Sifting Through Historical Maps. Methodology for the Implementation of Cartographic Content in Urban Planning: Case Study of Desio

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Abstract. Numerous conventions and recommendations for the protection of cultural heritage state the importance of implementing an integrated conservation approach, taking care of built and natural elements in their settings. For small, widespread historical centres in Lombardy, historical stratigraphy is complex and often there is a lack of historical material to understand the towns' evolution. With neglected and forgotten heritage values, historical centres are suffering degradation and abandonment. The study will examine the content which can be extracted from historical maps in the form of implicit and non-implicit characteristics and focus on the means and tools for their use in urban planning. The research suggests the essential implementation of historical cartography and accompanying documents in the creation of the Municipal Urban Plan, by building the database in the Geographic Information System. The developed methodology offers adaptable approaches for analysing maps regardless of their scale or aim. Decomposition of elements, systematisation of the features presented on the historical map and application of modern urban theories, will allow researchers to compare spatial and textual elements on different maps and link them with the contemporary survey. The research criticizes the potential errors that can occur in urban plans if the historical background is not thoroughly investigated and there is no comparison between past and present data. Study will assist spatial thinking though contextualised historical data as tool for participatory planning to support GeoDesign concepts and methods.

Keywords: Historical cartography · Urban planning methods · Municipal Urban Plan of Desio (PGT) · Map deconstruction approach

1 Introduction

The practice of cartography goes beyond mere physical representation - it is a record of human history that reflects the attitudes, knowledge, and expectations of the society in which it was created [1]. Historical maps are the primary medium for transmitting ideas and knowledge about space. Additionally, they offer political, economic, religious, and social context of the towns they represent, which evoke complex meanings and responses;

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thus, they record more than just space [2, 3]. Multidisciplinary cartographic practices are reflected through the difficulty of defining and studying them [4]. The available research in the field of cartography grew in number over the past decades. This renewed interest occurred through the switch in perspective on the definition of cartography through time. It was described firstly as *science* [5], then it was positioned between *art, science, and technology* [6], followed by the definition of being a *discipline* [7]. Researchers are still discussing appropriate explanations of what are *cartography* and *maps* [8]. The main reason why defining cartography is not an easy task lies in generalization which does not include the crucial variables: period, aim, production process and visual representation of maps. Moreover, technologies are changing rapidly and they are influencing mapping practices. The differences between traditional and digital maps are creating a gap, and often researchers are unable to create connections between historical and contemporary cartography [9].

A map represents, describes, and relates to other cultural heritage depicted on it. As such, historical maps can be treated as heritage that should be preserved and digitized to be protected and used. To achieve this aim, it is necessary to use modern methods and digital technologies that form the backbone of non-invasive cultural preservation and investigation of its tangible and intangible values. The level of dissemination, availability and use of historical cartography and other historical documents has changed significantly with the introduction of recommendations for their digital preservation. The European Commission has recognized the importance of digitalization of archival documents, paying special attention to historical cartography [10]. It developed projects such as'Europeana', which works with the GLAM[1] sources, and created the educational platform 'European Digital Service Infrastructure' (DSI) [11] to distribute and actively use historical material across the world. The Steering Committee of the Italian Digital Library (ital. *Comitato Guida della Biblioteca Digitale Italiana*) developed guidelines for the digitization of cartographic material and the management of its sources [4]. This was a ground-breaking step in reconstructing the public and private archives for a better propagation and protection of cartographic material. Once cartographic material is accessible, it can be used from education to preservation and participatory planning projects [12]. Nevertheless, the practice and results show that these applications of GeoDesign were not easy to attain on behalf of public administration, scholars, and individual practitioners in the studied context.

There is an increasing need to rethink the planning approaches, especially of the small, widespread historical centres. They are unique traces of the past in cities today, and it is important to consider their spatial and cultural-historical values often hidden or destroyed while creating an urbanistic plan. Numerous studies show the good and bad practices of past urban planning, damaged on the one hand by industrialization and the widening of streets to meet the needs of the car, and on the other, good practices that restored cultural values of the city and remained functional for the needs of contemporary society [13]. Historical maps are gradually being incorporated by public administrations into territorial government plans. However, they are not used constructively to provide the historical stratigraphy, which is so important for urban planning, preservation, and revitalization of cultural heritage. Usually, they are presented only in the introduction

[1] GLAM – abbreviation for Galleries, Libraries, Archives and Museums.

to the plans and their true spatial values are completely neglected [14]. This research aims to provide planners and architects with methods and tools to actively use the content extracted from historical maps and accompanying documents in the framework of digital and urban planning recommendations for contextualizing planning projects. Through techniques of geovisualisation, the study will initiate participatory planning and accelerate spatial thinking for protection and maintenance of landscape and built cultural heritage.

2 Urban Planning Declarations

Planning practices changed in the mid-20th century, bringing more attention to the preservation and management of historical centres as an undividable part of built environments. Many recommendations appeared in this period regarding the heritage protection. The Venice Charter published in 1964 decreed that architectural heritage is inseparable from its urban or rural setting [15]. This was furthermore elaborated in 1975, in the Declaration of Amsterdam, which expressed the importance of considering cultural heritage and its surroundings as a unity and implementing conservation strategies as an integral part of regional and urban planning. This was a pioneering approach to the protection of cultural heritage and a crucial step in the development of more sustainable urban plans [16]. Moreover, the European Charter of the Architectural Heritage adopted a resolution in 1976, setting out policies and regulatory requirements for integrated urban conservation, including guidelines for the protection of historic centres and landscapes as a vital part of urban planning objectives. The focus shifted from the single monument to the historic centres and landscapes, which gave a wider context to the issues of preservation included in the urban planning process. Additionally, committees called upon local authorities and citizens to participate together in the preservation of their common goods, which aligns with the research goal and concepts of GeoDesign.

In 2017, as part of the UN strategic plan, UN-Habitat adopted the'New Urban Agenda' which emphasised the importance of strengthening communities and decentralizing territories by empowering towns locally [17]. The ICOMOS's Resolution on the Conservation of Smaller Historic Towns (1975) listed threats and dangers for small historical centres: lack of economic activity, an outflow of population, and overall decay and abandonment of structures. The resolution recommends vital actions to be implemented to maintain the cultural heritage values and provides authorities with the strategies for planning and protecting indigenous spatial and cultural qualities. It stresses the importance of coordination in all planning stages [18]. The process of conservation of historical centres was significantly improved since the introduction of digitalized material which accelerated the multidisciplinary approach and engagement of various stakeholders. Digitization allowed online dissemination of accessible historical material and the creation of interconnected databases for future planning activities.

3 Location: Importance and Reasoning

The region of Lombardy was selected as a territory for the selection of the case study for numerous reasons. Firstly, the cartographic material coming from the Statal Archive of Milan (ital. *Archivio di Stato di Milano* (ASMi)) describes and presents the territory, which has remained relatively homogenous. Hence, the cartography was made for "internal purposes" by various administrations or entities [19], which also provided a good amount of diverse cartography. From the 13th century began an era of the lordship of influential families which changed the conceptualisation of public and private property [20]. In the 15th century, the progress of medieval settlements was interrupted by the turbulent period. In 1714, the Duchy of Milan passed from the hands of rulers of the Habsburgs of Spain to those of the Habsburgs of Austria. The territory was finally united in 1796, under the aegis of Napoleon Bonaparte, into the new Cisalpine Republic of which Milan was the capital [21].

This was also the period where the historical cartography available now started flourishing for tax and estimation purposes, census of population and tracking property ownership (i.e., *Catasto Teresiano*) [22]. After the defeat of Napoleon, the Duchy of Milan became a part of the Lombardo-Venetian Kingdom in 1815 (i.e., *Catasto Lombardo-Veneto*) until the unity of Italian states in 1861 (i.e., *Nuovo Catasto Terreni*) [23]. In the 19th and 20th centuries, there was increased activity in fashioning, remaking, and producing land cadastral maps with improved surveying techniques and technologies. Cities were undergoing constant rebuild and destruction phases, affected by human and natural hazards, and often heritage suffered greatly. The occurrence of various regimes produced different cadastres and thematic maps, which created the complex but fertile starting point for further research.

3.1 Case Study of Desio: Historical Background

The small historical centre of Desio, a town north of Milan, was chosen for the case study. Its strategic position since ancient times and the continuous demolition and reconstruction phases over the centuries have largely erased the cultural heritage values, and most of those remaining has been forgotten [24]. Desio emerged when Celtic Gallic tribes arrived. They were replaced by the Romans who established a military *castrum* with the main axis *Cardo* and *Decumano*, which are still traceable today. They fortified the city to control the important road that led from Milan to Como [25]. Due to the proximity of the military protection, rural houses and huts were being constructed outside of the walls of the *borgo*. With the coming of the *Longobardi*, Desio stayed an important chief town, which shape and history influenced the development of the modern town [26]. From 17th century, noble villas were emerging and the town served as a destination for leisure. Desio experienced rapid expansion during the industrial age and its heritage was slowly losing its form and authenticity. The advantage of the case study is the town's multi-layered history as a centre of a long-term establishment of administrative and religious power (see Fig. 1).



Fig. 1. Georeferenced maps of A: *Catasto Teresiano* (1721–22) (Source: ASMi); B: Georeferenced map *Catasto Lombardo-Veneto* (1865–73) (Source: ASMi); C: CTR (1980) (Source: Geoportale Lombardia); D: Orthophoto of Desio (2015) (Source: Geoportale Lombardia)[2]. The main physical characteristics of the town's transformations are schematically marked on all maps (Source: Authors).

The administrative body of the Lombardian Cultural Heritage (ital. *Beni Culturali Lombardia*) listed forty-one buildings in Desio as cultural heritage. More than half of them belong to the residential and tertiary sector architecture (51.2%). Religious and sacral architecture (22%) and rural architecture (17.1%) are especially interesting for Desio for their past agricultural activities and sacral importance. Buildings in the industrial and production sector (9.8%) are the least listed as patrimony. Desio has relatively poor architecture, mostly in the form of traditional Lombardian architecture of rural farmhouses or *cascine*. There are a few examples of *villas*, and they are distinguished with their precious artistic, architectural, and historical values from the rest of the urban area (e.g., Villa Traversi, Villa Klinkman, Villa Greppi, etc.). The villas and their gardens are unique examples of noble architecture from the 17th to 19th century. Other residential architecture, mostly houses with distinct types of courtyards, are characteristic of

[2] Archivio di Stato di Milano (ASMi), Fondo: Ufficio tecnico erariale. Milano. Catasti. Mappe sezione – Mappe piane I serie. A: - "Catasto teresiano. Mappe di attivazione (1721–1722)"; B: "Catasto lombardo veneto. Nuovo Censo. Mappe attivazione, Prima copia (1865–1873)"; C: "Carta Tenica Regionale (CTR) (1980)", sheets: B5B4, B5C4, Geoportale Regione Lombardia; D: Ortofoto Agea (2015), Geoportale Regione Lombardia.

Lombardy, too. Conversely, the Lombardian Cultural Heritage web portal did not list and categorize the natural heritage, open spaces, or water elements in the same manner.

3.2 Case Study of Desio: Municipal Urban Plan

Historical research is an undividable element of designing cities today and historical maps are an integral part of urban studies [27]. The maps on the scales from 1:1000 to 1:5000 are the most valuable for the investigation of the urban environment and physical relationships [28]. Historical cadastral maps and contemporary urban plans were made in this scale range, providing detailed explanations about the forms and functions of the buildings and land. In Lombardy, for managing and planning the territory today, there are two main plans used in the local context. 'The Territorial Coordination Plan' (ital. *'Piano Territoriale di Coordinamento' (PTC)*) is the planning act through which the province provides policies and indicators for designing the structure of the territory, in line with the territorial policies of the regional body. The coordination occurs on two levels: provincial and municipal urban planning. 'The Provincial General Planning' act (ital. *'Piano Territoriale Provinciale Generale' (PTPG)*) is supporting environmental and sustainable development. It gives indicators for the municipal enhancement, measures the municipal urban tools, and evaluates the potentialities of the areas. Following the provincial recommendations, 'The Municipal Urban Plan' (ital. '*Piano di Governo del Territorio'*, furtherly referred to as PGT) is created to target specific zones in the city. The plan has the purpose to define the structure of the entire municipal area and it consists of three distinct acts (see Fig. 2).

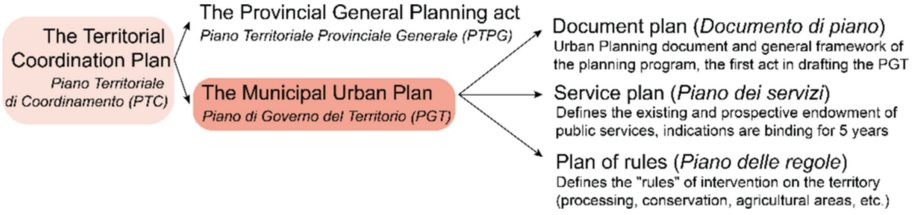


Fig. 2. The urban planning acts and plans in Lombardy and their content. Source: Authors.

Historical maps are appearing in the introduction of the PGT, in the chapter about the history of Desio, where they are mentioned as an important and initial source of information about the urban changes. Later, in the chapter'Census of Historical Heritage', the text refers to the tables in the form of the catalogue of cultural heritage, where historical maps are presented again, but not analysed [29]. The PGT made by the Municipality of Desio on the scale of 1:2000 will be the main critical point on which the developed methodology will be applied to produce better administrative plans concerning complex and not well-defined historical centres. The first problem noticed in the PGT is that in the theoretical part of the document, the administration is aware of the importance of consulting historical maps, although in practice that is not applied efficiently. Historical maps throughout the document are used as an illustration, without georeferencing and comparing maps from different periods, which does not allow professionals or planners

to understand the evolution of the town. Moreover, other historical documents, such as land registers, illustrations and descriptions are not used for the census or assessment of cultural heritage.

In conclusion, the study aims to uncover implicit and non-implicit features on the historical maps, to be used for the creation of official municipal urban plans. The analyses of the spatial relationships through the different maps and documents, the use of modern urban theories and the Geographic Information System (GIS) software, can develop an elaborated study through deductive and critical analyses. This will significantly increase efficiency, nurture the communication and multi-disciplinarity between engaged parties, and allow faster and less expensive dissemination.

4 Methodology: Implementing Content from Historical Maps

Cartographic content is neglected in city designing, although it can provide insights into past functions, developments of urban areas, and changes in land use. It is essential to rethink historical documentation as a source of scientific data to build a spatial-temporal stratigraphy. The research provides a set of guidelines for using the contents of historical cadastral maps at the scale of 1:2000, produced from the 18th century onwards. Those maps are comparable with the actual PGT, geometrically measurable, and they have a vast variety of accompanying data (e.g., land registers, patterns, past planning actions, etc.). The changes in the built environment are inevitable, but the frameworks developed for GeoDesign in the past can support protection of cultural heritage, as well as design of contemporary cities with the respect to its values, above all taking care of the type of geography, scale, and size [30].

The application of the methodology starts with the systematization of the collected historical documentation and their deconstruction of primary features. To comprehend historical cartography, a combination of various skills and knowledge in different fields is required, therefore often it is not possible to study cartographic content *en bloc*. Dismantling the map on the features will focus on each element individually and on its relationship with the surrounding. The link between the flat presentation on the map and the information that the selected investigated element is providing should be broken to be rebuilt with other contemporary information. “Deconstructing maps” derived as a concept from J. B. Harley’s work [31], but his research did not include the question of the purpose and scale in which extracted content would be used. This study is adding both additional criteria, specifically targeting the applications in urban plans of small widespread historical centres. Since a map is already a complex project made in the past, the elements on historical maps need to be “deconstructed” into three categories: natural elements, man-made and natural elements which are artificially shaped by man. The division of the first two categories is based on the UNESCO convention [32] and urbanist theories [33]. The study proposes adding the third category which consists of natural elements artificially made (e.g., parks, water canals or hedges) (See Fig. 3).

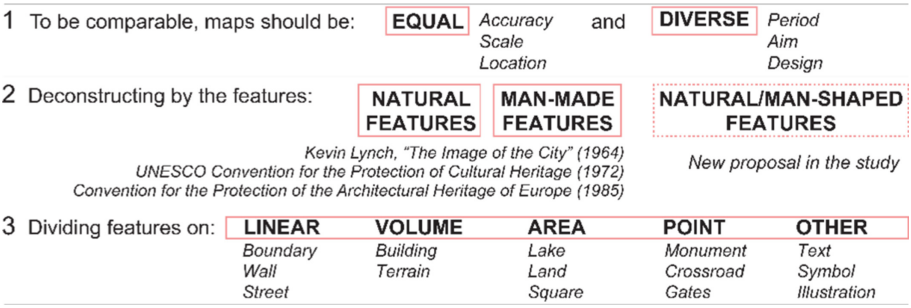


Fig. 3. Process of the selection, systematization, and deconstruction of historical maps on simplified elements for further analysis. Source: Authors.

The methodology uses theories of urban planning and design and examines physical features and cultural elements on historical maps that can be reused in planning by categorizing them in a generalized scheme. Generalized elements are divided into linear, volume, area, point and other features. This facilitates the implementation of modern concepts by selecting the features to be analysed and adapting specific methodology and techniques for in-depth study. Since all historical maps are individual scientific and artistic creations, flexible and adaptable methods are required but within well-defined and reproducible guidelines. After examining historical features and their relationship to one other and conducting a contemporary survey to create a spatial timeline, the pieces of data are reassembled using digital tools [34]. The inserted contemporary information will include administrative urban plans, photographic survey, experiences of citizens, and an assessment of the current state of cultural heritage.

The methodology provides the steps within the GIS to perform map regression analysis, allowing the user to access the metadata and link other historical material to their attributes. Georeferencing of historical maps inside the common coordinate system allows map regression for tracking the changes in the urban environment [35]. Three sets of historical cadastral maps that are held in the Statal Archive of Milan have been used for the study: *Catasto Teresiano* (1721–22), *Catasto Lombardo-Veneto* (1865–73 and 1875–1898) and *Nuovo Catasto Terreni* (1897–1902) all on the scale of 1:2000. The tool'Georeferencer' was used in the software QGIS for georeferencing maps. Deconstructed features, based on their origin and divided into simplified recognition elements, are identified and vectorized inside QGIS. Contemporary vector shapefiles are downloaded from the Lombardian geoportal (ital. *Geoportale Lombardia*), and other information about cultural heritage is imported from the SIRBeC[3] catalogue which describes patrimony. The two approaches, the decomposition of historical maps and contemporary analysis, are interdependent as good urban planning requires historical analysis and tracking transformations, both at the urban and city scale. The research criticizes the potential errors that can occur in urban plans if the historical background is not thoroughly investigated and past and present data are not compared (see Fig. 4).

[3] SIRBeC - Sistema Informativo Beni Culturali (regione.lombardia.it), accessed on 7.4.2022.

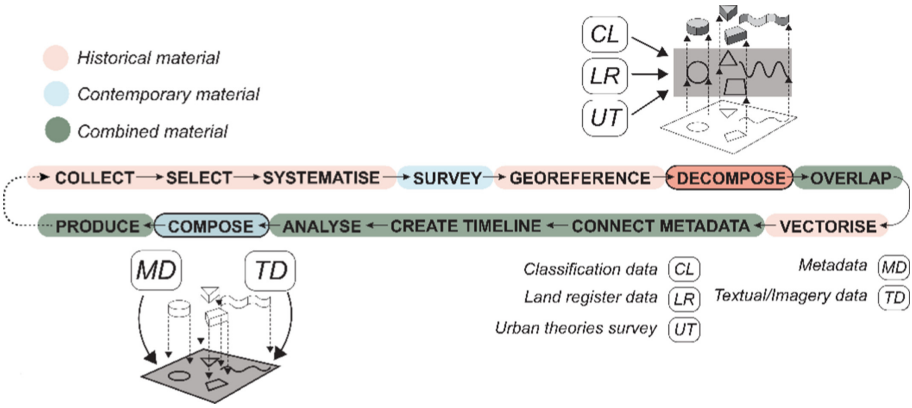


Fig. 4. Schematic preview of the developed methodology, used materials, and additional data linked to the historical and contemporary studies of the built environment. Source: Authors.

5 Results: Extracted Content and Its Evaluation

The applied methodological approach is adaptable to other sets of historical maps. Depending on the scale of the representation and typology of a map, researchers will be able to target their specific study of the urban environment of small centres. Decomposing and categorizing elements presented on the map allows the observation of single elements, and then their comparison to the related surrounding. Features on the map can be read as implicit and non-implicit. The former recognizes that what is represented should be taken as a fact: number and position of buildings, distribution of the streets, land use and surface, etc. However, the data that historical maps carry, and that is important for architects and urban planners, is often non-implicit. Those values can be read through the additional cross-referenced knowledge extracted from contemporary studies, urban theories and with the help of GIS technologies.

Non-implicit values can be translated from the map in terms of architectural style and evolution of buildings. Using land registers, it is possible to track the changes in ownership and function. The same approach can be employed for the investigation of land use, analysing why particular cultivation was in a specific area and what were the economic, social, and natural causes for those choices in the past. The use of open space, gardens, and piazzas had a significant role in the life of the community, and they are still the core of the town. Different arrangements and accessibility to those spaces can indicate the citizens' behaviour and political and economic influences. Street networks in historical centres have significantly changed, but historical alleys and ancient route can still be identified. The names of streets often suggest their previous use or that of nearby buildings, natural elements, or point to historical figures.

5.1 Urban Analysis and Thematic Maps

The study illustrates a developed methodology for investigating the cadastral historical maps on a scale of 1:2000 to be compared to Desio's actual PGT. The main aim is to find

ways to improve cultural heritage studies in planning activities through geovisualisation within the GIS software. In this way, a database for other documentation can be built, and data can be compared leading to better comprehension and contextualization of historical stratigraphy. Not all cadastral maps have the same aim, and it is important to combine the information to get a full image of the built environment. *Catasto Teresiano* made for taxation purposes was focused on the land-use diversity, while *Catasto Lombardo-Veneto* had only information about parcel division and shape of buildings but not about how the land was used. The ancient street network is still recognizable as well as the nuclei of antique formations. Since Desio was an important religious centre, sacral buildings were positioned in the important parts of the town next to the main axis. Churches were easily accessible from the squares in front of them, which also served for other gatherings. A water canal running from the north to the east and south, presented a boundary in the urban development but it accelerated agricultural one. This physical limitation remained until the canal was substituted with streets like in many other towns (see Fig. 5). The GIS software helps in the creation of thematic maps for faster and clearer visualization of the aimed group of features.

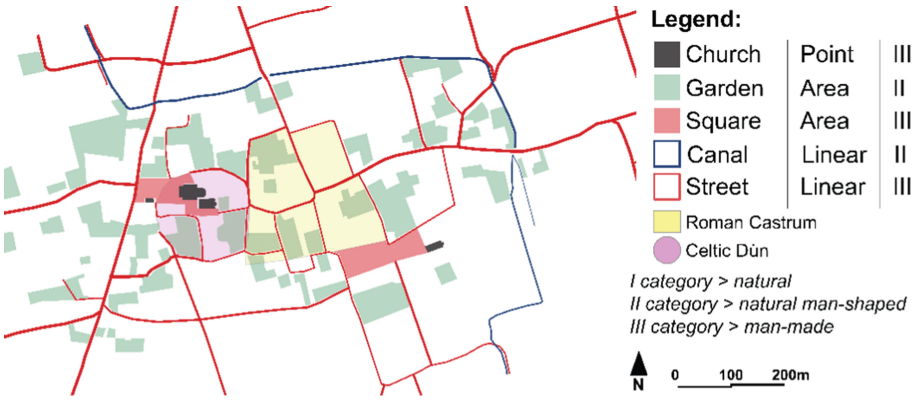


Fig. 5. Based on the *Catasto Teresiano* (1721–22) (source: ASMi, see Fig. 1 for details). Deconstructed on simplified and categorized features that were vectorised in QGIS. Source: Authors.

A newly produced thematic map can present the typology of noble villas (ital. *Ville gentilizie nell'Alto Milanese*) in Desio and building trends through time. The buildings in the city centre were built mostly in the typology house in a row and courtyard houses with several types of open and closed courtyards. In the oldest part of town, facades were facing the street, protecting the courtyards behind houses. Later on, houses were built further away, giving on to the street through open courtyards (see Fig. 6). Some future planning activities in the form of notes and sketches were directly drawn on the map (e.g., new openings, parcel divisions, paths, etc.).



Fig. 6. Based on the *Catasto Lombardo-Veneto* (1865–73) (source: ASMi, see Fig. 1 for details). Deconstructed features vectorised in QGIS for pattern recognition. Yellow colour represents important built residential cultural heritage. Source: Authors.

5.2 Analysis of Buildings and Cross-referencing Historical Documents

Ex-convent complex and oratory of San Francesco in Desio was used to test methodology on a single cultural heritage building. The monastery was built in the first half of the 13th century and went through many changes over time, both in architectural and functional terms, which can be traced on historical maps due to the lack of other documentation. The friars of San Francesco built their convent with the scattered stones of demolished ancient structures found on the ground [25]. Around 1410, the lords of Milan, who no longer used the ancient castle residence of Bernabò Visconti, donated the surface of the castle and its adjacent areas to the convent. The donation included the site of the ancient building, the moat and part of the forest [26]. The cloister was divided into three arches and two columns on each side, which can be seen on the original cadastral map of the first survey for *Catasto Teresiano* (1720–23). At that time, the surface belonging to the convent consisted of arable land, a garden next to the cloister, and a small *piazza* in front of the oratory with mulberry trees.

On the subsequent cadastral map *Catasto Lombardo-Veneto* (1865–73) the oratory and convent lost their functions, as immediately recognised by the absence of cross symbols. The convent was transformed into a farmhouse with a part being used as a greenhouse, serving the property of Villa Tittoni Traversi. The small *piazza* that was in front of the church lost its public function and became the internal courtyard of the complex. The shift of the functions initiated a change in the structure, now more closely imitating the organization of a Lombardian *cascina* (i.e., farmhouse). The building, by this new organization, also lost the spatial relationship with the public square (i.e., *'Piazza Castello'*, today *'Piazza Martiri di Fossoli'*) signifying the private property and enclosed space. The name *'Piazza Castello'* written on the map indicates the previously mentioned structure that was in the area, the castle of Bernabò Visconti on which land convent was built. The building volume changed once more on the north side of the oratory on the map *Nuovo Catasto Terreni* (1897–1902). Arable land, which was presented on the first map,

became part of the Tittoni park. An interesting bridge-ramp element was constructed on the south of the building. It is visible on all maps from the 19th century onwards, presented as external access from the park to the tower (see Fig. 7).

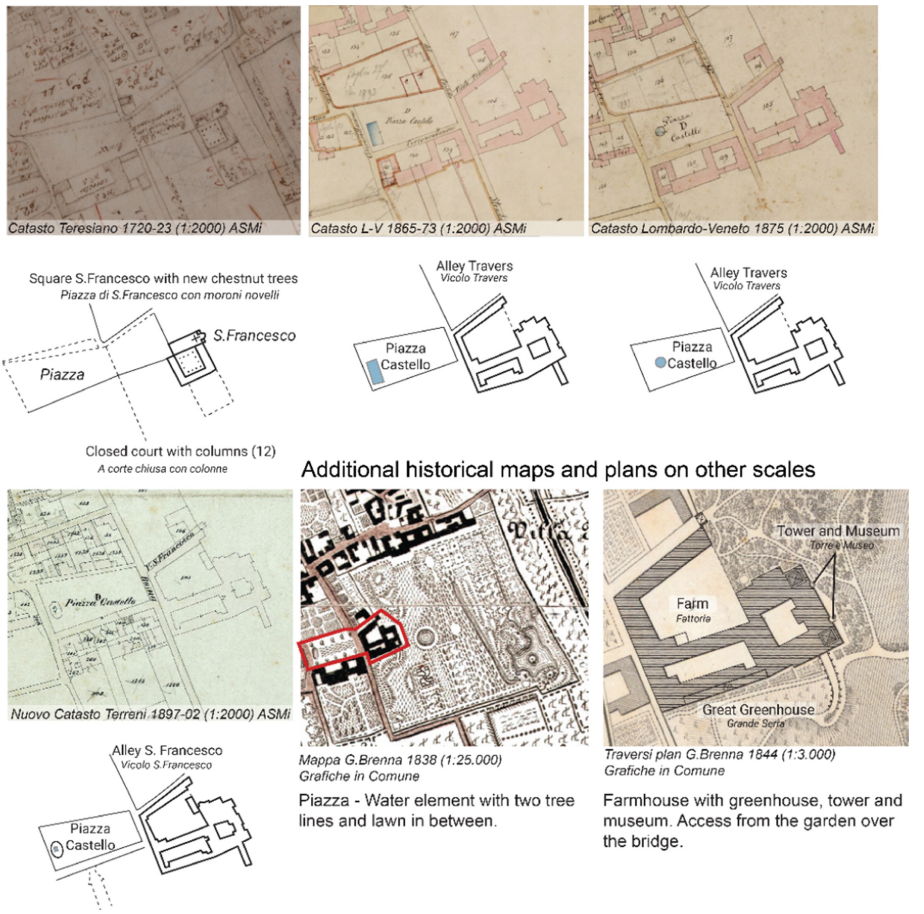


Fig. 7. Georeferenced cadastral historical maps in QGIS presenting the historical evolution of the ex-convent. oratory of San Francesco and piazza. The last two maps are not on the same scale, but they are presented as illustrations of the land use and functions of the buildings around 1840. (Map sources: indicated on the images, Analysis: Authors).

The old Cusani villa was substituted by Villa Tittoni Traversi. The architect Pelagio Palagi supervised all the works. He also built a tower, and in doing so changed the complex of the ex-convent. Torre Palagio was built in gothic style and was decorated with numerous sculptures and bas-reliefs. There is an inconsistency in examining available data deriving from the public administrations because there is no cross-referencing of the information from historical maps, land registers and other illustrative material. The catalogue of ICCD, which is a general catalogue of Lombardian Cultural Heritage (ital.

Beni Culturali Lombardia) filled by the Superintendence of Archaeology, Fine Arts and Landscape for the metropolitan city of Milan (ital. *Soprintendenza Archeologia, belle Arti e Paesaggio per la Citta' Metropolitana di Milano*), the date of construction is noted to be 1846. On the other hand, the SIRBeC documentation filled by *Beni Culturali* and Politecnico di Milano dates it between 1840 and 1844. Further investigation of historical maps and other documents suggests the tower was built a few years earlier, and other decorative elements were added through the years (see Fig. 8).

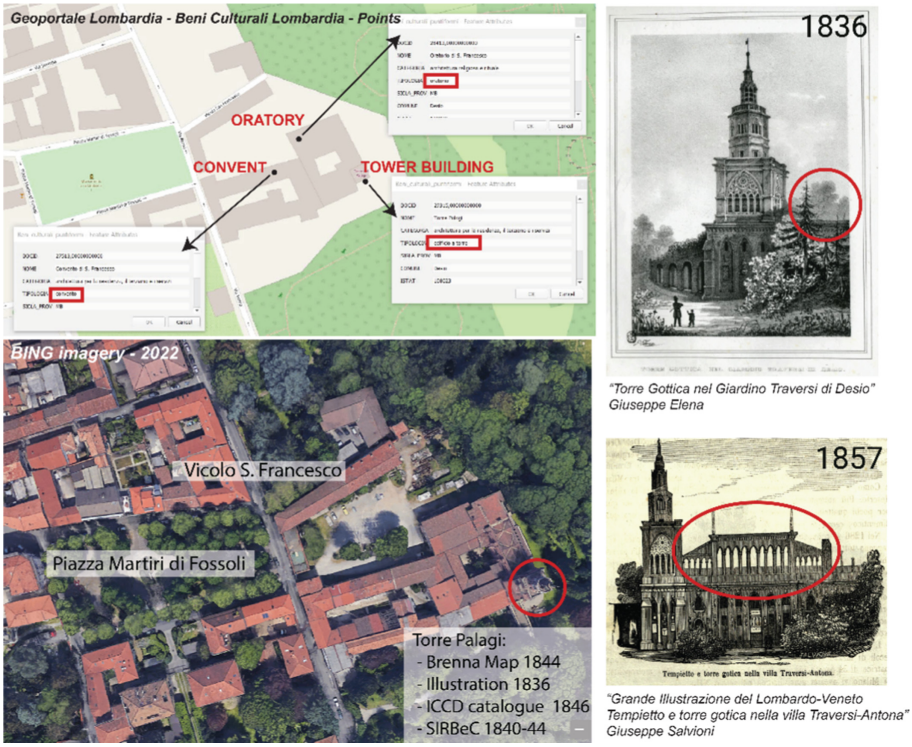


Fig. 8. Data downloaded from Geoportal of Lombardy and orthophoto are showing the current state of the building and the inconsistency of the date of construction of Torre Palagio. Illustrations are indicating that it was built at least a few years before the date indicated on administrative documents. (See changes on the illustrations from 1836 and 1857. Illustration source: Grafiche in Comune).

In the 2015 Desio PGT, under the section dedicated to the 'Census of Historical Heritage', Torre Palagio is listed as planned for restoration. It is noted that the tower is under a set of protection rules and constraints for its historical, artistic, and architectural values. Environmental qualities, in the context of the tower, are stated as"remarkable". The table was made in such a way that divides and describes single buildings but does not treat them as part of the complex or in the comparison to the surroundings and their historical timeline. In the section of the PGT, 'Plan of rules' (ital. *'Piano delle Regole'*), the map presents the investigated area restricted by two categories: 'historic-artistic

valuable area' and as a 'zone of *villa urbana*'. Next to the area of interest is the cycling route, which has the potential to foster tourism and revitalize cultural values. There is a need for the creation of a database for all the collected and systematized historical and contemporary data to overcome the demonstrated inconsistencies between them.

The PGT can be improved with the georeferentiation of historical maps and linkage of historical documents and illustrations. Future administrations should revise investigation and planning activities for single buildings, built complexes and their surroundings. The core of the methodology contains geovisualisation techniques, to understand the complex set of geographical and cultural data and engage the participatory decision making with various stakeholders, by representing urban changes as simplified and processed on thematic maps.

6 Future Developments

Urban planning and mapping have a direct impact on citizens' decisions and actions. The next step in the research would be participation of citizens in municipal decision making for enhancement and protection of cultural heritage, and urban planning. Using geovisualisation techniques described, decomposing maps' elements on simplified patterns, will allow easier participatory planning and it will bring understanding of historical maps closer to the other non-professional stakeholders. Following participatory engagement, to implement the concepts of GeoDesign, would be valuable adding other set of maps and on different scale range. In this way, the natural and man-made characteristics of the towns which do not have well-defined and used urban tissue, will come to the fore. Through these methods, potential scenarios can be run, for using and designing towns, in their built and natural settings. At last, the research can be enriched with the contemporary environmental studies based on spatial-temporal data collected and assembled into one database project in GIS. The GIS can be useful in running the spatial analysis of the most endangered areas in the historical centre and target the level of their protection. Currently, selection of the areas under protection indicated in the PGT is generalised. They cover large surface, and by that block future projects on a legal level. Reconsidering the cultural values in the context, can be of the vital importance in making sustainable and participatory oriented town planning.

7 Conclusions

Urban planning and mapping have a direct impact on citizens' decisions and actions. Historical maps do not reflect the *status quo* of the place, but through comparative analysis researchers can draw conclusions, reconstruct, and eventually even predict the behavioural patterns of residents. The study will aid researchers, public administrations, and other stakeholders in conducting studies on historical maps and gaining valuable data to intersect with contemporary ones. Historical maps can provide insights into the implicit, but more importantly, the non-implicit values of past spaces. Systematization and generalization based on the recommendations and urban theories give the methodology immense potential. The methodology allows the shift of scale and focus, so that it can be replicated for other goals in research. In future, the PGT can be enriched with the

creation of a database, integrating necessary georeferenced historical maps. Other historical documents can be linked through the attribute tables. The research will potentially accelerate economic, educational, social, and touristic development. The methodology will preferably provide guidelines for cartographers and creators of municipal urban plans for historical centres. The use of a GIS can increase efficiency and improve internal and external communication and data exchange. In education, knowledge can be shared among citizens and interested parties. Potentially, the public can be involved in the decision-making processes, and this collaboration can promote a sense of identity and culture. Recalling the values of the past will boost tourism and strengthen the perception of the place in the historical context.

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