POLITECNICO DI TORINO
Repository ISTITUZIONALE

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

Original
Methodologies for the valorisation of research applied to the fortified heritage. The INFORTREAT project / Meloni, A., Rinascimento, M., Bevilacqua, M.G., Spallone, R.. - ELETTRONICO. - 24:(2026), pp. 173-180. (International Conference on Fortifications of the Mediterranean Coast FORTMED 2026 Roma (IT) 18-21 Febbraio 2026) [10.4995/Fortmed2026.2026.21494].

Availability:
This version is available at: 11583/3007681 since: 2026-03-04T13:11:15Z

Publisher:
Sapienza Università Editrice - edUPV (Universitat Politècnica de València

Published
DOI:10.4995/Fortmed2026.2026.21494

Terms of use:

This article is made available under terms and conditions as specified in the corresponding bibliographic description in the repository

Publisher copyright

(Article begins on next page)

26 November 2026

24 DEFENSIVE ARCHITECTURE OF THE MEDITERRANEAN

Michele RUSSO, Marta ACIERNO (Eds.)



DEFENSIVE ARCHITECTURE OF THE MEDITERRANEAN

Vol. XXIV

DEFENSIVE ARCHITECTURE OF THE MEDITERRANEAN

Vol. XXIV

Editors
Michele Russo, Marta Acierno
Sapienza Università di Roma

SAPIENZA
UNIVERSITÀ DI ROMA

edUPV
Universitat Politècnica de València

Series *Defensive Architecture of the Mediterranean*

General editor: Pablo Rodríguez-Navarro

The papers published in this volume have been peer-reviewed by the Scientific Committee of FORTMED2026_Roma
© editors: Michele Russo, Marta Acierno
© editorial team: Silvia Seller, Martina Casciola, Giovanna Ferra, Giulia Flenghi, Carlotta Mellone, Luca Martelli
© cover picture: Francesco Giampietro
© papers: the authors
© publishers: Sapienza Università Editrice, edUPV (Universitat Politècnica de València)

© Copyright 2026 Sapienza Università Editrice
Dipartimento di Storia, Disegno e Restauro dell'Architettura
ISBN: 978-88-9377-433-8 (three-volume collection)
DOI: https://doi.org/10.13133/9788893774338
ISBN: 978-88-9377-436-9 (vol. 24)
DOI: https://doi.org/10.13133/9788893774369

© Copyright edUPV (Universitat Politècnica de València) 2026
ISBN: 978-84-1396-410-2 (three-volume collection)
ISBN: 978-84-1396-413-3 (vol. 24)
edUPV Ref. 6859_01_01_01
DOI: https://doi.org/10.4995/Fortmed2026.2026.21474
ISSN: 2792-5633 (Series *Defensive Architecture of the Mediterranean*)

Proceedings of the International Conference on Fortifications of the Mediterranean Coast FORTMED 2026
Roma, 19, 20 and 21 February 2026

CC BY-NC-SA 4.0
Legal Code: https://creativecommons.org/licenses/by-nc-sa/4.0/legalcode.en



© 2026 Sapienza Università di Roma / edUPV

Organization and committees

Organizing Committee

Chairs:
Russo Michele. Sapienza Università di Roma
Acierno Marta. Sapienza Università di Roma

Scientific Secretary:
Seller Silvia. Sapienza Università di Roma

Topic Chairs:
Acierno Marta. Sapienza Università di Roma
Cutarelli Silvia. Sapienza Università di Roma
Russo Michele. Sapienza Università di Roma
Spadafora Giovanna. Università di Roma Tre

Members:
Casciola Martina, Ferra Giovanna, Flenghi Giulia, Martelli Luca,
Mellone Carlotta. Sapienza Università di Roma

Scientific Committee

Acierno, Marta. Sapienza Università di Roma. Italy
Almagro Gorbea, Antonio. Real Academia de Bellas Artes de San Fernando. Spain
Barrera Vera, José Antonio. Universidad de Sevilla. Spain
Bertocci, Stefano. Università degli Studi di Firenze. Italy
Bevilacqua, Marco Giorgio. Università di Pisa. Italy
Bouzid, Boutheina. École Nationale d'Architecture. Tunisia
Bragard, Philippe. Université Catholique de Louvain. Belgium
Bru Castro, Miguel Ángel. Instituto de Estudios de las Fortificaciones – AEAC. Spain
Cámara Muñoz, Alicia. UNED. Spain
Camiz, Alessandro. Özyeğin University. Turkey
Campos, João. Centro de Estudos de Arquitectura Militar de Almeida. Portugal
Castrorao Barba, Angelo. Escuela de Estudios Árabes, CSIC. Spain
Cherradi, Faissal. Ministère de la Culture du Royaume du Maroc. Morocco
Cirafici, Alessandra. Università degli Studi della Campania *Luigi Vanvitelli*. Italy
Cirillo, Vincenzo. Università degli Studi della Campania *Luigi Vanvitelli*. Italy
Cobos Guerra, Fernando. Arquitecto. Spain
Columbu, Stefano. Università di Cagliari. Italy
Coppola, Giovanni. Università degli Studi Suor Orsola Benincasa di Napoli. Italy
Córdoba de la Llave, Ricardo. Universidad de Córdoba. Spain
Cornell, Per. University of Gothenburg. Sweden
Corniello, Luigi. University of Campania *Luigi Vanvitelli*. Italy
Cutarelli, Silvia. Sapienza Università di Roma. Italy
Daci, Entela. Universiteti Politeknik i Tiranës. Albania
Dameri, Annalisa. Politecnico di Torino. Italy
Eppich, Rand. Universidad Politécnica de Madrid. Spain
Fairchild Ruggles, Dorothy. University of Illinois at Urbana-Champaign. USA
Fatta, Francesca. Università Mediterranea di Reggio Calabria. Italy
Faucherre, Nicolas. Aix-Marseille Université – CNRS. France
Fiorino, Donatella Rita. Università degli Studi di Cagliari. Italy

García Porras, Alberto. Universidad de Granada. Spain
García-Pulido, Luis José. Escuela de Estudios Árabes, CSIC. Spain
Georgopoulos, Andreas. Nat. Tec. University of Athens. Greece
Gil Crespo, Ignacio Javier. Asociación Española de Amigos de los Castillos. Spain
Gil Piqueras, Teresa. Universitat Politècnica de València. Spain
Guarducci, Anna. Università di Siena. Italy
Guidi, Gabriele. Politecnico di Milano. Italy
González Avilés, Ángel Benigno. Universitat d'Alacant. Spain
Hadda, Lamia. Università degli Studi di Firenze. Italy
Harris, John. Fortress Study Group. United Kingdom
Islami, Gjergji. Universiteti Politeknik i Tiranës. Albania
Jiménez Castillo, Pedro. Escuela de Estudios Árabes, CSIC. Spain
León Muñoz, Alberto. Universidad de Córdoba. Spain
López González, Concepción. Universitat Politècnica de València. Spain
Marotta, Anna. Politecnico di Torino. Italy
Martín Civantos, José María. Universidad de Granada. Spain
Martínez Medina, Andrés. Universitat d'Alacant. Spain
Mazzoli-Guintard, Christine. Université de Nantes. France
Mirabella Roberti, Giulio. Università degli Studi di Bergamo. Italy
Mira Rico, Juan Antonio. Universitat Oberta de Catalunya. Spain
Navarro Palazón, Julio. Escuela de Estudios Árabes, CSIC. Spain
Orihuela Uzal, Antonio. Escuela de Estudios Árabes, CSIC. Spain
Pane, Andrea. Università Federico II di Napoli. Italy
Parrinello, Sandro. Università di Pavia. Italy
Pirinu, Andrea. Università di Cagliari. Italy
Piscitelli, Manuela. Università degli Studi della Campania *Luigi Vanvitelli*. Italy
Pompejano, Federica. Università di Genova, Italy
Quesada García, Santiago. Universidad de Sevilla. Spain
Rodríguez Domingo, José Manuel. Universidad de Granada. Spain
Rodríguez-Navarro, Pablo. Universitat Politècnica de València. Spain
Romagnoli, Giuseppe. Università degli Studi della Tuscia. Italy
Ruiz-Jaramillo, Jonathan. Universidad de Málaga. Spain
Russo, Michele. Sapienza Università di Roma. Italy
Santiago Zaragoza, Juan Manuel. Universidad de Granada. Spain
Spadafora, Giovanna. Università di Roma Tre. Italy
Spallone, Roberta. Politecnico di Torino. Italy
Toscano, Maurizio. Universidad de Granada. Spain
Ulivieri, Denise. Università di Pisa. Italy
Veizaj, Denada. Universiteti Politeknik i Tiranës. Albania
Varela Gomes, Rosa. Universidade Nova de Lisboa. Portugal
Verdiani, Giorgio. Università degli Studi di Firenze. Italy
Vitali, Marco. Politecnico di Torino. Italy
Vokshi, Armand. Universiteti Politeknik i Tiranës. Albania
Zaragoza, Catalán Arturo. Generalitat Valenciana. Spain
Zerlenga, Ornella. Università degli Studi della Campania *Luigi Vanvitelli*. Italy

Advisory Committee

Pablo Rodríguez-Navarro. President of FORTMED. Universitat Politècnica de València
Giorgio Verdiani. Vice-president of FORTMED. Università degli Studi di Firenze
Teresa Gil Piqueras. Secretary of FORTMED. Universitat Politècnica de València
Roberta Spallone. FORTMED advisor. Politecnico di Torino
Ornella Zerlenga. FORTMED advisor. Università degli Studi della Campania *Luigi Vanvitelli*
Vincenzo Cirillo, FORTMED advisor. Università degli Studi della Campania *Luigi Vanvitelli*

Organized by:

SAPIENZA UNIVERSITÀ DI ROMA

DIPARTIMENTO DI STORIA DISEGNO E RESTAURO DELL'ARCHITETTURA

FACOLTÀ DI ARCHITETTURA

Partnership:

UNIVERSITAT POLITÈCNICA DE VALÈNCIA

UNIVERSITÀ DEGLI STUDI FIRENZE — DIDA DIPARTIMENTO DI ARCHITETTURA

Universitat d'Alacant Universidad de Alicante

Politecnico di Torino — Dipartimento di Architettura e Design

DESTEC DIPARTIMENTO DI INGEGNERIA DELL'ENERGIA, DEI SISTEMI, DEL TERRITORIO E DELLE COSTRUZIONI

CSIC CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

UNIVERSITETI POLITEKNIK I TIRANËS

Università degli Studi della Campania *Luigi Vanvitelli* — *Dipartimento di Architettura Disegno Industriale*

SAPIENZA UNIVERSITÀ DI ROMA

With the patronage of:

unione italiana disegno

Istituto Italiano dei Castelli

SIRA

ICOMOS COMITATO NAZIONALE ITALIANO

International Council on Monuments and Sites

Consiglio Nazionale Italiano dei Monumenti e dei Siti

With the sponsorship of:

COIMA ITALIA

DIA PREMIUM FOOD COMPANY

© 2026 Sapienza Università di Roma / edUPV

Table of contents

Preface XIII

Contributions

CHARACTERIZATION OF GEO-MATERIALS

Archaeometric and geophysical analyses for the study and conservation of the watchtower of St. Agatha (Red Tower) in Malta 5
Maurizio Lazzari, Francesco Cavalcante, Emanuele Colica, Sebastiano D'Amico, Lara De Giorgi, Antonio Lettino, Giovanni Leucci, Raffaele Persico

Preliminary archaeometric analyses of reused Roman materials: the case of the tower at Via dei Montanini 16 in Siena, Italy 11
Gioele Rossi, Fabio Gabbrielli, Marco Giamello, Andrea Scala, Enrico Tavarnelli

DIGITAL HERITAGE

Architectural analysis of the Aragones castle of Venosa. Pirro del Balzo 21
Luis Agustín-Hernández, Michele Buldo, Marta Quintilla Castán, Javier Domingo Ballesti

Digital translation of early-modern fortification models. The case of "Della fortificatione delle citta…" by Girolamo Maggi and Giacomo Fusti Castriotto 29
Lorenzo Belli, Piergiuseppe Rechichi, Denise Ulivieri, Marco Giorgio Bevilacqua

Watchtowers on the coast of the kingdom of Granada (Spain). Graphic documentation as a starting point for their protection and conservation. Case studies: Melicena tower 37
Jose Antonio Benavides-Lopez, Jose Antonio Barrera-Vera, Enrique-José Fernandez-Tapia, Maria Isabel Mancilla Cabello

The digital survey for the construction of information models of fortified architecture on the island of Capri 45
Massimiliano Campi, Carmine Gambardella, Valeria Cera, Rosaria Parente, Marika Falcone, Marica Camerino

Reconstrucción digital y análisis morfológico del trazado de la muralla de Trujillo (Perú) mediante herramientas SIG 53
Diego Javier Celis Estrada, Teresa Gil-Piqueras, Pablo Rodríguez-Navarro

Franciscan reinterpretations: architectural adaptations and reuse of medieval fortified structures in Campania 61
Valeria Cera, Giuseppe Antuono

The fortified island of Ortigia: rediscovering a lost heritage through digitalization and historical memory 69
Roberta Cerruto

Kruja Castle in Albania: digital technologies for the knowledge and valorisation of the fortified heritage 77
Angelo De Cicco, Andrea Maliqari

Monastic Fortifications in the Judean Desert (*al-Barriyya*): 3D geo-mapping and Virtual Heritage for the assessment of dynamic heritage values 85
Raffaella De Marco

Eastern Elba: The Birth and Transformations of Portoferraio and Its Military Architecture 93
Tommaso Empler, Adriana Caldarone, Pasquale Micelli

The medieval museum of Casentino valley: the case study of Romena castle as a design and research lab 101
Alessio Fantoni

The coastal tower of San Giovanni in Ugento (Le): historical investigations, architectural survey and digital restoration 109
Ivan Ferrari, Francesco Giuri

Historical-architectural analysis and digital documentation of the military complex and Norman castle of *Civitas Allipharum* 117
Raffaela Fiorillo, Angelo De Cicco

The Castellina of Norcia: from historical knowledge to digital valorization 125
Francesca Funis, Valeria Menchetelli, Serena Pallotti

Defending the Venetian Lagoon: Digital Reconstruction of the Early Modern Fortress at the *Lido* 133
Ludovica Galeazzo, Gianlorenzo Dellabartola, Federico Panarotto

Virtual Tours and BIM as Heritage Tools: The Case of Forte San Giovanni 141
Riccardo Maria Giannelli, Volha Petravets, Maksim Afonchanka, Michele Codeglia, Daniela Barbieri, Norbert Frroku

Digitization of fortifications using UAV and TLS for conservation, diagnosis and structural analysis: the case of the Castles of Callosa del Segura and Forna 149
José Antonio Huesca-Tortosa, Yolanda Spairani-Berrio, María Isabel Pérez-Millán, Carlos Pérez-Carramiñana

Geospatial analysis of the visual domain exercised by the Trigueros castle and its insertion in the castral system of the county of Niebla in the 15th Century 157
Juan José Fondevilla Aparicio

The bunkers of Clot de Galvany, Mediterranean Wall, 1937-1938 165
Andrés Martínez Medina, Giancarlo Sanna, Pablo Jeremías Juan Gutiérrez

Methodologies for the valorisation of research applied to the fortified heritage. The INFORTREAT project 173
Alessandro Meloni, Martina Rinascimento, Marco Giorgio Bevilacqua, Roberta Spallone

The Guglielmi Castle on Isola Maggiore: from Architectural Survey to a Proposal for Valorization and Communication 181
Valeria Menchetelli, Francesco Cotana, Chiara Spippoli

Sacrum et Munitum: architecture between faith and defense. The case of the Church of Saints Peter and Paul in Agrò 189
Sonia Mercurio, Marinella Arena

Parametric modelling between supputation and graphic descriptions in Antoine de Ville's Les fortifications (1628) 197
Martino Pavignano, Fabrizio Natta, Roberta Spallone

Strategy and optimisation of the surveying process using SfM photogrammetry: the case of Alcudia de Veo Castle (Castellón) 205
Ana Pérez-Vila, Teresa Gil-Piqueras, Pablo Rodríguez-Navarro

Endangered fortifications: The kulla of northern Albania in survey and conservation 211
Edmond Pergega, Blerina Tabaku, Saimira Arapi, Gjergji Islami

Advanced digital modelling of the Torre del Mar (Borriana, Castellón): from digital fabrication to immersive experience through eXtended Reality (XR) 219
Enrico Pupi, Roberta Spallone, Teresa Gil-Piqueras, Pablo Rodriguez-Navarro

Patterns of settlement in rural Andalusia in the Cocentaina region (Alicante) 227
Santiago Quesada-García, María Lozano-Gómez

LiDAR sensors and mobile mapping for the survey of historical architecture: the case study of the Castellare degli Ugurgeri - Siena (Italy) 235
Gioele Rossi, Jacopo Bruttini, Fabio Gabbrielli, Marco Giamello, Enrico Tavarnelli

Bastion survey protocol: operational activity framework for multi-scale surveys of fortified walls 243
Michele Russo, Gabriella Caroti

Stone sentinels: the coastal towers of Forio d'Ischia 251
Patryk Rynkowski, Francesca Romana Stabile, Daniele Calisi

Defensive architecture between land and coast: the tower of Sessa Aurunca and the tower of Lago Patria 259
Michele Sabatino, Maria Prisco

The Alcamo Stronghold: Multi-Scalar Survey and Hybrid Representation of the Sardinian Defensive Front (1942–1943) 267
Giancarlo Sanna, Andrea Pirinu, Andrés Martínez Medina, Nicola Paba

New perspectives on the Theodosian Land Walls of Istanbul through digital photogrammetry 275
Mustafa Sayan, Zeynep Eres

The Pietrenere Coastal Battery in Taureana di Palmi (RC) 283
Francesco Stilo, Lorella Pizzonia

Semantic representation of historical architectural heritage with digital modeling methods: The Aragonese Tower in Bitonto (Bari) 291
Riccardo Tavolare, Giovanni Mongiello

Fortification, transformations, disasters, a complex vicissitude for the Krujë Fortress in Albania 299
Giorgio Verdiani, Stéphane Giraudeau, Elisa Miho

Consistence of memories and lightness of the present: the Rigena Tower in Larnaca, Cyprus 309
Giorgio Verdiani, Alexia Charalambous

Digitally Reframing Coastal Fortifications: Enhancing Visibility and Meaning in the Mediterranean Landscape 317
Giorgio Verdiani, Ylenia Ricci, Andrea Pasquali

The Montalbano Fortress in La Spezia, third session and last notes 325
Giorgio Verdiani, Ludovica Marinaro

The Castelluccio of Gela: from documentation to digital rediscovery 333
Antonella Versaci, Alessio Cardaci, Paola Cammilleri

CULTURE AND MANAGEMENT

Defending the Langhe: the potential for castle networks within regional and cultural development policy 343
Fabio Ambrogio, Emanuele Romeo

Ancona: from fortress city to an inclusive city of the future. Military heritage as a driver for urban identity, experimentation, exploration, and regeneration..... 351
Giovanna Badaloni

The Night of Fortresses: A transnational model for sustainable and inclusive cultural heritage management..... 359
Gorana Barišić Bačelić, Đurđa Vrljević Šarić

Interdisciplinary methodological perspectives in university research. The ForteMare project: an ongoing research path..... 367
Zaira Barone, Clelia La Mantia

Wartime landscapes and cultural heritage: the Gustav Line's Abruzzo segment between historical memory and territorial development 375
Annalisa Colecchia

Participatory Model for the Management and Enhancement of the Cultural Heritage of Mussomeli (CL): The Manfredonian Castle as a Driver of Widespread Tourism..... 383
Mariateresa Galizia, Gloria Russo, Graziana D'Agostino, Giuseppe Maria Spera

The fortress *Le Castella* on the Ionian Sea. Results of a diagnostic plan 391
Caterina Gattuso, Domenico Gattuso

Analysis and proposals for Genoese Walls and Forts Park..... 399
Massimo Malagugini

The Museum of Defensive Systems in Europe, in the Citadel of Alexandria 407
Anna Marotta

A proposal for regional development: towards a network of 'fortresses/faro' in the Alessandria area .. 415
Anna Marotta, Piera Migliore

Heritage education and dissemination in the castles of the province of Alicante (Spain) and the voivodeship of Pomorskie (Poland) 423
Juan Antonio Mira Rico, Agniezska Kowalska, Monika Rogalewska

MISCELLANY

Rocks, settlements and fortifications in Calabria, between tangible and intangible protection…..... 433
Rosario Chimirri

Adaptive Reuse and Musealization Strategies for the Rocca di Sala in Pietrasanta..... 441
Andrea Crudeli

The submerged wall of the Bocagrande canal in Cartagena de Indias, a defensive work by the military engineer Antonio de Arévalo (1769-1788)..... 449
Jorge Galindo-Díaz, Joan Fontás-Serrat

Thaddeus' Tower. A modern-era defensive structure in Burriana (Castellón, Spain)……..... 457
Jose Manuel Melchor Monserrat

The Castle of Casertavecchia: ongoing research between archaeological excavation and digital surveying..... 463
Ornella Zerlenga, Nicola Busino, Domenico Iovane, Rosina Iaderosa

Defensive Architecture of the Mediterranean / Vol. XXIV / Russo, Acierno (Eds.)
© Sapienza Università di Roma/ edUPV

DOI: https://doi.org/10.4995/Fortmed2026.2026.21494

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

Alessandro Meloni[a], Martina Rinascimento[b], Marco Giorgio Bevilacqua[a], Roberta Spallone[b]

[a] University of Pisa, Pisa, Italy, alessandro.meloni@unipi.it, marco.giorgio.bevilacqua@unipi.it, [b] Politecnico di Torino, Turin, Italy, martina.rinascimento@polito.it, roberta.spallone@polito.it

How to cite: Meloni, A., Rinascimento, M., Bevilacqua, M. G. & Spallone, R. (2026). Methodologies for the valorisation of research applied to the fortified heritage. The INFORTREAT project. In: Russo, M. & Acierno, M. (eds.) *Defensive Architecture of the Mediterranean*, vol. XXIV, Proceedings of FORTMED - Fortification of the Mediterranean Coast, 19-21 February 2026, Rome. Rome-Valencia: Sapienza Università Editrice / edUPV
https://doi.org/10.4995/Fortmed2026.2026.21494

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.

BY-NC-SA

1. Introduction

The contribution presents part of the progress of the National Research Project – PRIN 2022 entitled INFRORTREAT. 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 rhythmed 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 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.

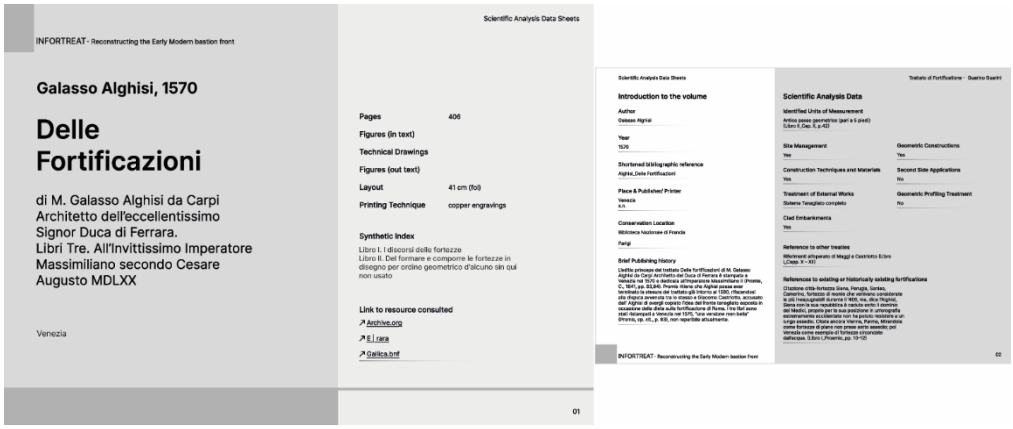


Fig. 1- Analysis data sheets layout (Author: M. Rinascimento)

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 treaties. 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.



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

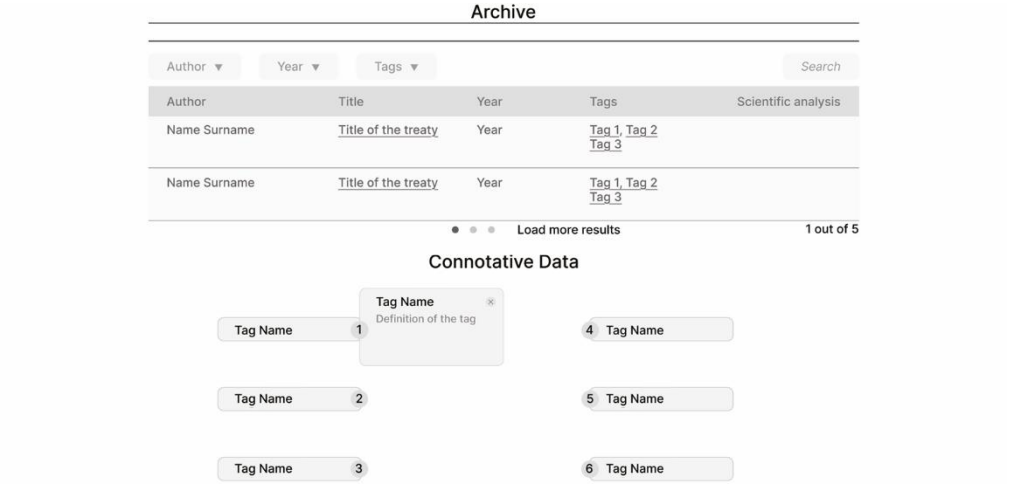


Fig. 3- Design layout of the web page produced using Figma *(Author: A. Meloni)*

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.

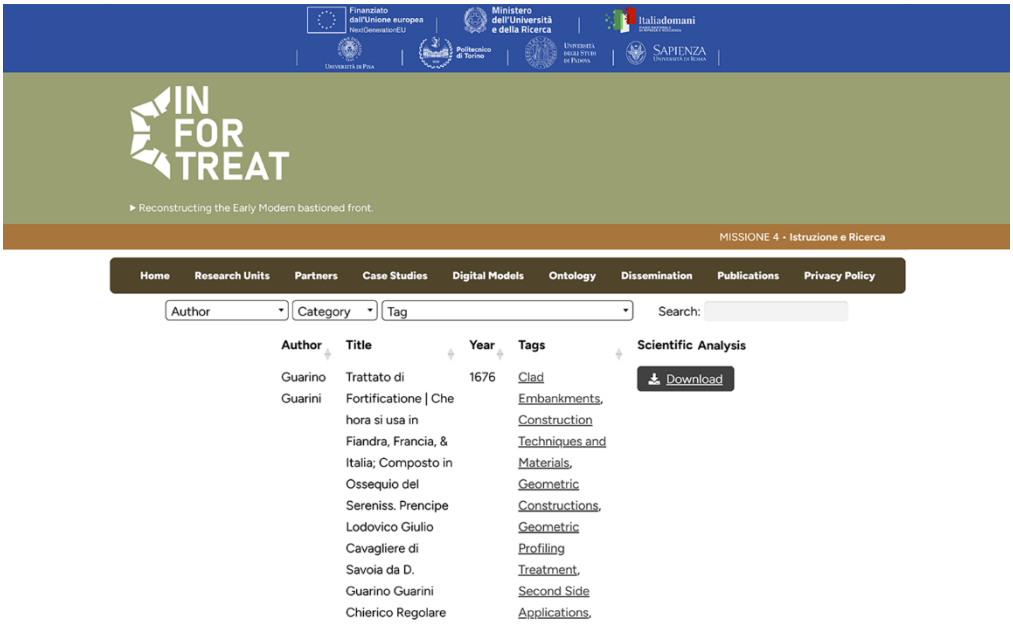


Fig. 4- Example of the interface of the project website developed using Barn2 (Author: M. Rinascimento)

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.

Acknowledgement

This study received funding from the European Union - Next-GenerationEU - National Recovery and Resilience Plan (NRRP) – MISSION 4 COMPONENT 2, INVESTMENT N. 1.1, CALL PRIN 2022 D.D. 104 02-02-2022 – (*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*) CUP N. I53D23005420006. The paper was elaborated as a team, but Alessandro Meloni wrote chapters 2, 3 and 4; Martina Rinascimento 5, 6, 6.1 and 6.2; Roberta Spallone and Marco Giorgio Bevilacqua wrote chapter 1 Introduction.

References

Cardello, J. (2023) *The difference between information architecture (IA) and navigation.* Nielsen Norman Group, available at: https://www.nngroup.com/articles/ia-vs-navigation/ (Accessed: 26 June 2025).

Dudda, L., Kormann E., Kozula, M., De Vito N.J. & Klebel T. (2025) *Open science interventions to improve reproducibility and replicability of research: a scoping review*. *Royal Society Open Science,* 12 (242057), 1-23.

European Commission (2025) available at: https://rea.ec.europa.eu/open-science_en (Accessed: 11 June 2025).

Figma (2025a) *What is a Use Case? How to Write One, Examples & Template*, available at: https://www.figma.com/resource-library/what-is-a-use-case/ (Accessed: 24 June 2025).

Figma (2025b) *What is Wireframing? The Complete Guide*. Figma, available at: https://www.figma.com/resource-library/what-is-wireframing/ (Accessed: 24 June 2025).

Klebel, T., Traag, V., Grypari, I., Stoy, L. & Ross-Hellauer, T. (2025) The academic impact of Open Science: a scoping review. *Royal Society Open Science*, 12 (241248), 1-43.

Moedas, C. (2016) *Introduction Open Innovation, Open Science, Open to the World – a vision for Europe.* In: European Commission: Directorate-General for Research and Innovation (ed.) *Open Innovation, Open Science, Open to the World – a vision for Europe*. Luxembourg, Publications Office of European Union, pp. 6-8.

Nowotny, H. (2015) *The radical openness of science and innovation: Why uncertainty is inherent in the openness towards the future*. *EMBO Rep*. 16(12), 1601-1604.

UNESCO (2023) *Open science outlook 1: status and trends around the world*. Paris, United Nations Educational, Scientific and Cultural Organization.

Van Vaerenbergh, Y., Hazée, S. & Zwienenberg, T. J. (2025) Open Science: A Review of Its Effectiveness and Implications for Service Research. *Journal of Service Research*, XX (X), 1-24.

Wilkinson, M.D., Dumontier, M., Aalbersberg, J.J., Appleton G. & Axton, M. (2016) The FAIR Guiding Principles for scientific data management and stewardship. *Scientific Data,* 3 (160018), 1-9.