025). For Open Science to be fully effective, it must be embraced on a global scale, requiring a profound change in the international scientific culture, as authoritatively emphasized by UNESCO in its Open Science Outlook 2023 (UNESCO 2023: p. 15).

4. Digital Heritage collection for an accessible dissemination

Considering the principles of Open Science as essential, it is now appropriate to delimit the specific disciplinary field of the contribution: early modern age fortifications. This is a topic that involves heterogeneous research areas, linked to the study of historical sources and architectural analysis through an approach that integrates theory and constructive practice. To understand the innovative contribution of the proposal presented here, it is necessary to contextualise the design activity within the existing panorama. The issue of access to historical documentation and the structuring of reliable databases is crucial for the progress of research. In the architectural field, but not only, numerous systems are already active: BnF Gallica (<http://gallica.bnf.fr/>), for example, is one of the most well-known, providing access to over one million digital contents belonging to different disciplines. This network represents a fundamental reference for treatises studies, offering accessibility to historical documents entirely remotely. Many institutions, with different tools and methods, are advancing towards the structuring of accessible information systems that enhance the richness of their archives, making materials available that would otherwise remain hidden. At the basis of this process lies digitisation, which allows archives and museums to bring to light and make available large quantities of materials; among the many examples, one may cite the Archivio del Moderno in Mendrisio. Despite these initiatives, most existing databases are configured as autonomous

digital infrastructures, lacking external connections and therefore intrinsically limited. The possibility of having a unified digital space, capable of integrating information from different domains, is complex to achieve, but certainly desirable. The Europeana (www.europeana.eu) project moves in this direction, creating a European platform able to gather heterogeneous contents and to offer a single place where scholars can easily access a wide range of information related to European cultural heritage. Considering these aspects, it becomes evident that for a datum to be truly useful, it is essential that it be placed in a functional way and in accordance with the needs of other researchers.

5. Methodology

The research and design activities led by the authors of this contribution comprehend the design of the website interfaces dedicated to the documents collection, research, examination and download as well as the re-design of technical data sheets resulting from in-depth scientific analyses developed by the researchers involved in the aforementioned project *INFORTREAT* and institutions. In order to meet the expected results and outputs of the project, the methodologies and approaches adopted along the research and design phases conducted to generate the digital outputs narrated in this contribution refer to the field of User Experience (UX) Design as this approach to the research and design processes succeeds in both understanding profoundly user targets' needs, familiarities and expectations and translate them in precise design requirements that are met in usable and intuitive digital outputs. The UX Design Process is indeed rhythmised by the combination of relevant tools and methodologies precisely capable of understanding and analysing a scenario, spotting the design opportunities and formulating solid hypotheses regarding the use of a digital system and the flux of interactions between the users and digital applications. The methods used by the contributors to proceed in the design outputs ideation are described as follows, specifying for which design outputs they were useful and what were the results of their application. Starting from the re-design of the data sheets displaying the scientific analysis of the selected fortifications treatises, a benchmarking analysis was conducted to take inspiration from structured ways to communicate scientific-relevant data and display them with

visual consistency and coherence as well as support the comprehension through graphical and involving assets in order to ‘open’ scientific data to the audience and support its understanding with visual devices. By searching examples of how market actors display scientific data resulted useful to understand strengths and pain points to get inspired by or give up on. Using this method, it was particularly interesting looking at examples of data communication, whether scientific or not, even those unrelated to the topics covered in this contribution, in order to understand how to potentially innovate data communication while maintaining its scientific nature, thus proposing methods and means that are well-known and commonly used in the world of communication but not traditionally employed for scientific documentation such as treatises on fortifications. Regarding the intervention in the already existing website of *INFORTREAT* project, the contributors first achieved the Information Architecture (IA) of the web page dedicated to host the archive and research input. The IA is a research output corresponding to a graphical scheme representing the contents displayed in a digital system and their underlying organization, structure, and nomenclature defining the findability, usability, and accessibility of the digital system (Cardello, 2023). This method was used as it allowed to imagine correctly where the new webpage would have been inserted in the already existing website, in order to keep the web structure the most similar and neat of the original configuration as possible and to prevent users from feeling disoriented in an already-known platform, and define and evaluate the disposition of contents in the new page to achieve usefulness, accuracy and overall effectiveness. This last objective was particularly important given the nature and objective of the archive page as users would interact with a research filtering system based on technical terminology: since the task is naturally complex, it’s essential not to force users to exert unnecessary cognitive effort. Finally, a wireframe was designed to imagine the layout of the contents displayed in the new webpage. Wireframes are the blueprints of digital systems’ interfaces, and they represent essential elements, components, and features of a digital output that help communicate to the design team and stakeholders what the interface is going to display and how (Figma, 2025a; 2025b). Wireframing already falls into the prototyping phase and employing this method helped the contributors of

this paper to reason together about the content disposition in the new webpage at a very early stage and prove the ease in navigating and interacting with UX design elements within the page simulating also some use situations, thus specific scenarios in which a user interacts with the page to achieve a specific goal (e.g. searching a document of an known author) (<https://www.figma.com/resource-library/what-is-a-use-case/>). Additionally, wireframes usually differ in terms of the degree of completeness of the interface, i.e. how close they are to the final result, and they can fall under the label of low-fidelity, mid-fidelity and high-fidelity prototypes; in this case, the contributors achieved a simple yet effective low-fidelity prototype that sooner was used as a baseline for the actual development of the webpage.

6. Research and Design Process

In the following paragraph of the contribution it will be thoroughly described the process adopted to achieve the desired research and design results, thus consisting in the ideation of an easy-to-read and engaging layout for the scientific analysis conducted by research team members of *INFORTREAT* project and the development of the usable and accessible Archive webpage hosted in the already-existing *INFORTREAT* website.

6.1. Scientific Data Sheets

Among the 24 treatises selected and analyzed by *INFORTREAT* project members, the authors of this contribution chose to use as applicative case 3 of them, specifically the ones entitled *Trattato di Fortificatione* of Guarino Guarini, *Corno Dogale* of Pietro Sardi, and *Delle Fortificationi* of Galasso Alghisi. This selection was made to formalize a flexible proposal modular to the resting part of the treatises analyzed.

In order to achieve a simple and easy-to-read graphic representation and layout so that consultation with the technical data sheets would facilitate the retrieval of useful information for the scientific community, the authors of the contribution focused on identifying a graphic language capable of systematising and enhancing the information contained in the analyses, in order to make them more accessible and usable once archived in the digital platform. Using the software Figma, some greyscale drafts were designed to imagine the new layout of the

analysis data sheets (Fig. 1). Given the technical and scientific complexity of the treatises and the quantity of information displayed in the analyses, the team of contributors proposes a neat layout useful to cluster the information narrated into coherent groups and to dedicate each group a

space in the layout. It was decided to opt for a horizontal ratio in order to depict all the information needed in the dedicated page at a time, imagining users skim-reading the documents by their computer desktops and thus exploiting the 16:9 proportion of the screen.

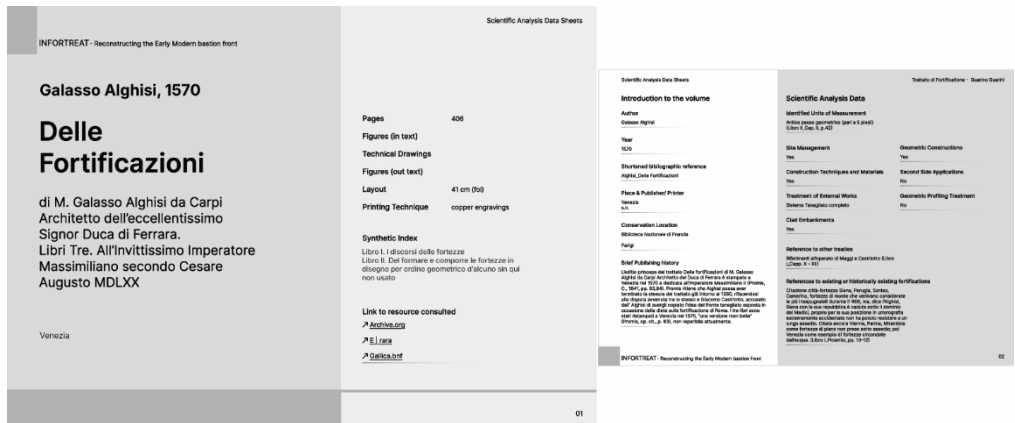


Fig. 1- Analysis data sheets layout (Author: M. Rinascimento)

The adopted layout was conceived in an orderly and clear manner, articulating the main information into three sections: the first, dedicated to the header, contains the fundamental data of the volume; the second organises the contents considered most relevant; and the third, finally, gathers the additional information, including bibliographic references. As for the opening page, the choice was made to highlight the main elements with maximum clarity — author, year, title, publisher and place of publication. The colour scheme follows the palette used in the project (Fig. 2). Finally, it was decided to make technical data sheets available as downloadable PDF documents, a decision that would facilitate not only reading the document itself but also sharing the document and exchanging information between users and members of the scientific community in case they have doubts or need to discuss information, research and analysis results.

6.2. The Research Archive webpage

Starting from the design of the webpage hosting the archive and search interactions, a wireframe depicting the user interface was designed using the software Figma (Fig. 3) which was later used as a blueprint to develop the actual library of documents and the search system using

Wordpress and its plugin Barn2 (Fig. 4). Given the breadth of the topics covered in the fortification treatises analysed and the heterogeneity of the content, as well as their technical and scientific complexity, it was necessary to define first useful criteria for classifying the documents to be displayed and identifying in advance certain elements considered strategic as research inputs usable by users when interacting with the digital archive webpage.

The proposed filtering system is advanced and allows users to filter and search for documents of interest according to the following criteria: author, year and tags. The first two search criteria are common to many archive systems that manage sources and research documents, while the third was added because of the results that emerged from the analysis of fortification treatises. This criterion refers to technical terms commonly used in the field of fortification studies, the so-called ‘Connotative Data’ and they include the following tags: site management, geometric constructions, construction techniques and materials, second side applications, treatment of external works, geometric profiling treatment, clad embankments. By adding these searchable tags, users could be supported in finding the right document depending on their research interests.

Additionally, users can either search the document needed by inputting directly its name in the search bar displayed to the right of the filtering system. In order to provide an intuitive, user-friendly and efficient archive page, the digital archive storing all the documents of the analyzed treatises are displayed as a table in the webpage so that users are provided with an additional method to navigate the library and search their document of interest, thus by

scrolling down until they find what they want. These design choices resulted in providing two fluxes of interaction, thus a more guided and structured navigation and search interaction and a freer one according to the user's choice. This was done so that the navigability and usability of the search system would meet the expectations and digital habits of users, including both those unfamiliar with the subject and experts who were not involved in the project.

IN FOR TREAT - Reconstructing the Early Modern bastion front

Guarino Guarini, 1676

Trattato di Fortificatione che hora si usa in Fiandra, Francia, & Italia

Composto in Ossequio del Sereniss. Principe Lodovico Giulio Cavagliere di Savoia da D. Guarino Guarini Chierico Regolare

Torino: Appresso gli'Heredi di Carlo Gianelli Con Licenza de' Superiori

Scientific Analysis Data Sheets

Pages	128
Figures (in text)	57
Technical Drawings	1, end of Preludio I
Figures (out text)	12
Layout	in-octavo 10,2×18,1 cm
Printing Technique	xilography

Synthetic Index

- Dedica al Principe Lodovico Giulio
- Dedica ai Lettori
- Preludio I (principi di geometria piana)
- Preludio II (principi di aritmetica)
- Architettura militare
- Libro I (principi dell'architettura militare)
- Libro II (fortezze irregolari)
- Libro III (seconda delineazione - pianta e prospetto)
- Libro IV (costruzione di fortezze in luoghi particolari)
- Libro V (arte della guerra - attacco)
- Libro VI (arte della guerra - difesa)

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Italiani alمامانی

01

Scientific Analysis Data Sheets

Introduction to the volume

Author
Guarino Guarini

Year
1676

Shortened bibliographic reference
Trattato di Fortificatione

Place & Publisher/ Printer
Torino
Appresso gli'Heredi di Carlo Gianelli
Con Licenza de' Superiori

Conservation Location
Biblioteca di storia ed analisi dell'architettura e degli insediamenti
Castello del Valentino,
Politecnico di Torino

Brief Publishing history

Link to resource consulted
Original resource
[Google Books](#)
last consultation 08/05/2024

Trattato di Fortificatione - Guarino Guarini

Scientific Analysis Data

Identified Units of Measurement

Piede geometrico, coincide con il piede del Re usato in Francia e corrisponde a sette once di piede liprando, cioè circa 0,299697 m (Guarini, p. 44)

Piede olandese, pari a circa 0,283133 m è il riferimento per le costruzioni di baluardi all'olandese (pp. 47-48)

Site Management	Geometric Constructions
No	Yes
Construction Techniques and Materials	Second Side Applications
Yes	Yes
Treatment of External Works	Geometric Profiling Treatment
Yes	Yes
Ciad Embankments	
Yes	
Reference to other treatises	
Goldmann Pagan Doghen Fritsch (p. 48)	
References to existing or historically existing fortifications	

02

Fig. 2- Excerpts from the documentation sheet of Guarino Guarini's treatise (Author: A. Meloni)

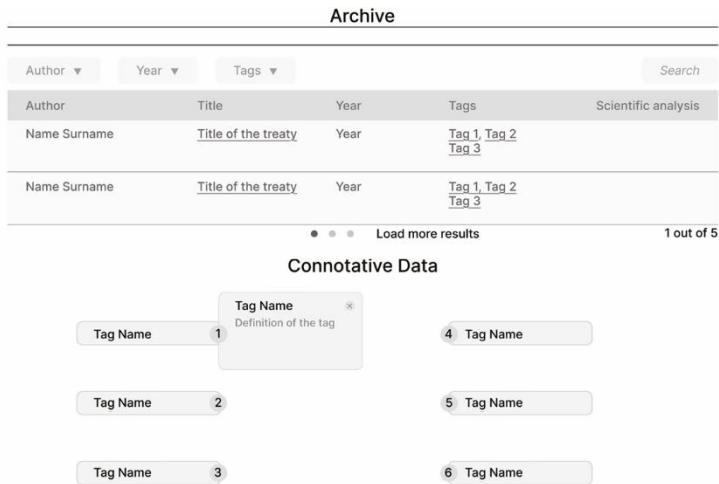


Fig. 3- Design layout of the web page produced using Figma (Author: A. Meloni)

These choices proved to be decisive in designing a smooth digital user experience through an effective, intuitive and satisfying navigation system, capable of ensuring a direct link to both the sources available for consultation and the other outputs of the project. While the search the inputs are the author of the treaty, the year of writing and the aforementioned tags, it was

decided that the outputs displayed would additionally be the title of the treaty and, coherently to the objectives of easiness of dissemination and consultation of this contribution, the downloadable document corresponding to the scientific data sheets previously discussed.

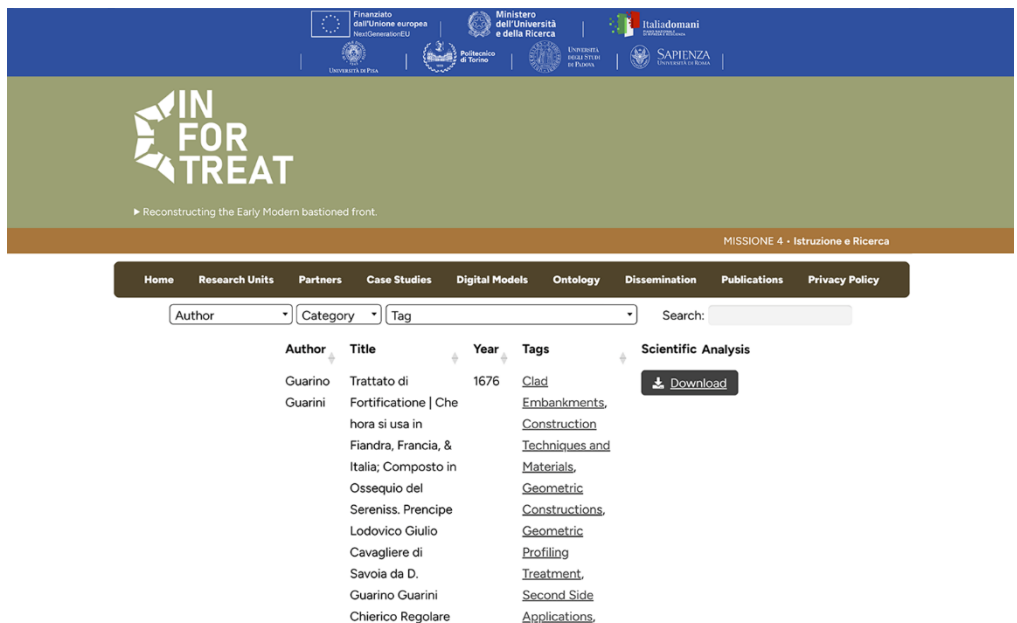


Fig. 4- Example of the interface of the project website developed using Barn2 (Author: M. Rinascimento)

7. Conclusions

The contribution demonstrates how the application of Open Science principles, combined with a design approach oriented towards user experience, can generate innovative tools for the sharing and enhancement of historical and scientific heritage. The development of an accessible and navigable digital archive not only systematises the analytical work on military architecture treatises but also extends it to a broader and more diverse audience, fostering new opportunities for interdisciplinary research. The experimentation carried out through the design of scientific data sheets and the web platform has highlighted the importance of translating complex content into clear and usable communicative forms, without compromising scientific rigor. This balance is an essential condition for ensuring that data are not only preserved but, above all, reused, in line with the FAIR principles. In perspective, the work paves the way for further developments: from the integration with other archives and digital infrastructures, to the experimentation of more advanced modes of consultation. In this sense, the

INFORTREAT project is not limited to being a mere repository of data, but is configured as a laboratory of practices for the innovation of historical and architectural research, contributing to redefining the role of digital technologies in the transmission of knowledge.

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