An innovative methodological and operational approach to developing Management Plans for UNESCO World Heritage Sites: a Geographic

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An innovative methodological and operational approach to developing Management Plans for UNESCO World Heritage Sites: a Geographic Information System for "Ivrea, industrial city of the 20th century"

The model for developing Management Plans for UNESCO World Heritage Sites drawn up by the Italian Ministry of Cultural Heritage and Activities in 2005 is no longer wholly adequate in terms of promoting heritage resources and their local contexts.
The article considers the innovation developed in the IT/ICT field and provides theoretical and methodological considerations, based on which a new methodology for devising Management Plans could be developed.
A Geographic Information System (GIS) for the knowledge and management of the site "Ivrea, industrial city of the 20th century", is proposed as an innovative, dynamic, interoperable model that can both support urban-scale projects to capture the economic value of cultural heritage and promote forms of indirect enjoyment of the site.

Introduction

The results achieved for a revision of the methodology proposed by MIBAC for the development of Management Plans for UNESCO World Heritage candidate sites (MIBAC, 2005) are the outcome of an analysis conducted starting from the Management Plan drawn up in order that the site "Ivrea, industrial city of the 20th century" can be included in the UNESCO World Heritage List. It should be pointed out that the case of Ivrea presents different characteristics from the two UNESCO sites that were taken as reference points for drawing up the MIBAC methodology: "Cilento and Vallo di Diano National Park with the Archaeological Sites of Paestum and Velia, and the Certosa di Padula" and the "Sassi of Matera". Indeed, in contrast to these two UNESCO sites, capturing the economic value and promoting the enjoyment of the cultural heritage of the 20th century industrial city of Ivrea, although considered in terms of industrial landscape, depends in large part on restoring and/or reusing more than 100 buildings designed by internationally-acclaimed architects belonging to the Modern Movement. Aside from their architectural value, these 20th century buildings should be considered the

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concrete expression of the social model of community on which Adriano Olivetti based production and conceived the Industrial City.

Improving the value of and promoting Olivetti's cultural heritage in Ivrea – considered as a single integrated system of buildings, largely underused and difficult to repurpose, in an economically and socially not-dynamic local context – has led to its cultural heritage to be re-evaluated in terms of enjoyment in all of its many forms.

In the case of Ivrea, restoration and/or reusing of Olivetti's 20th century heritage comes up against the existing imbalance between the supply of premises and real/potential demand from locally-based enterprises and public and private services. As a result, in the case of such fragile contexts, the economic value of both tangible and intangible cultural heritage must be captured by placing special emphasis on enjoyment of heritage in its indirect forms, which can increase the number of people accessing it (directly, indirectly, potentially and in the future) and involve new visitors, including with the support of IT/ICT technologies (Haus 2016; Veltman 2005).

The purpose of this article, therefore, is to lay the foundations for the development of a new methodology for the creation of Management Plans for UNESCO World Heritage Sites, a methodology which is more effective in terms of capturing the economic value of tangible cultural heritage. Particular attention will be given to two distinct integrated actions:

- the first is based on the restoration and reusing of existing buildings of cultural interest, an action that is difficult to pursue given the lack of public resources and in contexts that are unable to generate new demand for private goods and services;
- the second action is based on indirect enjoyment of heritage, which may be pursued irrespective of the states of conservation of the assets of cultural interest in question. Enjoyment should be considered in relation to the effects it has in transmitting values to ordinary people and in improving the value of economic contexts. This is particularly clear in the case of contemporary architectural heritage, the occupants of which and citizens in general are themselves unaware of works that have received full international recognition.

To this end, after a brief analysis of the strengths and weaknesses of the current MIBAC methodology (Section 1), the role of Geographic Information Systems is investigated, not only as data- and information-gathering tools for acquiring knowledge about UNESCO sites but also as tools for managing projects and the process of improving their value. Taking the case of "Ivrea, industrial city of the 20th century", Section 2 sets out an innovative, dynamic and interoperable model for management and enjoyment of the site, by designing a Geographic Information System for managing urban-scale projects to capture the economic value of the city's cultural heritage and promote forms of indirect enjoyment by relating its built heritage assets to their local context. Finally, Section 3 illustrates a number of potential operational proposals, starting from the results achieved; specifically, it proposes the creation of a web platform which, starting from GIS data, builds a virtual environment for the indirect enjoyment of the site. In this sense, a real,

concretely achievable results could be the renovation of the current MAAM Museum (open-air Museum of Modern Architecture), for which a number of design proposals are described.[1]

1. The current MIBAC methodology for the development of Management Plans for UNESCO World Heritage sites

The need to draw up a model for developing Management Plans stemmed initially from an official request made by UNESCO to all sites inscribed on its List of World Heritage Sites (Rodwell, 2002). According to UNESCO, such plans were to focus above all on the programming of measures to implement in order to maintain the integrity over time of the values that enabled the site in question to be inscribed on the list, so as to preserve the site for future generations (WHC, 2016).

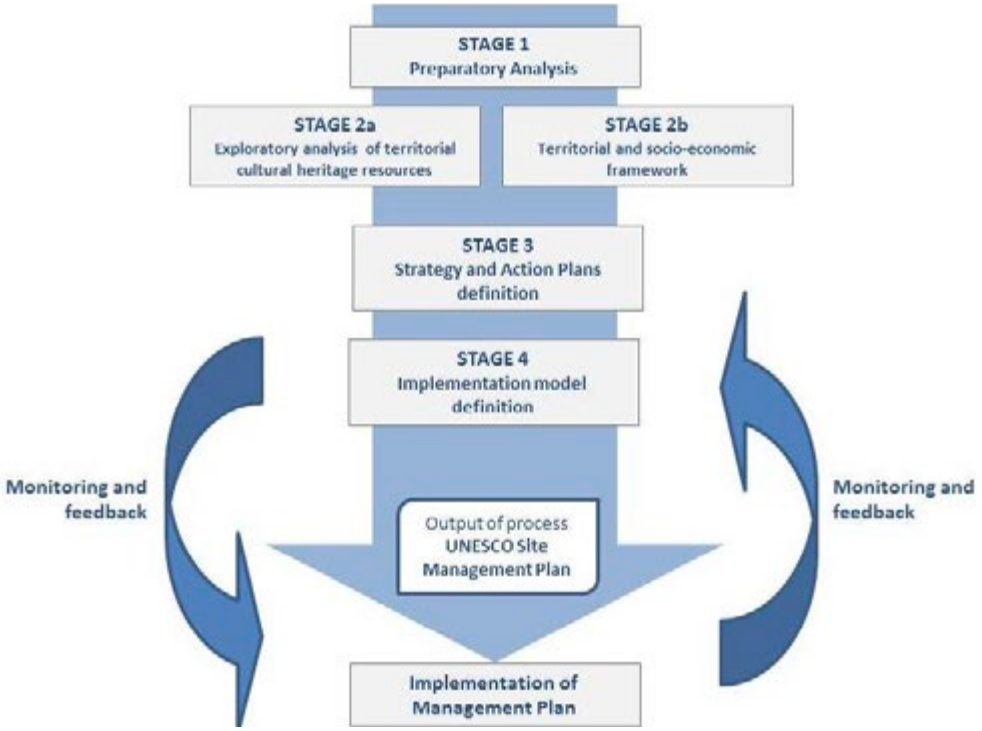
In Italy, through its World Heritage List department and with the support of Ernst & Young, MIBAC (the Italian Ministry of Cultural Heritage and Activities) drew up a methodology and a model for the development of Management Plans for all of the Italian sites inscribed on the List of World Heritage Sites. Although the approach set out by MIBAC in 2005 contains several aspects which still represent valid points of reference for an appropriate, structured approach to managing UNESCO sites, today it is in need of a partial overhaul, as it has a number of strengths that deserve to be developed and elaborated upon yet a number of weaknesses too (Borgarino et al., 2016; Sibilio Parri, 2011).

The methodology drawn up in 2005 by MIBAC and illustrated in detail in the document entitled "*Progetto di definizione di un modello per la realizzazione dei Piani di Gestione dei siti UNESCO*" (MIBAC, 2005) consists of 4 stages which describe all of the operations necessary for the drawing up of a Management Plan (Figure 1).

The methodology stresses that the 4 Action Plans must be integrated with each other into a single, integrated Strategic Plan which establishes sustainable development objectives as well as the necessary plans and programmes to achieve

[1] The subject of capturing the economic value and promoting the enjoyment of Olivetti's cultural heritage has recently been tackled by Coscia and Curto (2017), who have spurred a series of advances on the theoretical level and operational tools concerning the subject of capturing economic value on and promoting enjoyment of UNESCO sites, taking their cue from the case of Ivrea. This article develops on Coscia and Curto's essay and is the outcome of the experimental teaching module *Atelier di Restauro e Valorizzazione del Patrimonio* (Architecture Heritage Preservation and Enhancement Atelier) (conducted by Professors Lisa Accurti and Rocco Curto) as part of the Master of Science course in Architecture for Heritage Preservation and Enhancement held at the Politecnico di Torino during the 2016-2017 academic year. Students learned about the structure of the GIS designed for educational purposes and provided by the teachers for the implementation of the information layers concerning the environments and buildings for the development of heritage restoration and promotion projects. It should also be mentioned that the workshop activities were conducted applying a Problem-Based Learning (PBL) approach as part of the "CityLab LA" Erasmus+ project co-funded by the European Union (https://www.uantwerpen.be/en/projects/citylab/).

Figure 1. Methodological process for the development of Management Plans for UNESCO sites.



Source: Italian Ministry of Cultural Heritage and Activities – MIBAC (2005), Progetto di definizione di un modello per la realizzazione dei Piani di Gestione dei siti UNESCO, drawn up with the support of Ernst & Young Financial Business Advisor S.p.A.

short- and medium-term objectives. The model also indicates potential means of implementation and coordination of the integrated Strategic Plan, specific indicators for monitoring its achievement and the most suitable management structure for its implementation (MIBAC, 2005). The plans and programmes are supported by a series of data that can be managed by one single information system.

The MIBAC methodology in 2005 marked an advance which goes beyond the management of UNESCO sites and is transferable to all sites in Italy which, although not inscribed on the World Heritage List, nevertheless have a high value in terms of culture and identity and constitute part of its cultural wealth.

The MIBAC methodology recommends making use of three existing information systems as an initial knowledge base, each of them devised for protection purposes:

1. the *Sistema Informativo Generale del Catalogo* (SIGEC, General Information System for Cataloguing, now SIGECweb), set up by the *Istituto Centrale del Catalogo e Documentazione* (ICCD, Central Institute for Cataloguing and Documentation) of the Ministry of Cultural Heritage, which, despite advances made over

time in terms of methodology, manages the ICCD records, conceived of as records purely for cataloguing purposes in order to meet protection goals alone;[2]
2. the *Sistema Informativo Territoriale Ambientale Paesaggistico* (SITAP, Land Information System for the Environmental and Landscape), a webGIS system designed to protect heritage by means of management, consultation and sharing of information concerning areas with restrictions in accordance with landscape protection legislation in force;[3]
3. the *Carta del Rischio del Patrimonio Culturale* (Risk Map of Cultural Heritage), a webGIS system created by the *Istituto Centrale per il Restauro* (ICR, Central Institute for Restoration) which provides government and local bodies responsible for protecting, safeguarding and preserving heritage with an individual vulnerability indicator for each property (Bartolomucci and Cacace 2009).[4]

To date, these three databases have been made interoperable and available for consultation through the *Vincoli in Rete* web platform which, after an enormous amount of work georeferencing and harmonising identification data and geographical notations, produced detailed files of the properties which are available on an open-access basis (Negri 2014). [5]

1.1. Strengths and weaknesses of the MIBAC methodology

One of the strengths of the MIBAC methodology lies in the fact that it takes into account knowledge not only of heritage resources but also of their economic and social contexts, thus shifting the focus attention to capturing the economic value of cultural heritage, an aspect which had previously been dealt superficially if compared with the more firmly-rooted culture of protection.[6]

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[2] http://www.iccd.beniculturali.it/index.php?it/118/sistema-informativo-generale-del-catalogo-sigec

[3] The system contains georeferenced perimeters and information identifying and describing all landscape-related planning restrictions in force. As such, it enables a detailed analysis of existing restrictions on the site and on the reference area to be made so that it is possible to draw up a protection plan and evaluate whether it is necessary to verify the declaration of cultural interest, in accordance with the *Codice dei Beni Culturali e del Paesaggio* (Italy's Code of the Cultural and Landscape Heritage). Website: http://sitap.beniculturali.it/

[4] This vulnerability indicator, combined with the local danger indicator, which is available for all Italian municipalities, makes it possible to obtain the risk indicator for all assets located within a given area. With regard to risk analysis for monumental heritage the Central Institute for Restoration has implemented the local information system MaRis (*Mappa del Rischio*, Risk Map) which manages information relating to the entire national archaeological and monumental heritage, and data relating to the physical and chemical processes and to the social phenomena that lead to the deterioration of monuments. Website: http://www.cartadelrischio.it/

[5] http://vincoliinrete.beniculturali.it

[6] In this regard, for example, Legislative Decree no. 85 of 28 May 2010 provides an emblematic example of how the issue of harnessing the economic value and promoting the enjoyment of cultural heritage has not been tackled – either at the legislative level or in policies – using a method which structures the problems according to their many aspects. In accordance with

In this regard, the MIBAC methodology focuses above all on local contexts and considers the Management Plan "a strategic, operational tool, on one hand", which "seeks to establish short- and long-term conservation objectives, and on the other hand the strategies and actions that are to be implemented in order to achieve them" (MIBAC, 2005).

Specifically, the methodology exhibits the following strengths:

- it makes a distinction between capturing the value of cultural heritage and that of the related economic and social contexts, thus anticipating closely integrated actions (as in the case of "Ivrea, industrial city of the 20th century");
- in Stage 2a, in line with the *Codice dei Beni Culturali e del Paesaggio* (Code of the Cultural and Landscape Heritage) in force since 2004, identifies "the minimum technical documentation to be gathered, archived and made available for consultation in accordance with uniform, prescribed standards, for monuments, settlements and sites";
- it dedicates a specific space to Stage 2b, "Territorial and socio-economic framework", which includes a description of the infrastructure system as well as current and potential supply and demand in relation to the industries connected to the heritage enjoyment (culture, tourism, agriculture, crafts).
- it requires a CAD survey drawing of the site and georeferenced, with the representation of the main stages of development along with information regarding any collapses, demolitions or interventions carried out by means of renovation or restoration projects that may have occurred (MIBAC, 2005, p. 28).

The methodology displays the following weaknesses:

- it does not enter into detail with regard to the analysis of heritage resources (Stage 2a): ICCD records are considered as a basis for an initial technical and documentary survey, without examining a number of their limitations;
- in Stage 2b, "Territorial and socio-economic framework", despite distinguishing between analyses of the static type (MIBAC, 2005, pp. 63-85) and those of the dynamic type (MIBAC, 2005, pp. 86-102), it does not examine in depth instruments and analyses (Brigato et al., 2014);
- in its analysis of the surveys it only considers the aspect of restoration and not the fact that a substantial part of Italian cultural heritage needs to be reused, having lost its original function. It therefore does not take into account either the role of reusing in improving the economic value of the heritage or the economic and financial feasibility of interventions (Badia, 2007);

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the subsidiarity principle, the decree provides that state-owned assets of historical and architectural interest can be transferred to their local communities, with a view to capturing the economic value and promoting the enjoyment of local contexts. It binds the transfer of assets to local communities to an economic and financial feasibility assessment of the actions, which is taken into account for the first time by the Italian legislative framework. It does not, however, take into account the fact that repurposing, considered essential for capturing the economic value of assets, depends on how dynamic their economic and social contexts are, which is the true deciding factor in the absence of public resources.

- it does not analyse the environmental and energy-saving aspects of construction components and therefore does not consider the retrofitting of existing buildings or connect them to processes of sustainable urban regeneration;
- it takes the structure of the ICCD records as a basis, considering only the buildings and not the related micro-surroundings, public and private open spaces which often constitute an integral part of the assets themselves.

In light of these considerations, it bears repeating that the most in-depth aspect is represented by the space given to capturing the value of economic and local contexts, primarily considered with respect to tourist flows, on which the related Action Plans hinge (web platform, communication plan, marketing and geo-marketing plans, etc.). In this respect, the MIBAC methodology pays special attention to segmentation of target visitors (principal component analysis and cluster analysis) and the visualisation of the various market segments. Furthermore, it already anticipated data geo-referencing and considered the possibility of setting up a Geographic Information System (GIS) created on an ad-hoc basis which, in addition to gathering all of the information archived in the various existing (geographic and non- geographic) information systems, would also include further information considered necessary and useful for the efficient management of the reference area and, in addition, would be flexible and constantly modifiable, thus facilitating the archiving, consultation and updating of the databases (MIBAC, 2005, p. 139).

2. A Geographic Information System for the management of the UNESCO World Heritage Site "Ivrea, industrial city of the 20th century"

A revision of the MIBAC methodology for developing Management Plans for UNESCO World Heritage Sites, over ten years since their publication, cannot disregard the structuring and use of Geographic Information Systems (GIS), not only as databases to query in order to construct a knowledge base regarding heritage and sites but also and above all as dynamic, interoperable instruments that can support both the management of urban-scale measures to capture the economic value and promote forms of indirect enjoyment of UNESCO sites by relating architectural assets to their local context. Thus the objectives underpinning the creation of the GIS "Ivrea, industrial city of the 20th century", the general model for which can be applied to the management of other cultural sites, UNESCO or otherwise, can be summarised as follows:

- the GIS must represent the core of the Management Plan: the geographical databases must constitute an operational reference point for drawing up the Action Plans provided for by the current MIBAC methodology, i.e. the Knowledge Plan, the Protection and Conservation Plan, Valorisation/Promotion Plan and Communication Plan (MIBAC, 2005);
- the GIS must be interoperable with other existing Geographic Information Systems at the national, regional and municipal level (Signore, 2011);
- the GIS must be complete, updated and updatable (Griffiths, 2017; Sobrino et al., 2016);

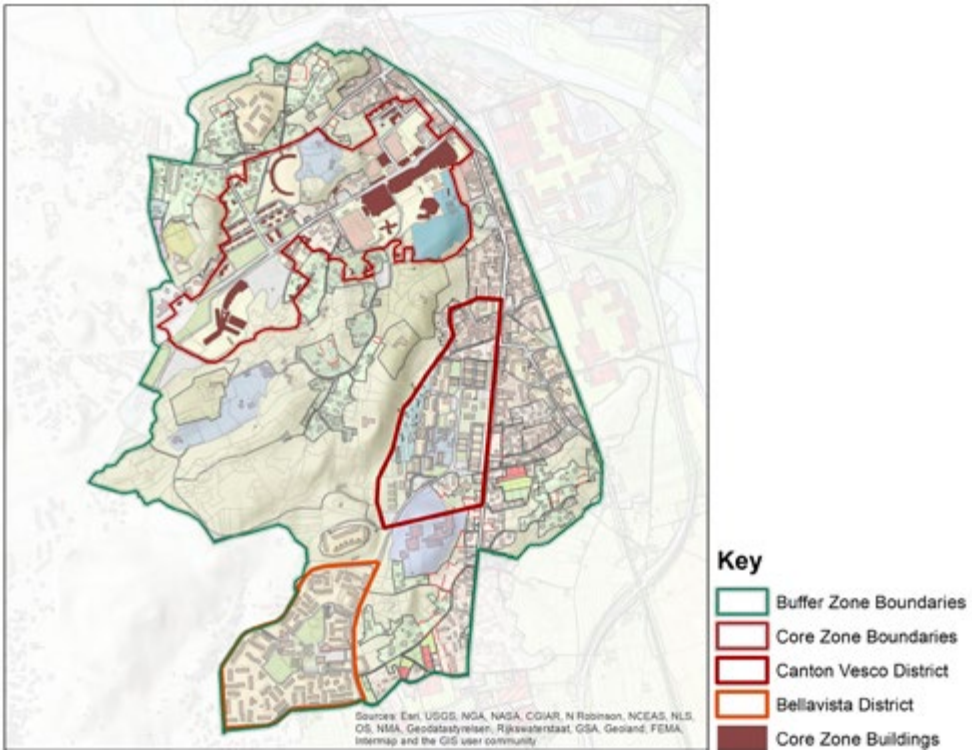
- the GIS must be able to manage and integrate various types of data (land use data, size data, economic data);
- the GIS must represent a support tool for preliminary analyses, managing projects and planning actions (Coscia et al., 2015);
- the GIS must also be functional for the development of a web platform designed for virtual enjoyment with real images or 3D models and with a user-friendly, open-access interface (Soler 2016).

These requirements form the basis of the objectives and structure of the experimental GIS developed in 2016 for the analysis of the heritage of Ivrea's Core Zone, currently nominated for UNESCO's World Heritage List, deferring the integration of the Canton Vesco and Bellavista areas, which are also included in the Buffer Zone (Figure 2), pending future developments.

2.1 The "Ivrea, industrial city of the 20th century" GIS : preliminary analyses

During the initial launch phase, all of the information contained in the UNESCO nomination proposal and in the Management Plan for "Ivrea, industrial city

Figure 2. The Ivrea's Core Zone (CZ) inside the Buffer Zone.



Source: map by authors based on Management Plan data and Municipality of Ivrea GIS data.

of the 20th century" – drawn up by the *Fondazione Guelpa* (Guelpa Foundation) in agreement with the Steering Committee,[7] were collected and georeferenced in the records regarding restrictions concerning the heritage assets located in the Core Zone.

Subsequently, taking into account the indications contained in the MIBAC methodology (see Stages 2a and 2b), this initial core of data (regarding the Urban Contexts) was integrated and significantly expanded with additional information drawn from direct, digitised surveys (CAD), archival researches and bibliographical analyses:

- information for knowledge of the local context, with a view to capturing the economic and cultural value of the site and its existing heritage assets;
- information for knowledge of the regional and socio-economic context, selected according to variable geographical units (UNESCO site, urban and suburban boundaries, regional scale).

Specifically, for knowledge of the local context, the information indicated in the MIBAC methodology, grouped by topic, was collected and new information, considered essential to protecting and capturing the economic value of the site and its cultural heritage, was added to it: "Register of assets in micro-surroundings", "Elements pertaining to identity and memory of built heritage", "Urban image" and "Capturing economic value", some of which are not included in the ICCD records (Figure 3).

For knowledge of the regional and socio-economic context, the layers of information included in the MIBAC methodology were integrated with some open data available online,[8] with the GIS made available by the Municipality of Ivrea – Town Planning Sector and other Geographic Information Systems already existing at the municipal level (*Carta della Qualità*, Quality Map) and regional level (http://geoportale.portalecomuni.net/ivrea/).

All of these geographical databases, integrated into the GIS and interconnected with each other by means of unique IDs, make it possible to carry out analyses at the regional (Regions, Provinces, ISTAT Areas and Municipalities), local and building scale.

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[7] The Steering Committee is formed by the UNESCO Department of MIBACT, the Municipality of Ivrea, the Adriano Olivetti Foundation and the Guelpa Foundation. The Steering Committee was designated in 2013 by the Coordinating group – set by the MIBACT World Heritage Department following the inclusion in the list of nominated sites. In addition to the Municipality of Ivrea, it includes the Ministry of Cultural Heritage and Activities and Tourism, and involved various bodies: General Secretariat, Pabaac, Superintendence for Architectural and Landscape Heritage and the Piedmont Regional Directorate, the Piedmont Region, the Metropolitan City of Turin, the Adriano Olivetti Foundation and the Guelpa Foundation.

[8] http://www.geoportale.piemonte.it/cms/; https://www.istat.it/it/archivio/104317; https://www.comune.ivrea.to.it/entra-in-comune/amministrazione-trasparente/disposizioni-generali/category/piano-regolatore.html; http://www.viefrancigene.org/it/piedi/; https://www.openstreetmap.org/#map=20/45.45711/7.87279&layers=NDG.

Figure 3. Necessary information for an analysis of the local context. The parts in bold are the authors' additions to the indications contained in the MIBAC methodology – Stages 2a and 2b of the methodology.

Theme	Information	Source of data
REGISTER OF ARCHITECTURAL ASSETS	identification, location and description of asset;	regional technical map (CTR) and elements, municipal technical map (CTC) and elements, land register (cadastral) map, orthophotograph, direct survey, ISTAT data, Management Plan, **direct survey, Chamber of Commerce, publications, archives, visual survey, superintendence records**
	photograph of asset;	
	ownership and state of use;	
	means of enjoyment;	
	accessibility;	
	risk factors;	
	Intended uses and **their distribution** (original, actual state, **planned state**)	
	State of conservation (survey of degradation, **definition of qualitative and distinguishing elements, definition of state of conservation of structural elements**)	
REGISTER OF ASSETS IN MICRO-SURROUNDINGS	**identification, localisation and description of asset;**	**regional technical map (CTR) and elements, municipal technical map (CTC) and elements, land register (cadastral) map, orthophotograph, direct survey, ISTAT data, Management Plan, direct survey, Chamber of Commerce, publications, archives, visual survey, superintendence records**
	photograph of asset;	
	ownership and state of use;	
	means of enjoyment;	
	accessibility;	
	risk factors;	
	level of use of empty and unbuilt areas	
	level of maintenance of empty and unbuilt areas	
	classification	
	State of conservation (survey of degradation, definition of qualitative and distinguishing elements, definition of state of conservation of structural elements)	
EXISTING RESTRICTIONS	Restrictions and communications in accordance with ex Law no. 490/1999;	**Municipal GIS , General Urban Development Plan, implementing technical standards and variations, regional land use restrictions maps, planning regulation maps, superintendence records.**
	Military restrictions;	
	Zones subject to restrictions under Law 615/1996;	
	Protected areas: SIC (Sites of Community Importance), SPA (Special Protection Areas), Natura 2000 areas, national/regional parks, WWF oases, nature reserves, etc.);	
	Hydrogeological restrictions;	
	Restrictions per General Urban Development Plans (PRGC)	
ELEMENTS PERTAINING TO IDENTITY AND MEMORY OF BUILT HERITAGE (significance/rarity/value)	**Olivetti idea of community**	**Superintendence records, Olivetti archive, publications, first-hand accounts, Management Plan**
	Philosophies behind Core Zone building design	
	Original designs/modifications over time	
	Period of buildings	
	History of original designers and projects	
	Subsequent functions **and distribution**	
	Current functions **and distribution**	
	Definition of qualitative and distinguishing elements	
	Survey of state of conservation	
URBAN IMAGE	**Definition of qualitative and distinguishing elements of building in its current state**	**Visual survey**
	Characteristics of enjoyment by external users/visitors	
	Definition of ideal walkable itineraries for enjoyment of heritage	
CAPTURING ECONOMIC VALUE	**hypothetical project costs**	**Conservation, restoration, energy retrofit and transformation projects**
	hypothetical investment costs	
	profitability	
	implementation timescale	
	degree of risk	

Source: table by authors, based on Management Plan data.

2.2 *Structure of territorial classes in the Core Zone: from buildings to urban framework*

Ivrea's Core Zone is a complex urban system of high historical and architectural value, consisting of several buildings of particular merit designed in the 20th century by young architects initially selected by Adriano Olivetti and subsequently acknowledged by architectural critics as being among the most representative figures of Italian "Modern Movement" (Figini and Pollini, Gardella, Vittoria, Gabetti and Isola, Cappai and Mainardis, Sgrelli) (Galuzzi 2016). The architectural assets of the Core Zone are the expression of Adriano Olivetti's community model and represent the Modern Movement in all of its manifold expressions. Among all of the building types (industrial buildings, research centre, offices, social services centre, residential buildings, etc.), some deserving of mention – in addition to examples of organic, rationalist architecture (the company canteen and leisure centre, the social services centre, the ICO workshops, etc.) – also include the Western Residential Unit (Talponia) by Gabetti and Isola, an example of underground architecture, the former Sertec office building by Sgrelli, an instance, perhaps a little forgotten, of brutalist architecture, and the *Eastern Residential Unit* (former Hotel La Serra) by Cappai and Mainardis, which unfortunately lies outside the Core Zone but represents an exceptional case of radical architecture (Coscia and Curto 2017) (Figure 4).

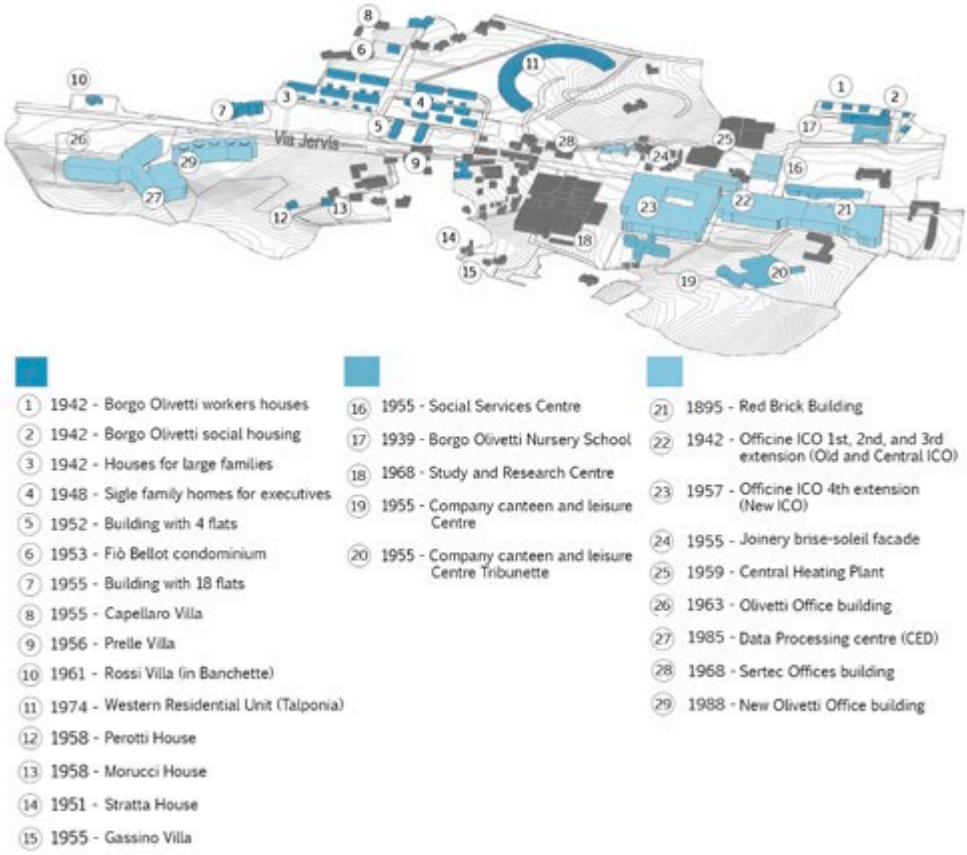
The buildings commissioned by Adriano Olivetti were conceived as non-separable elements, and constitute a single system of heritage for the purpose of an integrated approach to capturing their economic value; this system considers each building as a specific component of a single urban plan. Thus in developing the GIS a hierarchy of territorial classes (from buildings to the urban context) was adopted along with an "element-relation" structure in which each smaller-scale element is contained within a larger-scale element, inheriting its general characteristics (Figure 5).

Some territorial classes were taken from the Management Plan for the UNESCO nomination proposal: the Buffer Zone, Urban Areas (including the Core Zone) and Urban Settings (sometimes including groups of buildings and sometimes a individual building). Others were added by the authors: Buildings, Land Parcels (according to the Land Register), Elements of the System of Green Spaces, Elements of the Infrastructure System, and Projects. The latter class was deemed essential to the purpose of capturing the economic value of the site's heritage, which will require integrated actions at the architectural and urban scale, whereas the "Media" class includes all of the multimedia material available for the indirect enjoyment of the Olivetti system (Figure 6).

The structure of the GIS defines Buildings (main and secondary) as the smallest territorial class: each element belonging to this class was connected by means of a unique ID to an Urban Context and to a Land Parcel (Figure 7).

Although in most cases an urban setting corresponds to a single building, some urban contexts include several land parcels and buildings, as in the case of residential buildings, with the exception of the office buildings and the Data Processing Centre which are part of different contexts but located in a single land parcel (Figure 8).

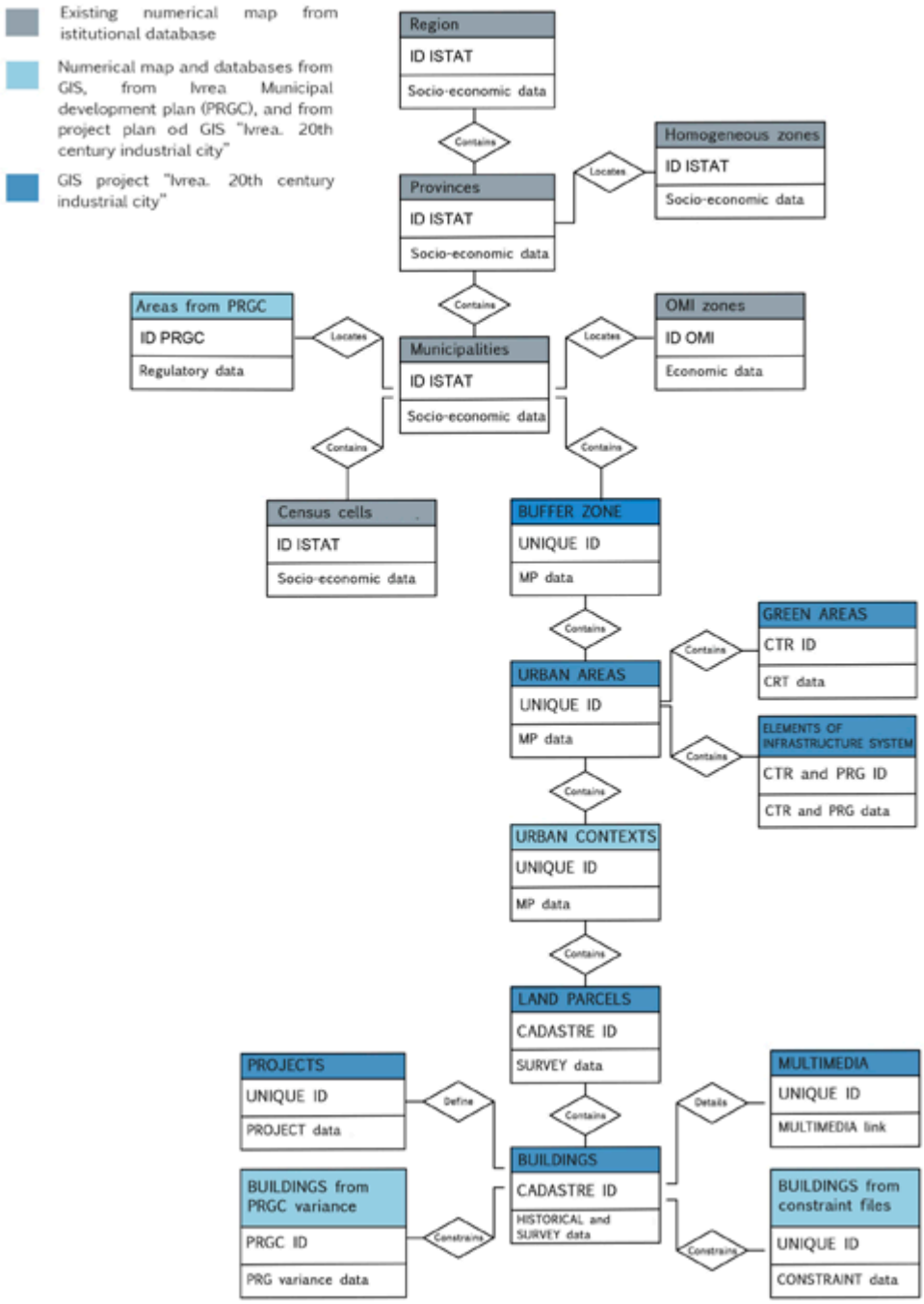
Figure 4. Ivrea's Core Zone.



Source: map by authors based on images by Matteo Arato, Giulio Bianco and Alberto Chialva, students at the Atelier di Restauro e Valorizzazione del Patrimonio (Architecture Heritage Preservation and Enhancement Atelier) held at the Politecnico di Torino, during the 2016/2017 academic year.

For each element belonging to the various layers of information in the GIS, georeferencing data, attributes (the features that describe its nature) and primary identification keys (unique IDs) were defined, enabling it to be connected with other elements. In addition, for each class, the structure of the metadata was defined, the fields of which make up the survey and cataloguing records used in data input the database (Baca 2003). For example, the classes representing Elements of the Infrastructure System and Elements of the System of Green Spaces contain information about the related micro-surroundings such as the state of conservation and adequacy of street furniture, materials and accessibility, that is, any information that can be used for the purpose of urban redevelopment of the Core Zone. The inclusion of the class pertaining to projects is particularly innova-

Figure 5. Conceptual framework of GIS "Ivrea, industrial city of the 20th century".



Source: framework by authors.

Figure 6. Classification and definition of territorial classes comprising the GIS and number of elements corresponding to each class.

Territorial Classes	Description	Number of elements
Buffer Zone	Sub-class of the Municipality. The area defined by the Management Plan for the UNESCO nomination proposal, the perimeter of which was defined taking into account the following aspects: the structural relations between each asset and the local context; its historical and representative value in relation to the values of the nomination; perception of the place, including its scenic, landscape, socio-economic and ecological characteristics; the perception that residents have of the values of the nomination; the different levels of protection enjoyed by the area.	1
Urban Areas	Sub-class of the Buffer Zone. The Urban Areas defined by the Management Plan are: the Core Zone, Canton Vesco and Bellavista. The Core Zone is defined as an area of the site which is located within the municipal boundaries of Ivrea and is significant in the urban context not only for its high historical, cultural and landscape value but also for the size of the surface area included, which is more than half of the urban perimeter.	3
Urban Contexts	Sub-class of Urban Areas. The Urban Contexts defined by the Management Plan may correspond to a single building, to a building situated within its appurtenant land or to a group of buildings. The Urban Contexts have been defined by virtue of their design or construction coherence and exhibit homogeneous typological and morphological characteristics within their perimeters. The geodatabase collects data concerning current state and original state and time of construction, highlighting any transformations that have been made over time (construction of new wings, demolitions, transformations changing the essential characteristics of the building).	29
Elements of the Infrastructure System	Elements of the road and rail system forming part of the portion of the city examined and its development dynamics. The geodatabase describes the main characteristics, divided by stretches of road or portions of pedestrian areas, the existing road classification from the technical map and qualitative information regarding level of use and state of maintenance.	29
Elements of the System of Green Spaces	Both public and private green assets present in the area. For each element, the geodatabase describes the surface area and the main distinguishing characteristics, including elements of degradation.	32
Land parcels	Sub-class of Urban Contexts. Land (cadastral) parcels are undeveloped areas of each context as defined in the land register. The geodatabase describes the distinguishing qualitative characteristics, land register identification data and related information, and the main urban planning indicators.	93
Buildings	Sub-class of Land Parcels. Architectural assets (either main or accessory) located within the urban contexts and land parcels. The geodatabase collects data regarding register of architectural assets, time and details of their construction, original state and current state. Their architectural characteristics which determine their form, size, materials, elements of value and of degradation, in order to highlight any transformations that have taken place over time.	114
Projects	Project proposals relating to any element included in the information system with a general description of the project proposed and main economic evaluation indicators.	34 (for buildings)
Media	Multimedia resources available to consult for any element included in the information system. Here the geodatabase collects, for example, period and current photographs, surveys, project drawings and audio/video files of first-hand accounts.	-

Source: compiled by authors.

tive, as in contrast to the current MIBAC methodology it does not consider only renovation but also other critical issues in capturing the economic value of cultural and architectural heritage. As an example, a series of initial data to be collected to test the system are listed in Figure 9.

In conclusion, each element belonging to the different territorial classes into which the Core Zone is divided can be associated with one or several conservation, restoration, energy retrofitting or reusing projects (architectural-scale), or projects to improve and redevelop public spaces such as streets and green areas (urban-scale). Specifically, projects regarding infrastructure and private and public open spaces are equally considered to these regarding built heritage, as their rede-

Figure 7. Context: "Single family homes for executives" indicating Contexts (AB), Land Parcels (L), Buildings (ED), Infrastructure (IN) and Green Areas (VR).

Source: map by authors based on Management Plan.

velopment can contribute to the economic and financial feasibility of interventions funded by private individuals and real estate funds. Design scheme simulations were carried out using the discounted cash-flow method in order to reduce conflicts between uses and facilitate convergence between the various stakeholders towards a single and shared Master Plan, all the more important considering the economic and social fragility of the local context.

2.3 Potential of the GIS "Ivrea, industrial city of the 20th century" for capturing the economic value of Olivetti's cultural heritage

The purpose of the innovative elements introduced in the GIS "Ivrea, industrial city of the 20th century" is to enable the Core Zone to be managed in a highly-integrated manner with the municipality of Ivrea. Specifically, the GIS makes it possible to gather, analyse and manage all of the information necessary to capture the economic value of the site.

The processes described below illustrate some of the potential benefits of analysing data concerning the Core Zone. The structure of the GIS has been complete for this urban area and is made up of 29 Urban Contexts, 94 Land Parcels, 114

Figure 8. List of Urban Contexts in the Core Zone from the Management Plan with corresponding number of buildings and land parcels.

Urban Context ID	Name of Urban Context	No. of land parcels	No. of principal buildings	No. of adjacent buildings
AB01	Social Services Centre	1	3	0
AB02	Borgo Olivetti Nursery school	1	1	2
AB03	Borgo Olivetti Social housing	1	1	0
AB04	Central Heating Plant	1	1	0
AB05	Olivetti Office Building	1	1	0
AB06	Data Processing Centre		1	0
AB07	New Olivetti Office Building		1	0
AB08	Joinery brise-soleil facade	1	1	0
AB09	Sertec Offices Building	1	1	0
AB10	Building with 18 flats	1	1	0
AB11	Houses for large families	54	29	27
AB12	Single family homes for executives	6	6	1
AB13	Building with 4 flats	2	2	0
AB14	Borgo Olivetti workers' houses	6	6	2
AB15	Western Residential Unit (Talponia)	1	1	0
AB16	Capellaro Villa	1	1	1
AB17	Red Brick Building	1	1	0
AB18	Officine ICO, 1st, 2nd and 3rd extension (Old and Central ICO)	1	3	0
AB19	Officine ICO, 4th extension (new ICO)	1	1	2
AB20	Company Canteen and leisure centre (and Tribunette)	1	2	0
AB21	Study and Research Centre	1	1	0
AB22	Prelle Villa	1	1	0
AB23	Fiò Bellot Condominium	3	1	2
AB24	Stratta House	1	1	1
AB25	Morucci House	1	1	0
AB26	Perotti House	1	1	0
AB27	Enriques Villa	1	1	2
AB28	Gassino Villa	1	1	1
AB29	Rossi Villa (Banchette)	1	1	0
TOTAL		**93**	**73**	**41**

Source: compiled by authors.

Buildings (73 principal buildings and 41 adjacent buildings), 29 Elements of the Infrastructure System and 32 Elements of the System of Green Spaces. Nevertheless, data input is only partially complete as, to date, data relating to 15 Urban Contexts[9] and to most of the Elements of the Systems of Infrastructure and Green Spaces have been entered in the geodatabase.

[9] *Centro Servizi Sociali* (Social Services Centre), *ICO Nuova* (Officine ICO 4th extension - New ICO), *Ex-Uffici SERTEC* (SERTEC offices Building), *Edificio Mattoni Rossi* (Red Brick Building), *Unità Residenziale Ovest* (Western Residential Unit - Talponia), *Ex-Mensa Aziendale e Centro Ricreativo* (Company Canteen and Leisure Centre), *ICO Centrale* (Officine ICO 1st, 2nd and 3rd extensions – Old and central ICO), *Centrale Termica* (Central Heating Plant), *Nuovo Palazzo Uffici Olivetti* (New Olivetti Office Building) *Case per famiglie numerose* (Houses for large families), *Case unifamiliari dirigenti* (Singlefamily homes for executives), *Edificio con 4 alloggi* (Building with 4 flats), *Centro Studi ed Esperienze* (Study and Research Centre), *Edificio Uffici Olivetti* (Olivetti Office Building), *CED – Centro Elaborazione Dati* (Data Processing Centre).

Figure 9. Metadata for "Project" class.

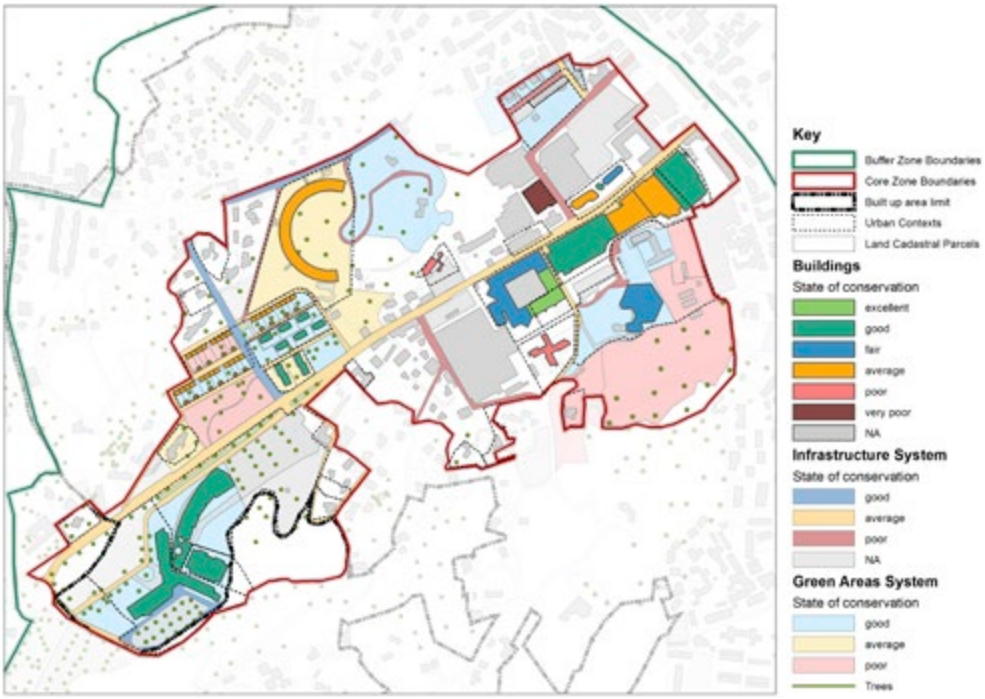
PROJECTS				
data structure	**data content**	**data value**		**source**
Field name		**vocabulary**	**levels**	
PROJECT ID	project identifier	closed	AB01PRG001,...,AB29PRG n	compiler
URBAN CONTEXT ID	urban context identifier	closed	AB01, ..., AB29	DB
LAND PARCEL ID	land (cadastral) parcel identifier	closed	L001, ..., L099	DB
BUILDING ID	building identifier	closed	ED001, ..., ED118	DB
PRGC ID Code Law 3595	building identifier as classified in General Urban Development Plans (PRGC)	closed	R0044400, R0044399, R0044412, ...	DB
PROJECT NAME	name assigned to project (if any)	open		compiler
PROJECT DESCRIPTION	brief description of specific project	open	new restaurant, new offices for start-ups, new research laboratories ...	compiler
PROJECT MAIN FUNCTION	definition of main function	open	DCA (day centre for eating disorders), bar, restaurant, physiotherapy centre, hotel, residence, ...	compiler
PROJECT TYPE	brief general classification of type of project	open	change of function use with interior modifications, extraordinary maintenance, expansion, division	compiler
CHANGE IN FUNCTION	from building's current use	closed	yes, no, n/a	compiler
SCENARIO TYPE	type of scenario used for evaluation	closed	sale, management	compiler
GUFA BUILDING	gross usable floor area of building (m^2)	open	numerical	compiler
NUFA BUILDING	net usable floor area of building (m^2)	open	numerical	compiler
GUFA PROJECT	gross usable floor area of project	open	numerical	compiler
COST OF INVESTMENT EUROS	cost of investment including costs of purchase of area and project costs (euros)	open	numerical	compiler
COST OF PROJECT EUROS	cost of project (euros)	open	numerical	compiler
IRR %	internal rate of return (%)	open	numerical	compiler
NPV	Net Present Value	open	numerical	compiler
COST OF INVESTMENT EUROS/M^2	cost of investment including costs of purchase of area and project costs (euros) divided by gross usable floor area of project (m^2)	open	numerical	compiler
COSTO OF PROJECT EUROS/M^2	cost of project (euros) divided by gross usable floor area of project (m^2)	open	numerical	compiler
PRIORITY	priority of project evaluated according to urgency, profitability and existence of available financing	closed	high, medium, low	compiler
ESTIMATED TOTAL DURATION MONTHS	estimation of duration of works	open	numerical	compiler
RESOURCES	estimation of human resources employed to complete project	open	numerical	compiler
AVAILABILITY OF FINANCING	availability of financing for type of project proposed	closed	yes, no, N/A	compiler
TYPE OF FINANCING	brief description of possible financing for implementation of project	open	non-repayable public or private financing, capital grants low-interest loans, etc.	compiler
references	sources used, bibliography	open		compiler
name of compiler	name of record compiler	closed	GR01, ..., GR20	compiler
date	date record compiled	open		compiler
note	any other information that does not fall within the official fields for compilation	open		compiler

Source: compiled by authors.

Using the information collected in the geodatabase, organised according to the hierarchical classification of territorial classes illustrated above, a number of potentials of the GIS were tested.

For example, with regard to the "Buildings" class, containing information from the survey concerning state of conservation and materials, information regarding

Figure 10. State of conservation of elements in the three classes, "Elements of the Infrastructure System", "Elements of the System of Green Spaces" and "Buildings" in Ivrea's Core Zone.



Source: map by authors.

the buildings' micro-surroundings, such as lighting, street furniture and state of conservation of road infrastructure as well as private and public green spaces, was collected and analysed (this information is contained in the "Elements of the Infrastructure System" and "Elements of the System of Green Spaces") (Figure 10).

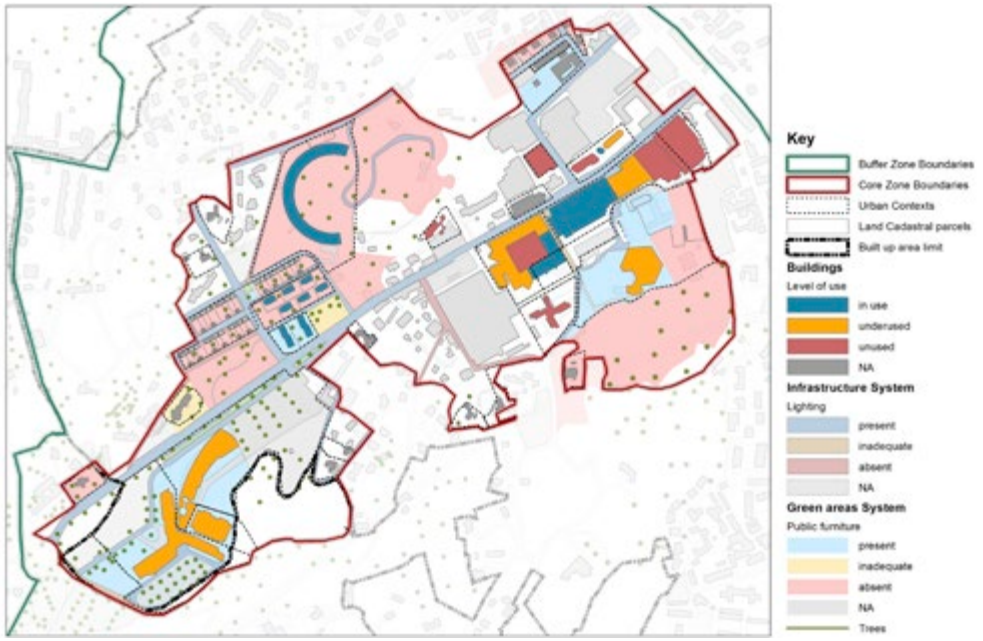
With the support of the GIS, it was therefore possible to highlight on a number of emblematic cases related to the state of conservation of certain urban elements and buildings in the area. For example, the *Central Heating Plant* and the *Western Residential Unit* (*Talponia*) are accessible via roads in need of repair, while the green areas in a better state of maintenance are contiguous with the residential and office building contexts. Another point highlighted is the problem of access to the offices for their enjoyment, which relates to the more general problem of road access, the most critical point being Via Jervis which represents the main axis of development of the site and is in a not really good state of conservation and constitutes an irreparable break in the Core Zone (one possible option is to cover over this road).

With regard to the buildings, the GIS collects information regarding their state of conservation in terms of degree of pathology and materials, deducing them from direct surveys (dwg files) (Figure 11). Based on these data, restoration projects have been developed and quantified in terms of cost for 14 buildings.

Figure 11. Illustration of state of conservation with survey of degradation of the project for the restoration and transformation of the Central Heating Plant.

Source: survey of state of degradation and materials by Monica Del Fabro and Elena Zanardo, students at the *Atelier di Restauro e Valorizzazione del Patrimonio* (Architecture Heritage Preservation and Enhancement Atelier) held at the Politecnico di Torino, during the 2016/2017 academic year.

Figure 12. Presence and adequacy of street furniture and lighting in the elements in the classes "Elements of the Infrastructure System" and "Elements of the System of Green Spaces" and level of use of elements in the "Buildings" class in Ivrea's Core Zone.



Source: map by authors.

The strength of the GIS lies in its integration of the data regarding buildings with data relating to public/private open spaces. The thematic, descriptive map shows that street furniture is absent in most of the green areas and that the streets are generally well lit (Figure 12).

The GIS also enables building restoration and reusing projects to be developed as part of urban and green space redevelopment programmes, operating at both the project and plan level. By way of example, the project relating to the public green area situated in the vicinity of the Houses for large families and Single family homes for executives is currently in a poor state of conservation and lacking in amenities (Figure 13).

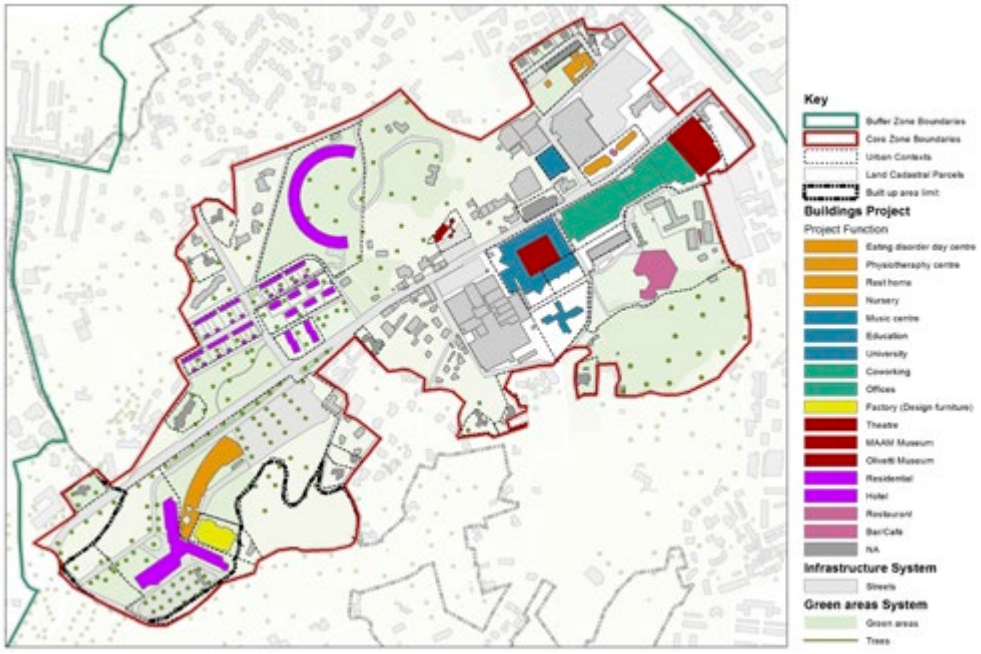
The "Projects" class thus made it possible to reconstruct at the urban level the redevelopment projects proposed during the "Atelier Architecture Heritage Preservation and Enhancement" and to evaluate any conflicts or incompatibilities between the new functions proposed. Through the GIS, therefore, the functional reconversion projects developed in CAD have been placed in systemic relation to each other.

For each building, alternative functions were established and compared with those envisaged for the other buildings that make up the system of Olivetti architectural heritage, in order to complete a Master Plan of the entire Core Zone

Figure 13. Redevelopment plan for green areas adjacent to Houses for large families and Single family homes for executives.

Source: project for green spaces by Josephine Buzzone, Alessandro Piovano and Giorgia Senini, students at the *Atelier di Restauro e Valorizzazione del Patrimonio* (Architecture Heritage Preservation and Enhancement Atelier) held at the Politecnico di Torino, during the 2016/2017 academic year.

Figure 14. New functions definition with examples of energy retrofit and reusing.



Source: map by authors.

(Figure 14). For example, it is interesting to note the functional mix (Olivetti Museum, university, offices, coworking facilities and theatre) proposed for the Red Brick Building and the Officine ICO and highlight the broad spectrum of potential functions for the entire system of Olivetti architectural heritage. The functional mixes proposed for each building were also verified in terms of the project's economic and financial feasibility.

Figure 14 should be interpreted in conjunction with Figure 15 – which shows in detail a broad range of functions responding to potential emerging demand – and taking into account the architectural characteristics, current level of use and state of conservation of the buildings. The geographical representation (Figure 14) shows how the new functions would be distributed geographically and how the buildings would constitute a single, coherent system both functionally and geographically.

The two main types of project proposed for the architectural heritage are energy retrofit and reusing projects.

With regard to contemporary architectural heritage, generally only the aspects of architectural restoration and perhaps reusing are considered, without taking into account the energy component, as dealt with in the context of Whole Building Design (Prowler and Vierra, 2008). Hence information was collected about

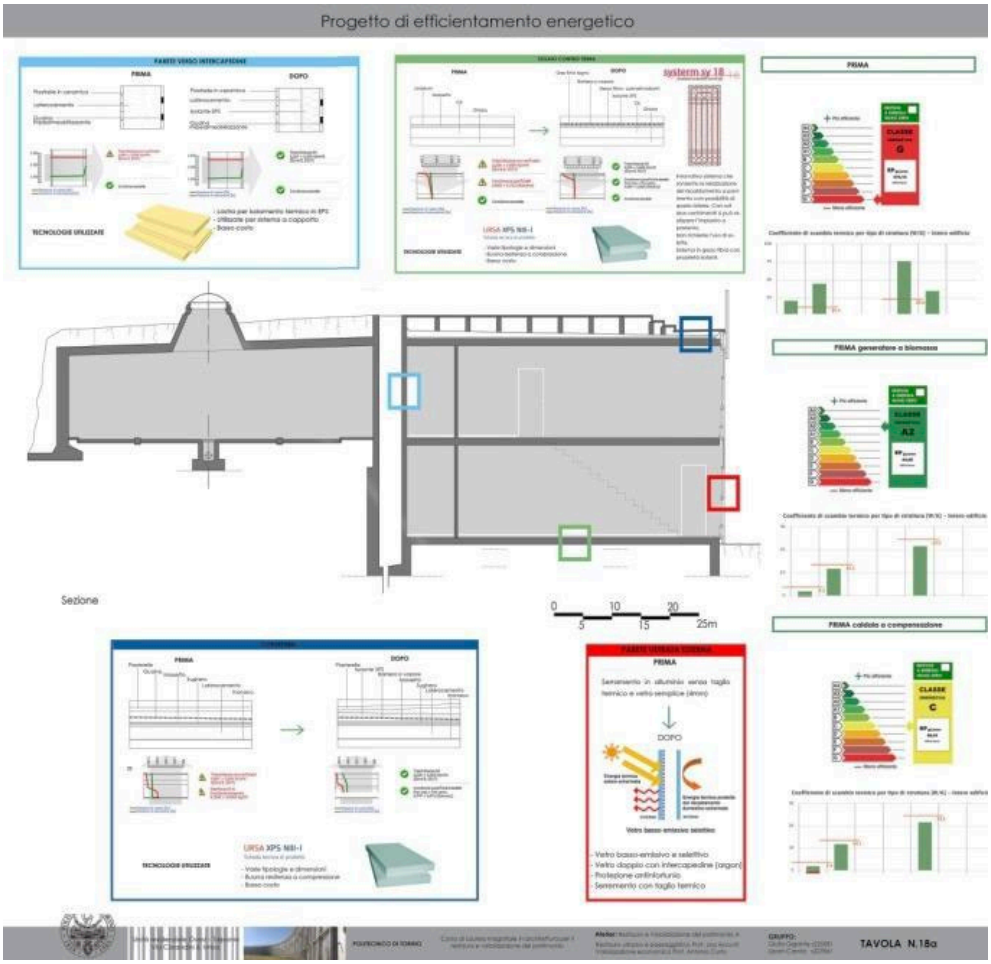
Figure 15. Buildings energy retrofit or reusing projects of in Ivrea's Core Zone. Definition of functional mixes.

BUILDING ID	BUILDING NAME	LEVEL OF USE	STATE OF CONSERVATION	PLANNED FUNCTION	PROJECT
ED001	Social Service Centre (West)	unused	average	day centre for eating disorders	restaurant on ground floor, day centre for eating disorders on first and second floor
ED002	Social Service Centre (Central)	in use	good	bar	bar, aperitivo room
ED003	Social Service Centre (East)	underused	fair	physiotherapy centre	physiotherapy centre, tea room on ground floor
ED006	Central Heating Plant	unused	very poor	music centre	discothèque, rehearsal rooms, music rooms
ED007	Olivetti Office Building	underused	good	hotel	hotel, spa, conference centre, restaurant, shopping centre, bank
ED008	Data Processing Centre	underused	good	factory (design furniture)	Design furniture production, showroom and sales
ED009	New Olivetti Office Building	underused	good	rest home	second and third floor rest home to be expanded to fourth and fifth floors
ED011	SERTEC Office Building	unused	poor	MAAM museum	MAAM Museum, indoor multimedia section, ticketing, start point of tour, bar, bookshop
ED034,ED035, ED036,ED037, ED038,ED039, ED041	Single family homes for executives	in use	good	residential	residential energy retrofit
ED042, ED043	Building with 4 flats	in use	good	residential	housing
ED051	Western Residential Unit (Talponia)	in use	average	residential	residential energy retrofit
ED053	Red Brick Building	unused	good	Olivetti Museum	three museums on Olivetti production, archive and library, commercial and retail premises, restaurant
ED054	Officine ICO- 1st extension (Old ICO)	unused	average	coworking	on ground floor: coworking spaces, offices, training rooms, study rooms, refreshments area, business incubators, call centre, showroom, bar, science laboratories
ED055	Officine ICO – 2nd extension (Central ICO)	unused	average	coworking	on ground floor: coworking spaces, offices, training rooms, study rooms, refreshments area, business incubators, call centre, showroom, bar, science laboratories
ED056	Officine ICO – 3rd extension (Central ICO)	in use	good	coworking	on ground floor: coworking spaces, offices, training rooms, study rooms, refreshments area, business incubators, call centre, showroom, bar, science laboratories
ED057	Officine ICO workshops -4th extension (New ICO)	underused	fair	offices	offices, call centre, refreshments, library, gymnasium, music and drama high school
ED058	Officine ICO workshops -4th extension (University of Turin)	in use	excellent	university	expansion of university
ED059	Officine ICO workshops -4th extension (courtyard Officine H)	unused	N/A	theatre	theatre, covered plaza
ED060	Company Canteen and Leisure Centre	underused	fair	catering	refreshments, restaurant, canteen, shops, gymnasium, health centre, games room, social spaces
ED061	Study and Research Centre	unused	poor	education	vocational training
ED201,ED202, ED203,ED204, ED205,ED206, ED207	Houses for large families	underused	average	residential	residential energy retrofit

Source: compiled by authors.

the characteristics of the construction and services of the residential buildings in the Core Zone, which must be taken into account in order to improve the comfort and energy performance of the buildings, while preserving their architectural features (Becchio et al., 2015; Fregonara et al., 2013; Fregonara et al., 2016). For ex-

Figure 16. Energy retrofit project, *Western Residential Unit (Talponia)*.



Source: energy renovation project by Giulia Gigante and Carola Lipani, students at the *Atelier di Restauro e Valorizzazione del Patrimonio* (Architecture Heritage Preservation and Enhancement Atelier) held at the Politecnico di Torino, during the 2016/2017 academic year.

ample, energy retrofitting of the Western Residential Unit (Talponia) has improved its energy performance certificate from Class G to Class A3 while fully complying with the original project, and the Houses for large families went from Class F to Class A3 (Figure 16).

The improvement in the energy performance of buildings of high historical and architectural value is so high that it urges retrofit policies dedicated to contemporary architectural heritage, which is generally characterised by high energy costs.

The proposal to reuse the buildings, based on intended uses established at the urban level, have made it possible to develop various design solutions – for whole

buildings or parts of them – following a sequence of interventions through development steps.

Based on the new intended uses proposed for each building in the Core Zone, and also taking into account the transmittance values of the materials and the survey and precise quantification of phenomena of degradation, it was possible to calculate the costs of the restoration, reusing and, in some cases, energy retrofit interventions. It should be noted that the costs were deduced from preliminary projects and that in many cases also costs relating to the management of new activities were also taken into account as well as the residual value at the time of disinvestment. Specifically, verification of the economic and financial feasibility of the reusing projects was carried out using the discounted cash-flow method and related profitability indicators such as the internal rate of return (IRR), the net present values (NPV) and return of capital. Sensitivity analyses were also carried out for alternative scenarios. Generally, it can be said that in most cases fairly high levels of risk exist, which has led to the projects being downscaled and broken down into smaller stages of work and timescales being extended. The analyses have also shown that the economic feasibility of investments often presupposes relatively low building acquisition costs compared with market values, themselves already low for the city of Ivrea. The results of the individual analyses confirm the need to consider assets as a system at the urban project level in which public intervention plays an important role with the regeneration of public spaces.

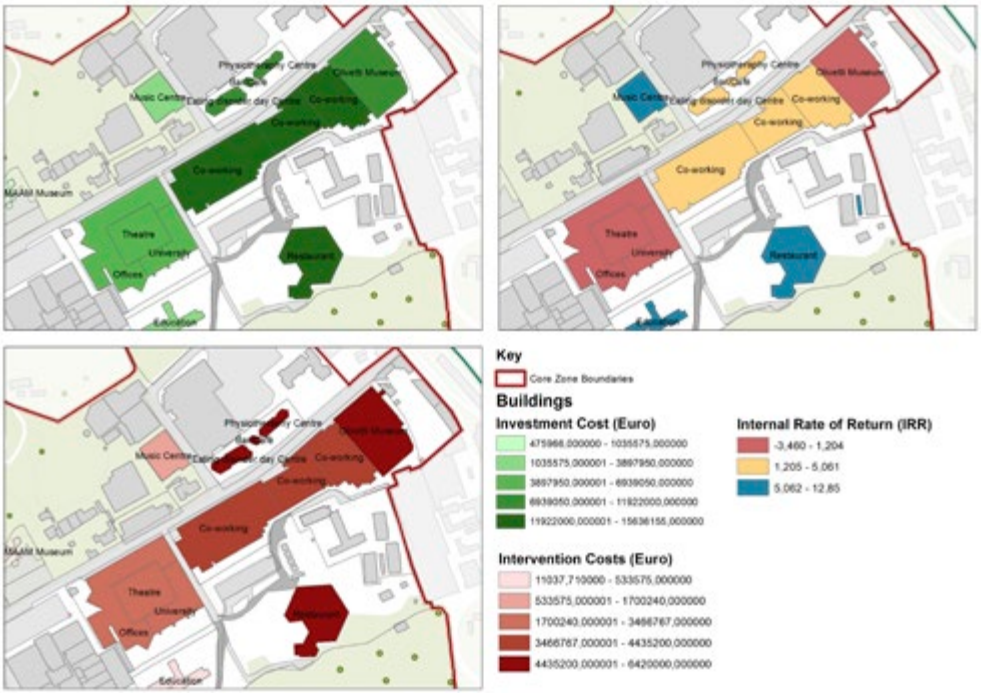
Nevertheless, it was also possible to compare the estimated profitability of the projects and, based on this, establish which projects are most feasible and which are the riskiest. In the case of Ivrea, which mirrors the situation in our country, the high level of risk is also the result of the severe crisis in the real estate market, and in particular the existing imbalance between supply and demand (Curto et al., 2015).

Analysing in detail the functional mix proposed for a number of buildings in the eastern area of the Core Zone, it is clear that the incorporation of coworking spaces on the ground floor of the *Officine ICO* is an extremely costly project which offers a relatively low return on investment, while the music hub (discotheque, rehearsal rooms, music rooms) in the *Central Heating Plant* and catering/leisure facilities (refreshments, restaurant, canteen, shops, gym, health centre, games room, social spaces) in the *Company Canteen and Leisure Centre* are the most feasible projects from an economic and financial point of view (Figure 17).

Thanks to its current structure, the GIS can be progressively enhanced with further layers of information, for example by extending project management from the preliminary evaluation stage of the economic and financial pre-feasibility of the project to the subsequent design and implementation stage, followed if appropriate by the maintenance stage (Heras Barros et al., 2016; Legnér et al., 2016).

The GIS constructed might potentially effectively interoperate with the GIS of the Municipality of Ivrea, from which it has already drawn part of the classification deriving from the General Urban Development Plan, by integrating the database of municipal building permits and declarations: this would provide the local authority with a useful tool for managing information regarding assets, planning projects to capture their economic value, monitoring transformation projects

Figure 17. Investment costs, project costs, IRR (assuming risk-free rates) of functional reconversion projects for some of the buildings in Ivrea's Core Zone. Example of data returned and processed by the GIS.



Source: map by authors.

in the area and thus supporting decision-making processes (Cerreta and De Toro, 2012; Morano and Tajani, 2017; Prieto et al., 2017).

Currently the GIS iconographic and information base is rather substantial even if only almost complete.. However, it is only partially complete. By implementing a web platform, the GIS may evolve into a collaborative project which can continue to be supplemented and updated, including the urban areas, contexts and buildings not considered during this initial launch phase, expanding potential sources[10] and extending the ability to supplement and update the information to various layer of users, such as associations and private citizens (Boeri et al., 2016; De Filippi et al., 2016; De Filippi et al., 2017).

In conclusion, the implementation of the GIS "Ivrea, industrial city of the 20th century" can potentially represent an example of best practice, thus forming the

[10] Possible additional data sources which might be rendered interoperable with the GIS include, for example: *Associazione Archivio Storico Olivetti, Archivio Nazionale del Cinema d'Impresa and Fondazione Natale Capellaro – Laboratorio Museo Tecnologic@mente.*

basis for a new methodological approach to developing Management Plans for UNESCO World Heritage Sites, which does not involve the use of an GIS only for the knowledge-building stage (see Stage 2a, MIBAC 2005), but also to support the entire process of capturing the value of heritage sites.

3. Enjoyment of Olivetti's architectural and cultural heritage: results and operational proposals based on data from the GIS

Extending and diversifying the visitor target is a key goal for the capturing of the economic and cultural value of UNESCO World Heritage sites. Based on the information and digital resources contained in the GIS, several layers of information content can be defined and differentiated according to the characteristics of the different potential targets (expert and non-expert public, visitors interested in specific resources as opposed to others, etc.).

In addition, the means by which this architectural and cultural heritage may be enjoyed indirectly may be differentiated according to the type of medium used for the creation of virtual itineraries (sferic 360° photos images or three-dimensional models) and according to the multimedia resources available (virtual tours, videos, new or period photographs, audio, historical documents, etc.) (Barberis et al., 2014; Rubino et al., 2013).

The GIS "Ivrea, industrial city of the 20th century" was in fact conceived and structured not only to support the management of restoration and reusing projects for the Olivetti heritage in Ivrea's Core Zone, but also to foster knowledge and indirect enjoyment of the Olivetti system of architecture. Based on data from the GIS, it will be possible to develop a web platform capable of displaying all of the materials connected with individual buildings in an intuitive manner and virtually representing and making the entire UNESCO candidate area easily accessible and enjoyable (Coscia and Curto, 2017). By exploiting the potential of IT/ICT technology, a user-friendly interface could be created through which all of the data contained in the "Buildings" and "Urban Contexts" classes and all of the multimedia resources contained in the "Media" class (the original projects digitised, period photographs, videos and articles from the journal "Edizioni di Comunità") could be made accessible and easy to consult (Sturiale and Trovato, 2015). To this end, the data collected for the structure/organisation of the GIS will need to be appropriately adapted in preparation for their inclusion on the web platform, which must be able to foster integrated enjoyment of all local cultural resources by connecting the individual assets into a system and setting out the relationships between systems of assets, both tangible and intangible.

One of the ways in which the site may be enjoyed indirectly could be through the creation of a new open-air museum (MAAM) which integrates real (cycle/pedestrian) paths outside the buildings with virtual visits inside the buildings, modelled by showing their current state together with their original state at the time of their construction (Armanno et al., 2012). The virtual 3D construction of the interiors is fundamental, not only because most of the buildings are not accessible to

the public (as they are owned by private individuals or real estate funds), but also because many of the interiors have been transformed and therefore merit being rebuilt and returned to their original state (Tscheu e Buhalis, 2016). For example, the Company Canteen by Gardella and the Social Services Centre by Figini and Pollini are not accessible and have been radically modified; the apartments of the Western Residential Unit (Talponia) cannot be visited and no longer have their original furniture.

In order to improve the quality of enjoyment on the cultural level and in a way which is consistent with the reasons that have led to the universal value of the 20th century Industrial City of Ivrea being acknowledged, it will be necessary to provide visitors both during their visit to the site and during the pre- and post-visit stages with some specific knowledge and support tools. For example, the web platform designed for virtual visits might support visitors before and after their visit, while during the visit to the site applications for mobile devices could be developed which, by using visitors' geolocation information (via GPS or local sensors), offer a personalised tour and suggest detailed information and multimedia content concerning the local assets, goods and services (for instance tourist information, hotels, restaurants and events) nearest the visitors' positions (Meyer et al., 2007; Pecchioli et al., 2011; Rua and Alvito, 2011).

The cultural information provided on the web platform will be accessible in different ways, for example via the distribution of tablets at the museum, visors for smartphone for augmented reality, or interactive, multimedia installations. The latter could be sited both along the visitors' route so that visitors can consult and interact with the information and multimedia content dedicated to supporting the visit itself and away from the route where the other cultural resources in the Ivrea area are located so as to attract their target visitors.

3.1 Renovation of the current MAAM Museum (Open-air Museum of Modern Architecture of Ivrea): operational proposals to promote the museum and increase visitor numbers

Increasing visitor numbers by attracting new targets is a primary objective for the new virtual MAAM. The current MAAM, largely due to its obsolescence and lack of appeal, attracts a small number of visitors, mainly limited to specialists. In addition, contemporary architecture is generally not recognised for its architectural value by ordinary visitors, who as a result do not even recognise the importance of conserving it, even in the case of important buildings which have received international critical acclaim not only in Ivrea, such as the *Torino Esposizioni* building in Turin by Nervi (Marinò, 2015). With regard to the Ivrea site, the MAAM cultural project integrated with visitor itineraries must correspond to the central objective of disseminating Adriano Olivetti's model of community by developing specific information content which is capable of conveying the radical change achieved in Ivrea with the introduction of the community company model, recognised as a universal value, based upon which Adriano Olivetti conceived of the organisation of labour, industrial production models, social relations,

the community and the city itself. For the purpose of promoting its enjoyment by visitors, it is therefore essential to develop a cultural project with broad historical scope and identify the content to be communicated, considering IT and ICT technologies as enabling tools.

For enjoyment purposes, it is considered that the current MAAM, conceived of as an open-air museum of 20th century architecture, can be supplemented by a fully-fledged indoor museum space, as the starting point where visitors are introduced to Adriano Olivetti's idea of community (pre-visit) and as the finishing point where visitors can find out more about what they have learned along the route. At the stages of the various possible visitor routes, where the interactive stopping points or "stations" could be placed, visitors can understand the historical and social value of the buildings without losing sight of the view of the system as a whole, and appreciate the aesthetic and architectural value of the individual buildings as various expressions of the Italian Modern Movement.

The itineraries, with their stopping points or stations, were also devised as the "concept" for a potential project to regenerate infrastructure as well as private and public green areas, which is considered a priority not only in terms of visitor enjoyment of the architectural and cultural heritage but also to facilitate the economic and financial feasibility of the restoration and reusing projects of the Olivetti buildings. Indeed, the integration of the itineraries with indoor museum spaces assumes architectural planning and the integration of the specific museum function with other functions.

For the purpose of visitors' enjoyment of the Core Zone and based on the layers of information contained in the GIS pertaining to the infrastructure, green spaces, buildings and media classes, three different visitor itineraries have been designed (with different starting and finishing points), which could be financed in part by the municipal authority with funds for scheduled and extraordinary maintenance:

- MAAM Visitor Route 1: starting from the museum situated in the "*Salone dei 2000*". The route from inside a large space situated inside the Old Officine ICO, which has a great symbolic value, as it was built when the Olivetti company reached 2,000 workers and needed to gather them all together in a wide space. Considering its space and volume, it is particularly suitable to host the museum function and related supplementary activities. The route proceeds along sheltered ways along which "virtual theatres" are located that enable visitors to learn more about and interact with the build heritage and connected multimedia materials. The route ends outside the Core Zone, in the Eastern Residential Unit (former *Hotel La Serra*), an extraordinary example of radical, multipurpose architecture by Cappai and Mainardis, in order to lead visitors to the edge of the oldest part of the city (Figures 18 and 19);
- MAAM Visitor Route 2: starting from the indoor museum situated in the *Sertec Office Building*, a sort of "Brutalist" landmark, which, in addition to housing the museum and related activities, lies in a particularly suitable position, being close to the station. The route traces the imagined movements of an Olivetti factory worker and ended in the residential area (outside the Core Zone) called Canton Vesco (Figure 20);

Figure 18. MAAM Visitor Route 1, starting from the "*Salone dei 2000*", with virtual theatres along the route and ending at "*La Serra*".

Source: project for MAAM by Savino Farucci, Marco Guicciardi and Elena Zanet, students at the *Atelier di Restauro e Valorizzazione del Patrimonio* (Architecture Heritage Preservation and Enhancement Atelier) held at the Politecnico di Torino, during the 2015/2016 academic year.

- MAAM Visitor Route 3: starting from the indoor museum situated in the *Sertec Office Building*, the route is organised according four different themes ("Houses", "Offices", "Industry" and "Services") which visitors can follow on foot or by bicycle. The route ends where it starts, bringing visitors back once again to the former Sertec offices building (Figure 21).

Conclusions

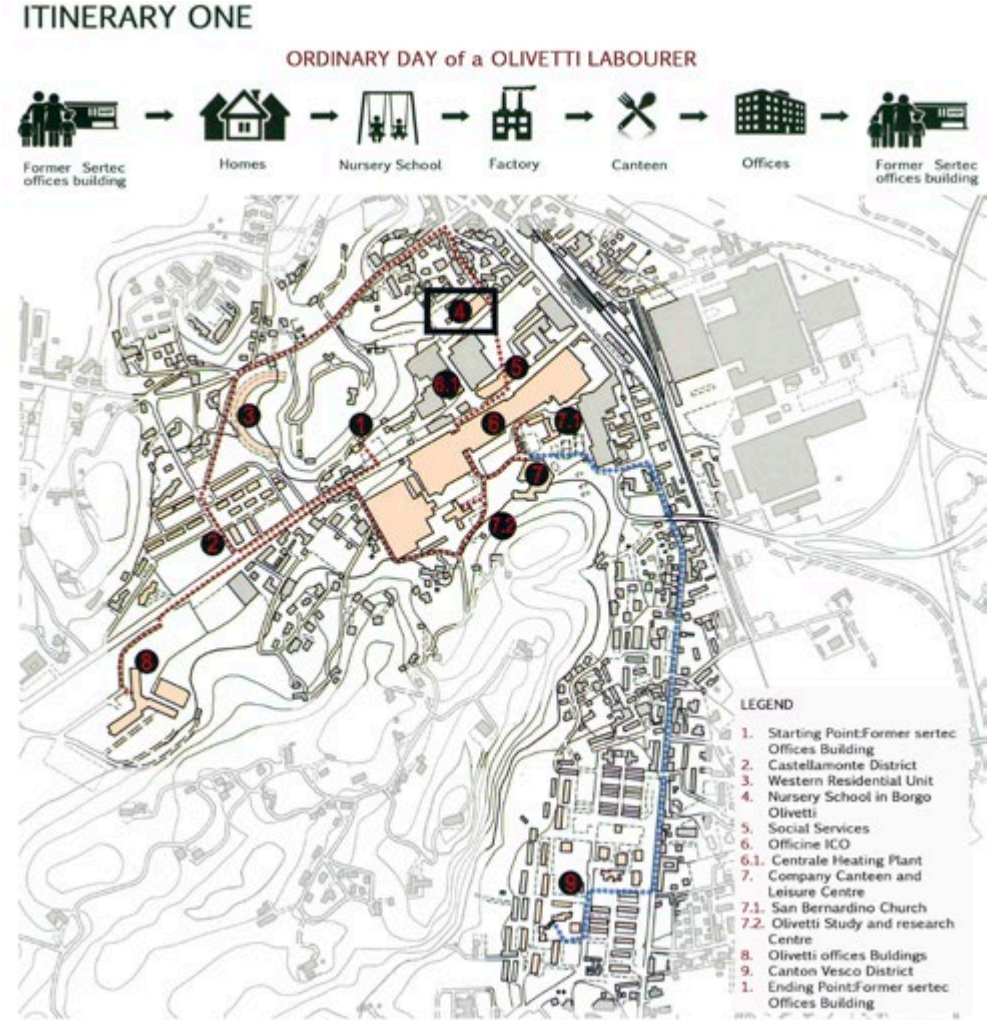
The analysis conducted to improve the economic and cultural value of Ivrea's Core Zone has adopted the guidelines of the MIBAC Methodology which were the most innovative at the time they were drawn up. In particular this study positively considered the attention paid to knowledge of the territorial context and the fact that they introduce the concept of capturing the economic value of contexts as one of the objectives of Management Plans. The analysis has nevertheless highlighted a number of weaknesses pertaining to capturing the economic value of heritage resources, in particular heritage of historical and architectural interest. The MIBAC

Figure 19. "*Salone dei 2000*": the possible indoor museum space integrated with MAAM Visitor Route 1.

Source: project for MAAM by Savino Farucci, Marco Guicciardi and Elena Zanet, students at the *Atelier di Restauro e Valorizzazione del Patrimonio* (Architecture Heritage Preservation and Enhancement Atelier) held at the Politecnico di Torino, during the 2015/2016 academic year.

Methodology goes beyond protection, yet considers conservation of heritage strictly in relation of restoration projects, in some cases without taking into consideration functional obsolescence and in others – particularly with regard to heritage of historical and architectural interest – the loss of their original function. In practice, capturing the economic value of architectural heritage cannot disregard the issues related to reusing. The case of Ivrea constitutes an emblematic example, considering the fragility of the economic and social context. Specifically, the study is founded upon the construction of an GIS which is interoperable with the current GIS of the City of Ivrea, based on a carefully-structured conceptual schema, in order to respond to both the aspect of architectural heritage reusing/restoration and the aspect of enjoyment of such cultural heritage in its many different forms. Adriano Olivetti's social model of community is "made concrete by the buildings" designed by emerging architects of the Modern Movement, which therefore combine high historical with high aesthetic and architectural value. While they can be considered as part of a system in its own right, recalling an industrial culture which goes

Figure 20. MAAM Visitor Route 2 based on a ordinary day of an Olivetti worker, starting from the *Sertec Offices Building* and ending in the residential district of Canton Vesco.

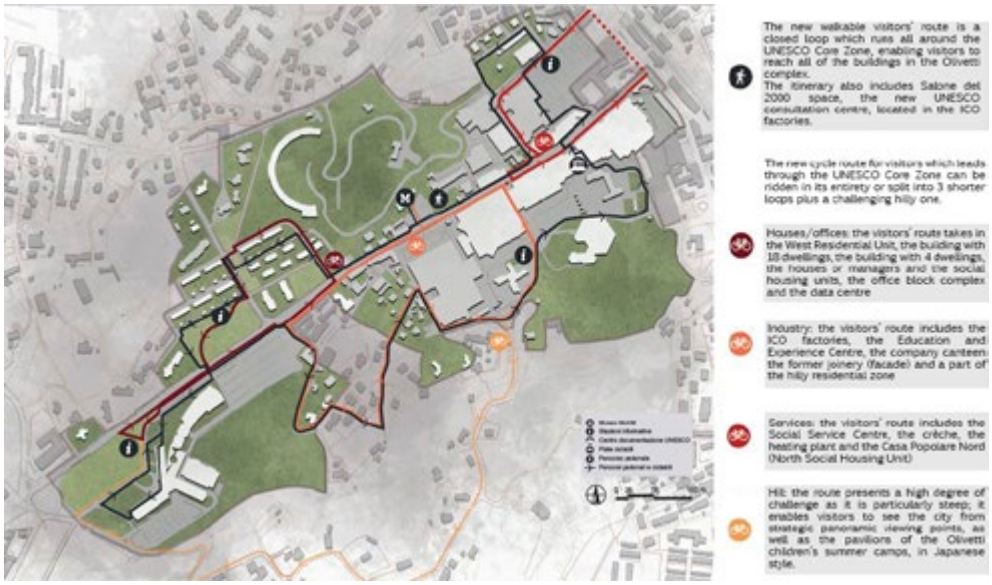


Source: project for MAAM by Alessia Rosinuolo, Rodrigo Sanchez and Allegra Vico, students at the *Atelier di Restauro e Valorizzazione del Patrimonio* (Architecture Heritage Preservation and Enhancement Atelier) held at the Politecnico di Torino, during the 2015/2016 academic year.

beyond the traditional antithesis between capitalist and Marxist models, they also represent the Modern Movement in its myriad expressions.

The case of Ivrea constitutes an opportunity to refocus attention on 20th century architectural heritage which, as it is more recent, is more easily neglected in terms of protection, while restoration projects do not seem to consider the energy efficiency or environmental aspects, despite the fact that it is possible to achieve

Figure 21. MAAM Visitor Route 3, showing the different thematic areas, starting and ending at the former Sertec offices building.



Source: project for MAAM by Alberto Peinetti, Gabriele Perotto and Ramona Ravera, students at the *Atelier di Restauro e Valorizzazione del Patrimonio* (Architecture Heritage Preservation and Enhancement Atelier) held at the Politecnico di Torino, during the 2015/2017 academic year.

significant results in terms of energy performance, at least in the case of residential architectural heritage. Furthermore, the value of more recent architecture is not perceived today, except for a relatively restricted public of experts and specialists. Furthermore it lends itself to tackling issues connected with improving the value of systems of building located in economically and socially not-dynamic contexts, which are unable to generate the demand for public services and above all for private goods and services in relation to the potential and availability of the unused spaces. In the case of Ivrea, there is such a great imbalance between the supply of unused spaces and real or potential demand that it is impossible to capture the economic value of individual buildings. It can only be done by considering the system as a whole and by giving a specific role to the "urban project", which considers the reusing of each building in relation to the reusing of other buildings and to a shared Master Plan which also take into account possible infrastructure projects and the regeneration of public and private open spaces.

The case of Ivrea involves a different relationship between public and private, both with regard to improving the economic value of the system of Olivetti architectures, all privately owned, and perhaps even more so with regard to the enjoyment of this architectural heritage, which is independent from the state of conservation and reuse of the individual buildings.

From this perspective, the aspect of enjoyment should be considered a priority, considering the role which the current, and currently obsolete, open-air museum (MAAM), may play if it is conceived of anew on the basis of a cultural project which communicates not only the value of the buildings but also the exceptional model of community underpinning the industrial city. In this regard, there is no doubt that IT/ICT technologies, considered as enabling tools, can have positive impacts on visitors by means of providing diversified forms of enjoyment, thus appealing to new target publics. The values made tangible in the site Ivrea, industrial city of the 20th century" must not remain the exclusive domain of the scientific community and specialists but must be conveyed to visitors who are often attracted by ancient architecture and are not sensitive to the values of the modern, still less to the importance of conserving them.

The GIS designed to capture the value of the site "Ivrea, industrial city of the 20th century" has thus been structured not only as an instrument for collecting and systematsing knowledge regarding the architectural heritage located in this area, but also and above all as an innovative, dynamic and interoperable model designed both to help to capture the economic value of the Core Zone by managing projects at the urban scale and, through indirect enjoyment of the UNESCO site, to relate its architectural heritage to its local context. The actual implementation of the GIS will thus constitute an instance of best practice, based on which a new methodology can be developed in order to draw up Management Plans for UNESCO sites and, more generally for urban cultural heritage, in which our country is particularly rich,.

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