Paolo Micalizzi[*], Stefano Magaudda[**], Paolo Buonora[***], Luca Sasso d'Elia[****]

A GIS for the city of Rome: archives, architecture, archeology

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Summary
The project for the creation of an historical GIS fort the city of Rome is financed from the bank foundation CARIPLO since several years, and involves institutions and specialist from several fields: historical archives, history of architecture, archaeology. The new phase of the project, "Portrait of towns", is now involving also other Italian cities: Milano and Bologna, in the perspective of focusing and developing methodologies to manage the complex cartographical and graphic historical information dealing with Italian towns.
The roman team of the project is now enhancing the existing WebGIS, adopting content manager tools to add any kind of documents to the GIS structure, based on the early XIXth century pontifical cadastre, and developing the GIS structure itself in a temporal dimension, with others maps and registers dating until 1870.
In the meanwhile, other institutional partners are joining the initiative, and creating a multidisciplinary network. This network is not necessarily limited to the CARIPLO project, or to Italian institution, but will be open to any institution (university, foundations) devoted to the study of Rome in Italy or abroad.

Urban Studies Department projects for a GIS[1]

Scholars see Rome as an eminent repository of artistic-architectural values; in consequence of this very particular condition the city has been – especially in the recent past – the destination of any real or intellectual tour aiming to reach those values. Nevertheless, the extraordinary extension of its cultural heritage as well as the large dissemination of related document sources make the knowledge of the city of Rome – this is the paradox – more difficult. This is the reason why our research, during more than ten years, is focusing on an instrument able to relate each other different document sources concerning urban architecture, and to promote and disseminate research activities on the subject.
It must be reminded that the ancient cadastral cartography on the city of Rome, and related *brogliardi* (the land office registers where characteristics and owner of the building are described) shape a document series of very high quality and detail; in consequence of that they represent the basic reference on any possible research concerning architecture and urban studies.
The work carried on focused on urban iconography and archaeological documentation about Rome, selected not only depending on its own artistic value, but mostly as a reliable representation of the historical city. Before the ongoing project two versions of a GIS (Geographic Information System) where available at the Urban Studies Department (Dipartimento di Studi Urbani - DIPSU) and at the Soprintendenza ai Beni Culturali di Roma Capitale, edited with Italian founding (Soprintendenza ai

[*] Università di Roma Tre - Dipartimenti di Studi Urbani [micalizz@uniroma3.it]
[**] Università di Roma Tre - Dipartimenti di Studi Urbani [stefano.magaudda@gmail.com]
[***] Archivio di Stato di Roma [paolo.buonora@beniculturali.it]
[****] Soprintendenza ai Beni Culturali di Roma Capitale [lucasassodelia@katamail.com]
[1] Text by Paolo Micalizzi: micalizz@uniroma3.it .

Beni Culturali di Roma Capitale 1999, MIUR 2000-2003) and European founding (CE - DGX C4 project – Raffaello 1999). The current product is much more complex and sophisticated than the previous one, is funded from the beginning by the Cariplo Foundation, and involves another crucial partner, the State Archive of Rome. More recent activities are part of the research project "Portraits of cities – enhancing collective memory of cities through digitization and dissemination of historical cartography", decided in 2007 by Cariplo Foundation, involving as well the Politecnico University of Milan and Bologna University to implement historical GIS applications for this two other cities.
The first GIS implementation of our Department was only based upon the G.B. Nolli map dated 1748. In the current development step instead, other graphic documentation is related to a more accurate cartographic reference – the Gregoriano cadastre – and the GIS itself is edited on the web to disseminate the information available in it. Maps and registers of the Gregoriano cadastre (1818-24), stored in the State Archive of Rome are now actually the starting point of the system. Both more ancient cartographic references (such as the Nolli map) and more recent ones (such as some upgraded maps of the cadastre itself) are related to the original 90 sheet maps that were first drawn to activate the cadastre, as well as many records and images concerning the architecture of the historical city. A further development of the system will deal with all the following upgrades of the cadastre maps and data, up to the contemporary times and the activation of the New Urban Cadastre after WW2.
Browsing the WebGIS it is possible to relate directly archival sources to the place (square, street, building, etc.) referred; two innovative options are possible in cataloguing and research: a) starting from a document, the automatic focus on the place where the building is (or was) referring to; b) starting from the graphic object (block, parcel, etc.) presented in a vector map.
The user can retrieve single documents within the database, as well as make thematic researches on an homogeneous subset of records, filtered with a common parameter (author, commissioner, year). This tool provides indeed both (for the archivists) a good way to classify and preserve original documents, and (for the scholars) a fast filing and retrieving system. The main goal is building a database on the city and its archeological evidences, to be accessed and enhanced time after time, also online by the users and/or by the operating partners from different institutions (libraries, archives, universities) and different countries: each scholar could be able to access the WebGIS records to comment documents and images on any part of the historical city.
Project goals take advantage of the easy access of the service, provided free and not limited, of the friendly interface for any kind of user, and of the possibility of enhancing in time data, documents, and cartographic references. At the moment many thousands of records are in the system, concerning documents from several archival fonds: *Titolo 54* from the Archivio Capitolino (the city archive); *Lettere patenti*, *Chirografi pontifici*, *Notai del Tribunale delle Acque e Strade* from the State Archive of Rome); also about one hundred prints by G. Vasi, from the 3rd volume of *Delle magnificenze di Roma*, 1753.
To provide a first evaluation of the potential users of the system, it must be said that about 30.000 documents are requested every year at the State Archive of Rome only, most of them concerning Rome. More in general – focusing on the extraordinary relevance of the city to the culture of Europe and of the world – it is evident that the availability of the GIS on the web is a crucial contribution to scientific community, providing a knowledge instrument that will drive information from and to the

international research community about the architectural and archeological heritage of the city of Rome[2].

The archival sources role[3]

To understand the role of the document sources that the State Archive of Rome supply to this project, we must first focus on the relevance of the Gregoriano cadastre, that was the first parcel cadastre in the Pontifical State and which plans and registers of the urban cadastre are part of, and describe briefly its origins[4].

In 1817 the survey work began to draw the cadastral map of the city of Rome; blocks "splitting" or *suddivisioni* were drawn from the Nolli map, where – as only blocks are represented – every non-built item (gardens, open spaces) is missing; buildings were only identified by the street number, and parcel number was chosen only at the end of the survey. As this series of operative cartography was achieved, 90 maps in a A0 format where drawn in a 1:1000 scale: in these maps, divided in sheets, all the urban elements are drawn, including "empty" spaces: streets, gardens, fields.

Beside the final version of the map sheets, the first series of *brogliardi* is edited: these registers identify for any parcel the owner and the value; after that, a long period of litigations began concerning the evaluation of properties and finally the cadastre was activated, in Rome, in 1824, using a new series of reviewed *brogliardi*. The original version map/registers, stored in the main census office, the *Presidenza del censo* in Roma, was copied to be used in the local *Cancellerie del censo* established in the main town of the Pontifical state: this daily use during more than 100 years is the reason for the frequent damages and losses we have in these local copies.

For several decades the cadastre kept recording of the changes in the properties within the register series of *volture*, *trasporti* and *catastini*. In 1870, with Rome becoming the capital city of Italy and in the new perspective of dramatic changes in the urban shape, duplicated map sheets of "upgrades" or *aggiornamenti* from the old *suddivisioni* in the Presidenza archive were drawn; these maps were corrected until 1887, as some notations on them demonstrate, and keep in red ink the draft of the many changes performed in those years. From this analysis of the sources some conclusions follow about the way to proceed in order to input them in a GIS.

- Original map sheets are a starting point, not only in an historical, but in a logical approach as well, and geo-referencing is the pivot of the entire system; both the *suddivisioni* and the later *aggiornamenti* have to be geo-referenced starting from the original map sheets, that only compose a complete map of the city of Rome without solution of continuity.

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[2] Just to mention two relevant examples in the USA, a specific website is devoted to the Nolli map at Oregon University (http://nolli.uoregon.edu), and a WebGIS is built by K. W. Rinne at Virginia University about the waters of ancient Rome (http://www3.iath.virginia.edu/waters). The main print collection concerning Rome, at the Istituto Nazionale per la Grafica – Calcografia Nazionale is searchable online at:
http://calcografica.ing.beniculturali.it/calcografica and high quality access to the most relevant historical maps of Rome is provided by the Herziana library in Rome – Max Plank Institute on the CIPRO project website http://fmdb.biblhertz.it/cipro/default.htm.

[3] Text by Paolo Buonora: paolo.buonora@beniculturali.it.

[4] L. Falchi, *Il catasto e le mappe della città di Roma, in L' assetto urbano di Roma nel catasto gregoriano - Archivio di Stato di Roma*, edited by Luigi Londei [S.l. : s.n.], 2009 (Città di Castello : Alfagrafica), pp. 5-12.

- Some building blocks may be missing in the *suddivisioni* and the *aggiornamenti.*
- All *brogliardi* series (original, reviewed and local) must be geo-referred to map sheets.
- Contemporary (from the former *Cancelleria del censo*, that was given to the State Archive only in the 50th by the *Ufficio tecnico erariale*) or later copies of the map sheets (as the heliographies stored in the municipal office for the naming of the roads in Rome, dating about 1930) must be geo-referred as well, starting on the original map sheets.

The Gregoriano cadastre provides actually the more detailed scenario of the city, also in a long run perspective. In any fixed image shot, as accurate as it can be, some elements of an ever changing urban reality can be missing: to mention an example, some ruined building of medieval mills and fullers, which at the time of the cadastre were abandoned since many years and without any economic value. This is the reason why archivists are working to relate any possible graphic or cartographic document to the spatial geo-referenced context built, starting from the Gregoriano cadastre, as will be shown further.

The State Archive of Rome has a long run experience in the digitization of document sources. In 1997-2000, using the Imago II project[5] funding, advanced solutions were tested to digitize, in a very high quality standard, also the watercolor cartography in very large format we have in modern cadastral series. Many series were digitized, as the *Catasto alessandrino* (a survey of properties around Rome, along the main roads, drawn at the end of 17th century); the main towns from the Gregoriano cadastre within the city walls, including the urban cadastre of Rome we mentioned; the *Cessato catasto rustico*, i.e. the local copy of the Gregoriano we mentioned as well. All these and other document series were made available to the users in a virtual access mode, first in the reading room and later (2002) on the web, using image server systems allowing the remote user to zoom the image in a full resolution, and to access it also on the web in a useful way.

In 2005 a further enhancement was made, digitizing in a single high quality image (250 ppi), with a special camera, the giant roll maps of the countryside around Rome, resulting in a 4m x 4m dimension. In 2007 these giant image files were available as well on the web, after migrating our virtual access service in the new digital laboratory of the CFLR (Centro di Fotoriproduzione degli Archivi di Stato)[6]. In consequence of the experiences we mentioned, the State Archive of Rome was ready to supply in digital format the graphic documents needed, and raster files were migrated with a long and accurate work to a vector format for editing the Gregoriano WebGIS.

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[5] P. Buonora, *Progetti di digitizzazione degli Archivi di Stato,* in *Scelte e strategie per la conservazione della memoria*, Proceedings of the Internazionale Conference, Dobbiaco (prov. Bolzano), 25-29 giugno 2002, edited by the Centro di Fotoriproduzione, Legatoria e Restauro degli Archivi di Stato, Roma 2005; Id., *Digitalizzazione e accesso on-line per la cartografia storica*, in *Un accesso migliore è possibile … verso l'integrazione delle risorse informative per l'architettura e l'urbanistica*, Atti delle ottave giornate di studio del CNBA, Venezia, 28 – 31 maggio 2003 (I quaderni del CNBA, n° 7), edited by L. Casagrande, S. Sangiorgi, P. Piccotti, Venezia CNBA-Casalini Libri, 2005; available at: http://www.iuav.it/CNBA/Giornate-d/2003-Le-Ot/Abstract--/Buonora.doc_cvt.htm ; Id., *Digitalizzazione e accesso on-line per la cartografia storica*, in *Patrimoni e trasformazioni urbane*, II Congresso dell'AISU, Roma, 24-26 giugno 2004, in « Proposte e ricerche », n° 53 (2004).

[6] CFLR was later moved to another place and was finally abolished, to create together with the Italian libraries restoration centre (Istituto centrale di Patologia del libro) the ICPAL, that still maintains the service: (www.cflr.beniculturali.it).

In the current development steps, the project involves also a working group cataloguing thoroughly all graphic attachments in the municipal notaries' acts, and compiling in the same time detailed finding aids for each notary office[7]. These documents, that often have a high architectural design quality[8], integrate the standardized scenario provided by the cadastre documents, that describe in an homogeneous way areas, functions and structure of the buildings floor by floor. The plans and drawings we find in the notaries acts, as in other archival series, show instead in detail characteristics of any single building considered from the architectural point of view.
This is the reason why we think the editing of the WebGIS will provide an excellent access tool for our archive users who will be able in this way to retrieve more easily old cadastral information on single buildings with a friendly graphic interface, without having to learn the specific structure of the traditional finding aids and facing the problems of reading an ancient document, or either to come in person in our reading room. Finally, they will also be able to map and record any other architectural or archeological document on a very detailed geo-referenced system.

The archeologists' city[9]

The ancient maps of cities also provide crucial archeological information. The "ruins" were part of the urban landscape and their graphic details integrate historical and descriptive information allowing to outline the preservation conditions of the ancient city before the great urban changes in the 20th century.
In the archaeological approach it is also important to relate the rich and interesting literature produced in the 19th century, when the awakening for the ancient period was rising and the basic preservation problems were set up, relating to the way the ruins appeared in that century.
We can say as well that archaeology and the antiquarian disciplines themselves promoted a big effort to outline the city of Rome finally using orthogonal projections instead of bird-eye maps. The need to have a joint cartography was rising up just in the 18th century; Giovan Battista Nolli devoted most of his life surveying in scale the city, namely aiming to place the several marble plan fragments, the *Forma Urbis*[10], many of which came out from excavations at the *forum pacis*.
Contemporary roman archeologists cannot but follow this remarkable tradition and this is the reason why the Sovraintendenza di Roma Capitale participates to the project. The WebGIS mentioned before is the instrument for the urban historians; for the Sovrintendenza archeologists instead vectorial information about items' shape and registers alphanumeric data constitute one of the levels of the "new FUR" SIT (sistema informativo territoriale), basically a database where all information is recorded relating them also to the ancient city topography. The ancient city knowledge is outlined overlaying and permeating different cartographies, starting with the most ancient marble *forma urbis* we mentioned, up to the contemporary satellite images. This knowledge includes both what has been destroyed and what is still preserved and we have to preserve in time.

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[7] Results of this working group are edited in "*In presentia mei notarii*". *Gli allegati iconografici nei protocolli dei notai capitolini*, edited by O. Verdi, Pubblicazioni degli Archivi di Stato, Strumenti CLXXXXVII, Roma 2009.
[8] See for instance, the detailed plans of the Gianicolo mills abandoned in the late 19th century, ivi.
[9] Edited by Luca Sasso d'Elia: lucasassodelia@katamail.com.
[10] http://formaurbis.stanford.edu/index.html.

The Gregoriano cadastre describes to the roman archeologists both about the past, representing ancient ruins in black ink, and about the present mission as it allows to place in detail all partial drawings and information about 19th century findings, and about the future as well, since it is possible to overlay on this ancient cadastre the contemporary city map.

A *webgis* and *content management system* for the Gregoriano cadastre of Rome[11]

The Urban Studies Department (DipSU), within the CARIPLO project, implemented a WebGis system aiming to publish on the web the geo-database built on the Gregoriano cadastre of Rome. This WebGIS provides all the standard features to browse and retrieve data and to access images and large scale cartography. It is possible with the WebGIS to access the geo-database and investigate on single cadastral parcel, getting information about properties, street address, typology and number of floors of the buildings. It is also possible to overlay to cadastral parcels both the digitized map sheets of the Gregoriano and the Nolli map.
The DipSU Webgis[12] has been implemented and is continuously maintained using open source solutions and products, and custom software to correspond to project needs. Main software products are:

- Map Server[13]: it is a software package developed and issued by Minnesota University, and used to implement the cartographic engine of the WebGIS.
- Postgres[14]/PostGIS[15]: Postgres is a *Data Base Management System*; the geo-database is implemented through *Postgis*, an extension that adds support for geographic objects allowing it to be used as a spatial database for geographic information systems.
- Apache Web Server[16] and PHP5[17]: used to edit and develop the system.

In the last year DipSU developed a new web portal aiming to implement a dynamic instrument to study the historical city and a performing tool to disseminate and share information. The goal is to expand the functionality of the Gregoriano WebGIS and to implement a software tool for document management called “Documenti e Archivi”, for the editing, retrieval and web browsing of records concerning archival documents. This step is still under development and it is planned to enhance the existing database and to implement a Content Management System (CMS) to manage and access all the sources supplied by the partners of the project.
From the technical point of view the system was oriented to a Web 2.0 approach that allowed to study and to implement solutions for increasing the involvement and sharing of the users on specific topics. An advanced tool to browse the documents has been activated allowing both spatial retrieving from the WebGIS, and database browsing with the CMS. The interface allows a cross-reference research on the different databases provided by the project partners and the possibility to visualize the information with a local reference on the cadastral maps through the WebGIS.

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[11] Text by Stefano Magaudda (stefano.magaudda@gmail.com) e Giuseppe De Marco (informatics engineer).
[12] http://www.dipsuwebgis.uniroma3.it.
[13] http://mapserver.org.
[14] http://www.postgresql.org.
[15] http://postgis.refractions.net.
[16] http://www.apache.org.
[17] http://php.net.

The innovative component of the project is the management and space retrieving tool of the archival documents and the ability of the previously registered users to share the information and the research results. By this point of view the system operates as a *social webgis*, i.e. a new instrument to expand knowledge sharing and cooperation between institutions and research centers.
In this scenario most difficult gaps to overcome are not in the technical field, but in the cultural approach. Often specialists (historians, archeologists, archivists) and public institutions are not used to sharing knowledge and to making it public, or they are jealous of their information assets and of their own researches. A different cultural approach must grow: public administration and research institutions have to share information data and standards and work together to enhance the overall quality of the geo-informative assets. It is necessary to promote cooperation projects between researchers and specialists and to face up to the interoperability of information systems and territorial data.

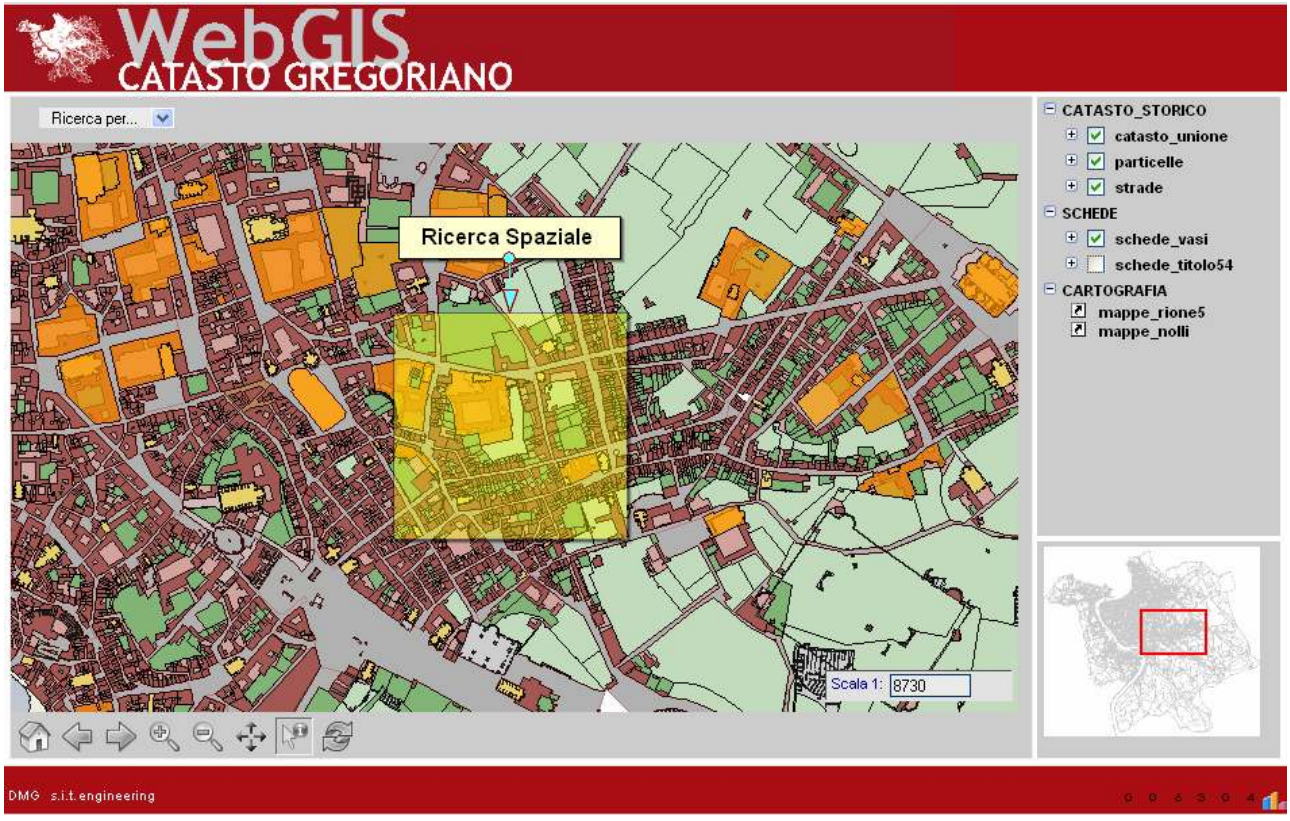

Figure 1. The Gregoriano cadastre WebGIS.

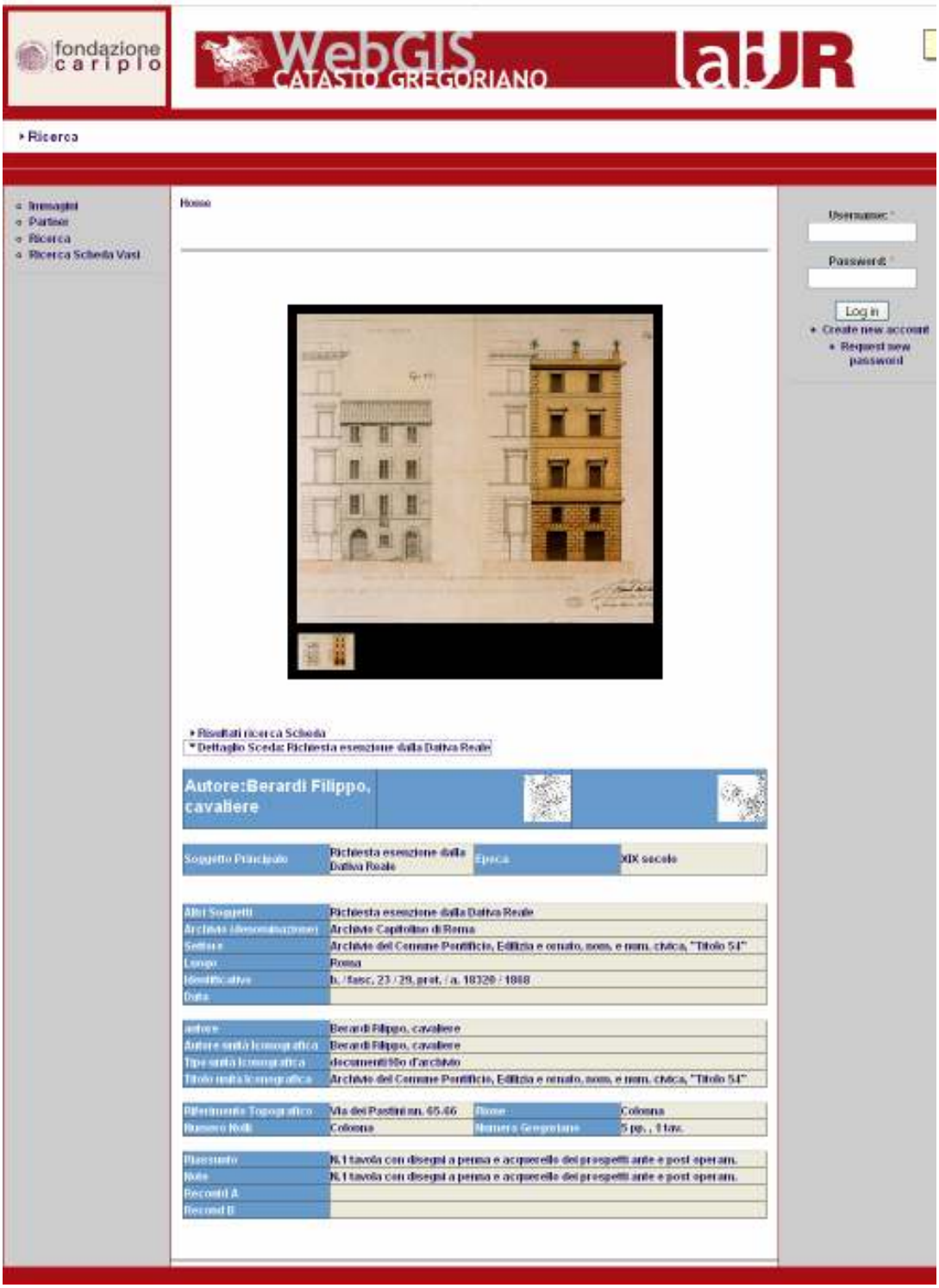

Figure 2. Archival sources records related to the WebGIS.